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An Annotated Bibliography of Eastern Redcedar

Thomas L. Schmidt and Ronald J. Piva

Cover Photo Credit: Jon S. Wilson. Jon, a District and Extension Forester for the Nebraska Forest Service/University of Nebraska, has spent many years working with eastern redcedar. Jon took this photograph on the Cedar Canyon State Forest, near North Platte, Nebraska.

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Introduction

This annotated bibliography of published literature on eastern redcedar (*Juniperus virginiana* L.) contains 719 references to both technical and popular articles available as of September 1994. We compiled this bibliography to provide a working tool for people interested in eastern redcedar. It is intended to serve as an international reference for literature and research about eastern redcedar. Most of the literature cited was located through computerized, global literature searches. In addition, we searched citations from eastern redcedar related publications and libraries for eastern redcedar references. Citations available after September 1994, unpublished theses and typewritten reports, are not included. The annotations provide a general idea of the information and results and are not intended to be complete abstracts. In broad-based articles, we excerpted only the information relevant to eastern redcedar. We tried to keep the organization of this bibliography simple; it is arranged by subject area and alphabetically by author with a number assigned to each entry. The number of the publication is listed by each author in the author index.

The *Juniperus* genus, in the Cupressaceae family of conifers, consists of about 70 species of trees and shrubs widely scattered throughout the Northern Hemisphere. Eastern redcedar (*Juniperus virginiana* L.) is the most widely distributed conifer of tree size in the Eastern United States, and it is indigenous in every State east of the 100th Meridian and in southern Ontario (fig. 1).

Eastern redcedar is a small to medium tree that can grow up to 60 feet in height and can attain bole diameters of more than 24 inches at breast height. The crown is dense and narrowly pyramidal or columnar, with the bole tapering to a potentially deep root system. The American Forestry Association's 1994 National Register of Big Trees lists the champion eastern redcedar as having a bole circumference of 211 inches, a height of 55 feet, and a crown spread of 68 feet. It is located at the Lone Hill Church Cemetery in Coffee County, Georgia.

Eastern redcedar grows under a wide range of climatic and soil conditions. Annual rainfall ranges from approximately 16 inches to almost 60 inches, and length of growing season ranges from 120 to 250 days. Soil types range from acidic sands to those derived from limestone. The best growth is made on deep alluvial soils. Eastern redcedar is most common on dry soils, in pure stands or open mixtures with pines or hardwoods. It is a slow-growing and somewhat shade-intolerant tree.

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Ronald J. Piva, Forester, received a bachelor's degree in forest management from the University of Missouri-Columbia. He joined the Forest Service in 1985 and has been working with the North Central Forest Experiment Station's Forest Inventory and Analysis Unit since.

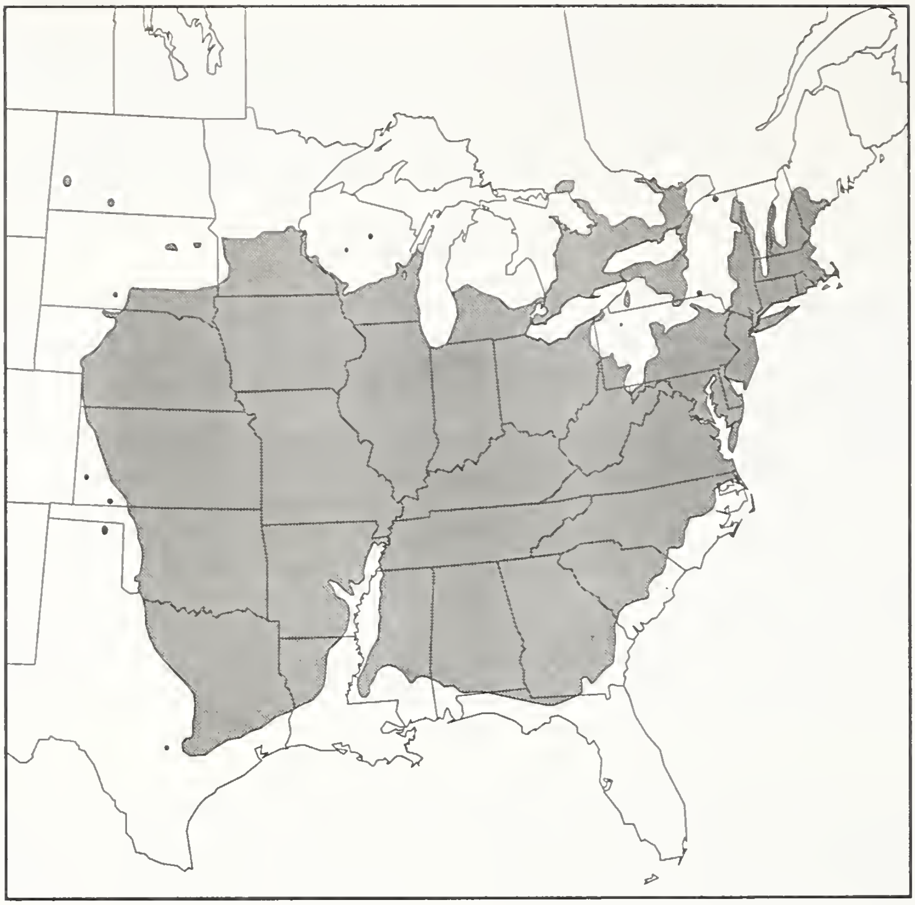

Figure 1.—*Range of eastern redcedar,* Juniperus virginiana *L. (Little 1971).*

Eastern redcedar is commonly used for posts, novelty items, chests, and as shelterbelts/ windbreaks. It is an important species for wildlife food and cover. Considerable variation in color and compactness makes eastern redcedar and its cultivars among the best of native ornamental evergreens.

This bibliography is a follow-up to E.R. Ferguson's "Eastern redcedar: an annotated bibliography," published in 1970 by the Southern Forest Experiment Station. We felt that the significant number of publications added to the literature since 1970 warranted this update. For more information about Ferguson's earlier publication, please see:

Ferguson, E.R. 1970. **Eastern redcedar: an annotated bibliography**. Res. Pap. SO-64. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 21 p.

PHYSIOLOGY

1. Adams, R.P. 1970. **Chemosystematic and numerical studies in natural populations of *Juniperus.*** Dissertation Abstracts International, B. Science and Engineering. 69(21): 755. 248 p.
   J. ashei and *J. pinchotii* were analyzed for areas of speciation and possible hybridization. Their interactions with each other and with *J. virginiana*, *J. scopulorum*, *J. monosperma*, *J. deppeana*, and *J. flaccida* were examined, using both morphological and terpenoid characters.

2. Adams, R.P. 1986. **Geographic variation in *Juniperus silicicola* and *J. virginiana* of the southeastern United States: multivariate analyses of morphology and terpenoids.** International Bureau of Plant Taxon Nomenclature. 35(1): 61-75. 25 refs.
   Concludes that *J. silicicola* is within the range of variation of *J. virginiana* and should be treated as a variety.

3. Agramont, F.; Busking, R.; Mitchell, J.; Enzinger, E. 1948. **The red cedar**. Missouri Botanical Garden Bulletin. 36: 86-92.
   Reports distribution of eastern redcedar in the St. Louis, Missouri area, wood color, and leaf variation.

4. Aleksandrovskij, E.S. 1966. **Embryological studies of *Juniperus* spp. of [Soviet] Central Asia.** Botanicheskii Zhurnal. 51(3): 436-446. 23 refs. Russian.
   A detailed illustrated account covers *J. seravschanica*, *J. semiglobosa,* and *J. turkestanica*, with *J. virginiana*, *J. communis*, *J. sabina*, and *Thuja orientalis* for comparison.

5. Aleksandrovskij, E.S. 1971. **Development of ovules and microsporogenesis in species of *Juniperus.*** Botanicheskii Zhurnal. 56(2): 193-201. 25 refs. Russian.
   Reports results of a comparative study of the development of male and female cones in *J. seravschanica*, *J. semiglobosa*, *J. turkestanica*, *J. turcomanica*, *J. communis*, and *J. virginiana* at Tashkent. Considerable differences were observed between species in the time of initiation and differentiation of cones.

6. Allison, F.E.; Klein, C.J. 1961. **Comparative rates of decomposition in soil of wood and bark particles of several softwood species.** Soil Science Society of America. 25(3): 193-196. 4 refs.
   In order to determine the suitability of finely ground woods and barks of *Libocedrus decurrens*, *Taxodium distichum*, *Sequoia sempervirens*, *Larix occidentalis*, *Tsuga canadensis*, *Abies magnifica*, *A. concolor*, *Pseudotsuga taxifolia*, *Juniperus virginiana,* and *Picea engelmannii* as mulches and soil amendments, their rates of decomposition in soil were determined in the laboratory at two levels of N by measuring CO_2 evolution for 53-800 days. The woods and barks of all these species were considerably more resistant to biological attack than was shortleaf pine sawdust. *L. decurrens*, *T. distichum*, *S. sempervirens*, *T. canadensis,* and *J. virginiana* were particularly resistant to decomposition. Owing to the slow rates of decomposition, the soil was able to furnish adequate available N for maximum rates of decomposition in all cases, and supplementary N was not needed.

7. Anseth, B. 1978. **Trees and shrubs, where are you?** Soil Conservation. 43(10): 20-21.
   Describes the work of MITOSIS (Montana Interagency Tree or Shrub Improvement Study), a program set up by three agencies (USDA Forest Service, USDA Soil Conservation Service, and the Forestry Division of the Montana Department of Natural Resources and Conservation) to develop improved varieties of trees or shrubs for conservation purposes. Projects include: collection and progeny testing of seed from superior trees and shrubs in shelterbelts; improving the establishment of conifers; standardization of woody plant certification; and evaluation of Rocky Mountain juniper (*Juniperus scopulorum*) and eastern redcedar (*J. virginiana*) strains in the Great Plains.

8. Baer, N.W. 1985. **Nutrient content in eastern redcedar foliage: seasonal variation.** Tech. Bull. 86. Brookings, SD: South Dakota State University, Agriculture Experiment Station. 9 p.

9. Bagley, W.T.; Read, R.A. 1960. **Some temperature and photoperiod effects on growth of eastern redcedar seedlings.** Iowa Journal of Science. 34(4): 595-602. 6 refs.
   Eastern redcedar seedlings grown at daytime temperatures of 90° F responded differently in top and root growth to four combinations of night temperature and photoperiod. Greatest growth and highest top/root ratios were obtained by a diurnal fluctuation from 90 to 59° F with a 20-hour photoperiod (long-moderate). A diurnal fluctuation from 90 to 45° F with a 20-hour photoperiod (long-cold) produced the smallest seedlings with the lowest top/root ratios. Heights and weights at 59° F (moderate) night temperature were significantly greater under 20-hour (long) photoperiod than under 14-hour (normal) photoperiod. Variation in growth response within treatment was greatest under the 90 to 45° F (long-cold) and least under the 90 to 80° F (long-hot) temperature regime. Seedling heights and top/root ratios tended to equalize after 6 months in an outdoor environment, but significant differences in total weight did not change.

10. Bahari, Z.A.; Pallardy, S.G.; Parker, W.C. 1985. **Photosynthesis, water relations, and drought adaptation in six woody species of**

oak-hickory forests in central Missouri. Forest Science. 31(3): 557-569. 33 refs.

Photosynthesis, leaf conductance, water potential, and tissue water relations were examined for 2- to 6-m-tall saplings of species from habitats of varying soil moisture content in the growing seasons of 1980 (hot and dry) and 1981 (wet). Drought substantially reduced leaf conductance in all angiosperm trees (*Quercus velutina*, *Q. alba*, *Q. rubra*, *Cornus florida*, and *Acer saccharum*), but only slightly reduced conductance of *Juniperus virginiana*. *C. florida* showed the most pronounced response to drought, because of its inability to avoid low water potential; this is attributable to its known habit of shallow rooting. Differences in drought adaptation were apparent among the broadleaves, with *Quercus* spp. (adapted to drier sites) showing generally lower osmotic potentials at full turgor and turgor loss point, higher moduli of leaf tissue elasticity, and higher rates of photosynthesis during drought, compared with *A. saccharum* and *C. florida*. *J. virginiana*, usually found on very dry sites, showed a different pattern of drought adaptation: an inherently low capacity for water loss, and the ability to sustain stomatal opening at low water potentials.

11. Bailey, L.H. 1933. **The cultivated conifers in North America, comprising the pine family and the taxads.** New York, NY: Macmillian Press. 404 p.

Presents a detailed botanical description of eastern redcedar, with very general information on cultivation, propagation, and on insects, diseases, and injuries.

12. Bannan, M.W. 1942. **Wood structure of the native Ontario species of *Juniperus*.** American Journal of Botany. 29: 245-252.

Many of the trends in anatomical variation in different parts of the tree in *J. virginiana* resembled those observed in *Thuja occidentalis*. Similar tendencies were noted in such characters as size of the tracheids, size and distribution of the intertracheary pits, size and number of pits per crossing field, height and distribution of rays, and size of ray cells. Other features usually regarded as valuable for purposes of identification such as the thickness and character of the walls of the ray and xylem parenchyma cells also varied considerably. Because of such variability, it is clear that the selection of characters that will ultimately prove diagnostic must be held in abeyance until there is more complete knowledge of the range of variation in related forms. An expansion of certain of the rays to a multiseriate condition, such as observed in *Thuja occidentalis*, was also noted in all three local species of *Juniperus*. All adventitious roots arising from stems or branches connected with rays in the xylem were nearly always of this unusual type.

13. Barton, L.V. 1951. **Germination of seeds of *Juniperus virginiana* L.** Contributions from Boyce Thompson Institute. 16(8): 387-393. 8 refs.

Seeds of *J. virginiana* possess dormant embryos that require a period of 3 months at 5° C to after-ripen; 1° C is less effective and 10° C is totally ineffective. A large percent of seeds have impermeable coats, which may be made permeable by exposure to moisture at a temperature of 25° C for 2-8 weeks or by soaking for 30 minutes in concentrated H_2SO_4. Such treatment should precede stratification.

14. Baslas, R.K.; Saxena, S. 1985. **Constituents of essential oil of cedar-wood [thymol, carvacrol, eugenol, beta-thujone, pi-anisaldehyde, pi-ethylvanillin, alfa-limonene, alfa-pinene, bisabolene oxide 1, limonene expoxide, bisabolene oxide, alfa-pinene epoxide, neoiso-menthol, alfa-terpineol].** Herba Hungarica. 24(1): 27-29. 1 ref.

15. Bauch, J.; Schweers, W.; Berndt, H. 1974. **Lignification during heartwood formation: comparative study of rays and bordered pit membranes in coniferous woods.** Holzforschung. 28(3): 86-91. 18 refs. German.

A comparative study was made of the lignification of the walls of ray parenchyma cells and membranes of bordered pits in specimens of *Pinus sylvestris*, *P. strobus*, *Larix decidua*, and *Juniperus virginiana* using light microscopy, histochemical tests, micro-autoradiography, and UV microspectrophotometry. It was shown that lignification in ray parenchyma cell walls of pines of the subgenus *Haploxylon* may occur during heartwood formation. In other species investigated, lignification of these cells occurred at the cambial zone. Incrustation of pit membranes by polyphenols also occurs during heartwood formation.

16. Baxter, D.V. 1954. **Some resupinate polypores from the region of the Great Lakes. XXVI.** Michigan Academy of Science. 40: 91-108. 8 refs.

Lists the polypores in eastern and northern plant associations in which the following species are dominant: (1) *Populus* spp. (chiefly *P. tacamahaca)*, (2) *Populus* spp. (chiefly *P. deltoides)*, (3) *Picea mariana*, (4) *Pinus banksiana*, (5) *Pinus resinosa*, (6) *Liriodendron tulipifera* and *L. tulipifera / Quercus alba*, (7) *Quercus montana*, (8) *Quercus stellata / Q. marilandica*, (9) *Juniperus virginiana*, (10) *Betula nigra / Platanus occidentalis*, (11) *Chamaecyparis thyoides*, (12) *Taxodium distichum / Nyssa aquatica / Liquidambar styraciflua*, (13) *Pinus serotina*, (14) *Quercus nigra / Liquidambar styraciflua*, and (15) *Quercus virginiana / Sabal palmetto*. An account is

also included of *Poria vaillantii*, a species found in North America mainly on greenhouse benches.

17. Belling, A.J. 1987. **A comparison of morphological characteristics of *Chamaecyparis thyoides, Thuja occidentalis* and *Juniperus virginiana*.** In: Lademan, A.D., ed. 1st Atlantic white cedar wetlands symposium; 1984 October; Woods Hole, MA. Boulder, CO: Westview Press: 231-240.

18. Bessey, C.E.; Webber, H.J. 1890. **Grasses and forage plants, and the catalogue of plants.** Report of the Botanist, Nebraska State Board Agricultural Report for 1889. Lincoln, NE: State Journal Company, Printers: 37-43.

19. Bifoss, C.G. 1947. **The water conducting capacity and growth habits of *Juniperus horizontalis* Moench and *Juniperus virginiana* L.** Ecology. 28(3): 281-289.
    A series of tests on the water conductivity and measurements of the tracheids of stems of *Juniperus horizontalis* and *J. virginiana* yielded the following facts: (1) No significant difference exists between the specific conductivity of these two species when taken from approximately the same habitat. Therefore, the creeping habit of *J. horizontalis* apparently has no direct relation to the specific water-conductivity of its stem. (2) The values for specific water-conductivity of both species are definitely low, and accordingly the dimensions of the tracheids and their lumen areas as seen in transverse view are also small. The deviations are negligibly small and compensatingly distributed. (3) The growth rate, as determined from transverse sections, varies in the two species. In seasons of severe drought it is apparently quite similar in both species, while under more favorable conditions *J. virginiana* grows much faster.

20. Blake, S.F. 1910. **Note on *Juniperus horizontalis* and *J. virginiana*.** Rhodora. 12: 218.

21. Brett, W.J.; Singer, A.C. 1970. **Long term chlorophyll fluctuation in an evergreen - *Juniperus virginiana*.** Indiana Academy of Science. 80: 95.
    Concentrations of chlorophyll a and b were determined in 1g of leaf material taken from a mature tree at weekly intervals over the period November 1967 to October 1969. A multiple regression analysis was made to determine the relations between chlorophyll concentrations and temperature, precipitation, cloud cover, and dry weight, and the results are briefly discussed.

22. Brett, W.J.; Singer, A.C. 1973. **Chlorophyll concentration in leaves of *Juniperus virginiana* L., measured over a 2-year period.** American Midland Naturalist. 90(1): 194-200. 17 refs.
    Significant positive correlations were found between the concentrations of chlorophyll a and chlorophyll b, and between chlorophyll and dry weight; and negative regressions of chlorophyll on temperature and on total radiation. Seasonal differences are discussed.

23. Burt, L.B. 1939. **The bearing of Zalenski's law on conifer leaves.** Transactions of the Kansas Academy of Science. 42: 113-121.
    Investigations on leaves of *Abies concolor*, *Juniperus virginiana*, *Picea pungens*, *Pinus banksiana*, *P. laricio*, *P. strobus*, *P. sylvestris*, and *Thuja orientalis* showed that photosynthetic cells decreased in size and increased in frequency from the basal to the apical parts. The stomatal frequency increased in the same direction. This bears out the observations made by Zalenski and others on plants in general.

24. Butler, D.R.; Walsh, S.J. 1988. **The use of eastern redcedar in a tree-ring study in Oklahoma.** Prairie Naturalist. 20(1): 47-56.
    Growth rings from *Juniperus virginiana* were examined from 10 trees at each of three sites distributed along an ecotonal transect in west-central Oklahoma. Tree rings were examined to determine the utility of eastern redcedar as a source of surrogate climatic data. False rings were common, and some were correlative amongst the three study sites. In spite of a westward-increasing tendency of partial false rings, the combination of correlative true annual rings, correlative false rings, and fire scars provided some useful data for identifying the presence of past droughts on the Great Plains.

25. Chadwick, L.C. 1946. **Seeds of redcedar.** American Nurseryman. 83(9): 10.
    The factors responsible for delayed germination of eastern redcedar (*Juniperus virginiana*) seed are the waxy coat and a resting condition of the embryo. The waxy coat can be removed by soaking seeds for several hours in alcohol, or by pouring warm water over the seeds and bringing it to the boil, repeating the operation twice. In order to overcome the resting condition of the embryo, seed should be stratified from about the middle of December to the middle of March, and then sown in well-prepared seedbeds of sandy soil.

26. Chandler, R.F. 1939. **The calcium content of the foliage of forest trees.** Rep. 228. Ithaca, NY: Cornell University, Cornell Agricultural Experiment Station. 15 p.
    The seasonal trends in the calcium content of the foliage of *Fagus grandifolia*, *Magnolia acuminata*, *Populus tremuloides*, *Juniperus virginiana*, and *Pinus strobus*, were studied. In all cases the

calcium content, expressed either on a percentage or on an absolute-amount basis, was found to increase progressively throughout the growing season. The calcium content of the foliage of evergreen trees increased throughout the growing season but remained fairly constant during the winter months. The longer the foliage of a single species remained on the tree, the higher was its calcium content. The calcium content of mature foliage of 27 forest trees was determined and they were grouped accordingly: (1) Species averaging more than 2.0 percent of calcium in their foliage - tulip poplar, redcedar, basswood, black locust, mockernut hickory, bitternut hickory, white cedar, hophornbeam, trembling aspen, white ash, and black cherry. (2) Species whose foliage contained from 1.0 to 2.0 percent of calcium - shagbark hickory, American elm, sugar maple, Norway spruce, white oak, red oak, yellow birch, chestnut oak, white pine, and balsam fir. (3) Species whose foliage contained less than 1.0 percent of calcium - red maple, red pine, hemlock, beech, scotch pine, and red spruce.

27. Chappelle, E.W.; Williams, D.L. 1987. **Laser-induced fluorescence (LIF) from plant foliage.** IEEE Transactions of Geoscience and Remote Sensing. GE-25(6): 726-736. 25 refs.

LIF spectra were measured from herbaceous dicotyledons (soybeans, sugar beet, tobacco), monocotyledons (maize, wheat, rice, barley), conifers (*Juniperus virginiana*, *Pinus strobus*, *P. taeda*, *Picea glauca*), broadleaves (*Quercus rubra*, *Acer rubrum*, *Carya ovata*) and two algae. All the plant types could be identified by their spectral characteristics. Trees differed from other groups by the presence of a fluorescent band at 525 nm. Conifers differed from all other groups by the absence of a band at 685 nm. Needles of *Picea glauca* exposed to an inhibitor of photosynthesis showed a fluorescent band at 685 nm. Differences in LIF spectra that could be related to tree vigor were found in needles of *Picea rubens* from an area known to receive acid rain. Changes in LIF spectra were also found in maize plants subjected to nutrient stress and in cotton plants subjected to drought stress.

28. Choong, E.T.; Fogg, P.J.1968. **Moisture movement in six wood species.** Forest Products Journal. 18(5): 66-70. 6 refs.

Reports drying and sorption tests on small sapwood and heartwood samples of timber of widely different permeability (*Quercus* sp., *Liquidambar styraciflua*, *Liriodendron tulipifera*, *Pinus sp.*, *Juniperus virginiana*, *Sequoia sempervirens*) to elucidate the mechanism of moisture movement. Other variables examined were specific gravity, grain direction, and sample thickness. It is concluded that movement of both vapor and bound water occurs at all moisture content ranges, the former predominating only longitudinally and at low moisture content. Movement is similar in sapwood and heartwood, but greater radially than tangentially, indicating that voids, including pits, have little effect. The results defied complete interpretation; they did not conform to Fick's laws of diffusion.

29. Cochran, K.D. 1992. **Evaluation of form and growth characteristics of *Juniperus* cultivars at the Secrest Arboretum.** Ohio Agricultural Research and Development Center. 140: 32-34. 7 refs.

Sixty-five ornamental cultivars of *Juniperus* (embracing *J. horizontalis*, *J. sabina*, *J. conferta*, *J. communis*, *J. procumbens*, *J. chinensis*, *J. davurica*, *J. virginiana*, *J. scopulorum*, and *J. squamata*) were evaluated. Form was categorized as disk, mound, ovoid, sphere, cylinder, ellipsoid, cone, or pyramid. Growth was designated according to branching habit: procumbent, horizontal, arched, ascending, fastigiate, or convergent. All plants were also evaluated for growth characteristics of open or closed outline.

30. Coile, T.S. 1933. **Soil reaction and forest types in the Duke Forest.** Ecology. 14: 323-333.

Eastern redcedar was found to occur in small pure stands within other forest types but was seldom found in the overstory on extensive areas. Eastern redcedar tended to raise the pH of normally acidic soils.

31. Collingwood, G.H. 1938. **Eastern red cedar**. American Forests. 44: 30-31.

Describes the occurrence, growth, characteristics, wood qualities, utilization, and pests.

32. Corliss, C.D. 1983. **Juniper plant—Corcorcor variety *Juniperus virginiana*, evergreen conifer, symmetrical and conical.** U.S. Pat. Plant. 5041. Washington, DC: U.S. Patent Trademark Office. 4 p.

33. Cregg, B.M. 1992. **Leaf area estimation of mature foliage of *Juniperus*.** Forest Science. 38(1): 61-67. 15 refs.

The ratio of total surface area to projected leaf area was determined for mature foliage samples collected at three canopy heights from three half-sib *Juniperus virginiana* families and one *J. scopulorum* family growing on a farm in southeast Nebraska. The relation of projected leaf area to leaf dry weight and volume was also determined. Total surface area was estimated to be 3.2X the projected surface area. This relation was independent of seed source or crown position. Projected leaf area can be satisfactorily estimated from weight or volume. However, these relations differed by crown position or seed source. These results indicate that leaf area of mature juniper foliage may be estimated through measurement of projected surface area. The leaf area of large samples may be estimated by determining the appropriate specific leaf area or surface-to-volume ratios.

34. Cutter, B.E.; Guyette, R.P. 1990. **A note on sap pH in eastern redcedar (*Juniperus virginiana* L.).** Wood and Fiber Science. 22(1): 109-112. 6 refs.

Twelve eastern redcedar (*Juniperus virginiana*) trees were sampled for the sap pH of the sapwood at three locations along the bole and one location on the roots. Soil pH measurements were taken at each tree site. Sap pH was positively correlated with soil pH. A regression model using mean soil pH as the independent variable accounted for 71 percent of the variation of the mean sap pH. There was a decreasing gradient in sap pH from crown to stump.

35. Cutter, B.E.; Guyette, R.P. 1993. **Anatomical, chemical, and ecological factors affecting tree species choice in dendrochemistry studies.** Journal of Environmental Quality. 22(3): 611-619.

Recently, element concentrations in tree rings have been used to monitor metal contamination, fertilization, and the effects of acid precipitation on soils. This has stimulated interest in which tree species may be suitable for use in studies of long-term trends in environmental chemistry. Potential radial translocation of elements across ring boundaries can be a confounding factor in assessing environmental change. Thus, the selection of species to minimize radial translocation of elements can be critical to the success of dendrochemical research. Criteria for the selection of species with characteristics favorable for dendrochemical analysis are categorized into (i) habitat-based factors, (ii) xylem-based factors, and (iii) element-based factors. Species with a wide geographic range and ecological amplitude provide an advantage in calibration and better controls on the effects of soil chemistry on element concentrations. The most important xylem-based criteria are heartwood moisture content, permeability, and the nature of the sapwood-heartwood transition. The element of experimental interest is important in determining which tree species will be suitable because all elements are not equally mobile or detectable in the xylem. Ideally, the tree species selected for dendrochemical study will be long-lived, grow on a wide range of sites over a large geographic distribution, have a distinct heartwood with a low number of rings in the sapwood, a low heartwood moisture content, and have low radial permeability. Recommended temperate zone North American species include white oak (*Quercus alba* L.), post oak (*Q. stellata* Wangenh.), eastern redcedar (*Juniperus virginiana* L.), old-growth Douglas-fir (*Pseudotsuga menziesii* Mirb.) and big sagebrush (*Artemisia tridentata* Nutt.). In addition, species such as bristlecone pine (*Pinus aristata* Engelm. syn. *longaeva*), old-growth redwood (*Sequoia sempervirens* Endl.), and giant sequoia (*S. gigantea* Deene) may be suitable for local purposes.

36. Czeczuga, B. 1987. **Different rhodoxanthin contents in the leaves of gymnosperms grown under various light intensities.** Biochemical Systematics and Ecology. 15(5): 531-533. 21 refs.

Rhodoxanthin and total carotenoid contents are tabulated for needles of 15 gymnosperm species from sun exposed and shaded sites. More rhodoxanthin was present in sun exposed needles than in shaded needles.

37. Davlenbaev, K.K. 1972. **Features of the flowering and fruiting of *Juniperus virginiana*.** Vestnik Karakalpakskogo Filiala. 2(48): 55-59. Russian.

Gives data on the phenology of flowering and fruiting of *J. virginiana* in various botanical gardens and parks in Soviet Central Asia.

38. Djavanshir, K.; Fechner, G.H. 1975. **Pollen germination and pollen tube growth of *Juniperus* from autumn and winter collections.** Silvae Genetica. 24(1): 26-29. 17 refs.

Branches of *J. virginiana* were collected at 10-day intervals from October to March at Fort Collins, Colorado, U.S.A., and forced in water to encourage dehiscence of the male strobili. Pollen shedding began with the collection made on November 10. The periods of predehiscence, dehiscence, and pollen shedding shortened gradually from November to March, and pollen germination percentage increased over the same period. Germination percentage and pollen-tube growth of the forced pollen were much higher than the corresponding figures for pollen extracted from the strobili at the time of collection. Storage for up to 3 months did not affect germination percentage or pollen-tube growth of either the forced or extracted pollen. Germination of viable pollen occurred within the 3 to 5 days of culturing, and the pollen tubes reached maximum length in 16 or 17 days.

39. Djavanshir, K.; Fechner, G.H. 1976. **Epicotyl and hypocotyl germination of eastern redcedar and Rocky Mountain juniper.** Forest Science. 22(3): 261-266. 8 refs.

Seeds of (a) *Juniperus virginiana* and (b) *J. scopulorum* were subjected to various treatments and germinated at 18°/8° C on damp paper. The treatments included removal of the seed tip or the seed base (hilum), extraction of embryos followed by chilling at 5-6° C, soaking of all or part of the seed in concentrated H_2SO_4, and cold storage of seed at -20° C. Seeds of (a) were also soaked in lukewarm water, dilute growth regulator, or acid solutions. Chilling of the seed was required for hypocotyl development, but not for epicotyl development. Softening of the seed coat by H_2SO_4 for 35 and 120 minutes for (a) and (b), respectively, increased the rate of germination provided that the carbonized surface was removed. Prolonged soaking or seed-base excision, two methods that remove the hilum, caused some abnormal germination in which only epicotyl development occurred; these epicotyls developed into normal seedlings under artificial conditions. It is concluded that slow germination is due to a combination of dormancy and seed-coat impermeability, and it is suggested that artificially germinated seedlings be transferred to peat moss/ vermiculite in the greenhouse.

40. Dupu, M. 1956. **Some data on the elasticity of the wood of some exotic species grown in Rumania.** Revista Padurilor. 9: 601-604. 5 refs. Rumanian.

Gives values of modulus of elasticity (static bending, compression parallel, tension parallel, and torsion) for *Pseudotsuga taxifolia*, *Taxodium distichum*, *Juniperus virginiana*, *Carya ovata*, *C. glabra*, *C. laciniosa* and *C. pecan*, grown in Rumania.

41. Engle, D.M.; Kulbeth, J.D. 1992. **Growth of crowns of eastern redcedar.** In: Bidwell, T.G.; Titus, D.; Cassels, D., eds. Range research highlights, 1983-1991. Circ. E. 905. Stillwater, OK: Oklahoma State University Cooperative Extension Service: 14.

42. Engle, D.M.; Kulbeth, J.D. 1992. **Growth dynamics of crowns of eastern redcedar at 3 locations in Oklahoma.** Journal of Range Mangement. 45(3): 301-305. 23 refs.

Encroachment of eastern redcedar (*Juniperus virginiana*) is extensive in tallgrass prairie in the central U.S.A. in the absence of fire. The relation of crown area and height with tree age was examined in 1987 by tree ring analysis of eastern redcedar trees from sites in western, central, and eastern Oklahoma. Tree height and crown area as a function of age were different at the three locations. Trees in the 28- to 29-year-old age class ranged in height from 6.2 m on the western site to 8.3 m on the eastern site. The oldest trees at all sites were still actively growing. The trees on the eastern location were younger when they grew beyond the height (2 m) at which they would effectively be killed by fire. This implies that burning should be more frequent in the east to provide similar protection from eastern redcedar invasion under the same rate of invasion. Crown area as a function of tree age was not as similar as tree height among the sites. Crown area of 28-year-old trees ranged from 15 m^2 on the central Oklahoma loamy prairie site to 40 m^2 on the eastern site. It is suggested that the smaller crown area of trees in central Oklahoma may reflect genetic differences. The reduction in forage production associated with eastern redcedar and the efficacy of prescribed burning for controlling eastern redcedar would change more rapidly as trees aged on the eastern location than on the other sites.

43. Fassett, N.C. 1943. **The validity of *Juniperus virginiana* var. *crebra.*** American Journal of Botany. 30: 469-477.

By means of photographs of more than 700 individual trees of *Juniperus virginiana*, the author has assembled data on the crown height / width ratio of this species in 19 American states. The narrow-crowned variety, *J. virginiana* var. *crebra* , is found chiefly in an area stretching from eastern Pennsylvania to southern Maine, and in a second area following a series of moraines from northern Indiana to southeastern Wisconsin. It also occurs sporadically in central New York, Tennessee, western Indiana, and eastern Missouri. Examination of the leaves of the species shows that the degree of acuteness is of no taxonomic value in distinguishing var. *crebra*; and although the seeds of var. *crebra* are rather less conspicuously pitted than are those of the typical broad-crowned tree, this characteristic is not sufficiently marked to be of use in diagnosis.

44. Fassett, N.C. 1944. ***Juniperus virginiana, J. horizontalis* and *J. scopulorum.* I. The specific characters. II. Hybrid swarms of *J. virginiana* and *J. scopulorum.* III. Possible hybridization of *J. horizontalis* and *J. scopulorum.*** Bulletin of the Torrey Botanical Club. 71(4): 475-483.

A study based on mass collections made throughout much of the ranges of *Juniperus virginiana*, *J. horizontalis*, and *J. scopulorum*, as well as on herbarium material, shows that these three species are always clearly recognizable on a number of characters, except when two species grow together. It also shows that the variation within each species is often more conspicuous than, but never as constant as, the variation that separates species. Where *Juniperus virginiana* grows by itself, and where *J. scopulorum* grows by itself, each species retains pure specific characteristics, except in areas in the western part of the range of *J. virginiana* where certain tendencies toward *J. scopulorum* suggest an ancient incursion of that species. Where the ranges of the two species meet, all recombinations of the characters of each occur in individuals of one colony.

45. Fassett, N.C. 1945. ***Juniperus virginiana, J. horizontalis* and *J. scopulorum* .- IV. Hybrid swarms of *J. virginiana* and *J. horizontalis.* V. Taxonomic treatment.** Bulletin of the Torrey Botanical Club. 72: 379-384.

Except in the regions where *Juniperus virginiana* and *J. horizontalis* overlap, the two species are quite distinct in several characters, including the following: (1) The epidermal cells of the leaves of *J. virginiana* average 9-12Ê in width, those of *J. horizontalis* average 13-19Ê. (2) The leaf tips of *J. virginiana* are rarely apiculate, those of *J. horizontalis* are always apiculate. (3) *J. virginiana* is an erect tree, and *J. horizontalis* is a creeping shrub. (4) In *J. virginiana* not more than a third of the peduncles of the female cones are curved, and in *J. horizontalis* half or more are curved. In the Driftless Area of Wisconsin where the two species grow together in the same colony, various intermediates occur, the most common is that described as *J. virginiana* var. *ambigens*, which combines the creeping habit of *J. horizontalis* with the fruit of *J. virginiana*. Part V includes two maps showing the approximate range of the three main species (*J. virginiana*, *J. scopulorum*, and *J. horizontalis*) and their varieties. A key is given for the identification of *J. virginiana*, *J. virginiana* var. *crebra*, *J. virginiana* var. *ambigens*, *J. scopulorum*, *J. scopulorum* var. *columnaris* var. *nov.*, *J. scopulorum* var. *patens*, and *J. horizontalis*.

46. Fechner, G.H. 1976. **Controlled pollination in eastern redcedar (*Juniperus virginiana*) and Rocky Mountain juniper (*J. scopulorum*).** Gen. Tech. Rep. NC-26. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 24-34. 15 refs.
Preliminary results from studies at Fort Collins, Colorado, indicate that wind pollination is less reliable than controlled pollination in obtaining sound seed set in *J. virginiana*. On the basis of fruit set, sound seed set, and first-year gametophyte development, it appears that hybridization between the two species is possible.

47. Ferguson, E.R. 1970. **Eastern redcedar: an annotated bibliography.** Res. Pap. SO-64. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 21 p.
Lists more than 300 publications on *Juniperus virginiana* with an author index.

48. Flake, R.H.; Turner, B.L. 1974. **Volatile constituents, especially terpenes, and their utility and potential as taxonomic characters in populational studies (*Juniperus virginiana*).** Chemical Botany Classification, 25th Nobel symposium: 123-128.

49. Flake, R.H.; VonRudloff, E.; Turner, B.L. 1969. **Quantitative study of clinical variation in *Juniperus virginiana* using terpenoid data.** Easton, PA: National Academy of Science. 64: 487-494. 17 refs.
Nine populations of *J. virginiana* were sampled at 150-mile intervals along a 1,500-mile transect from northeast Texas to Washington, DC, and analyses were made of their terpenoids and the variations in the components. The resulting data show that these populations cluster clinally from northeast to southwest. The more homogeneous populations occur in the Appalachian region, and the more divergent ones are found in progressively more distant regions as measured along the transect from northeast towards the southwest. No biochemical evidence was found to support the theory that hybridization with *J. ashei* might cause this variability.

50. Flake, R.H.; VonRudloff, E.; Turner, B.L. 1973. **Confirmation of a clinal pattern of chemical differentiation in *Juniperus virginiana* from terpenoid data obtained in successive years.** Phytochemistry. 6: 215-228.

51. Flake, R.H.; Urbatsch, L.; Turner, B.L. 1978. **Chemical documentation of allopatric introgression in *Juniperus*.** Systematic Botany. 3(2): 129-144. 27 refs.
Chemical data were obtained for volatile leaf extracts from an array of populations of *J. virginiana* and *J. scopulorum* extending along a transect from near St. Louis, Missouri, to the vicinity of Missoula, Montana. Analysis of the data strongly suggests that the variation found in *J. virginiana* across the Missouri River basin is due to allopatric introgression from its more western cohort, *J. scopulorum*.

52. Frey-Wyssling, A. 1938. **On the origin of resin pockets.** Holzforschung. 1: 329-332. German.
Evidence is put forward in support of the view that the resin pockets of larch and spruce originate as wind shakes in the cambial region of the stem, the cavities thus formed becoming filled with resin from the ruptured radial ducts. Similar shakes (not attributable to seasoning) occur in *Juniperus virginiana*, but in that species no resin enters the cavities and no wound tissue is produced. It is suggested that the formation of wound tissue in larch and spruce may be excited by the resin itself, and some confirmation of this is afforded by experiments with potato tubers. Pockets were cut in the tubers and resin was injected into some of the cavities; wound tissue formed in the resin-filled cavities, while the tissues of empty cavities remained unaltered. Resin pockets are not to be confused with cankerous resin-galls, which arise in other ways.

53. Gabisova, A.I. 1984. **Winter hardiness of conifers in Northern Tajikistan.** Byulleten Glavnogo Botanicheskogo Sada. 131: 51-54. 4 refs. Russian.
A report on a 20-year-old collection at the Leninabad Botanical Garden, with tabulated data on the growth of 27 species and 8 varieties surviving in 1981 (out of a planted total of 69 species and 13 varieties). Many species were intolerant of the dry climate and saline soils. Many others were lost in the winter of 1968/69 (minimum temperature -22.6º C). Frost damage during that and other severe winters is discussed. The most promising ornamental species

were characterized by rapid regeneration of crowns damaged by frost, including *Cupressus sempervirens* var. *umbilicata*, *Juniperus virginiana*, etc.; of these, the fastest growing were *Pinus eldarica* and *P. pityusa* var. *stankewiczii*.

54. Gao, X.P. 1982. **Effects of chlorine on respiration of plants.** Plant Physiology Commission Zhiwushenglixue Tongxun. 2: 12-14. 6 refs. Chinese.

After chlorine fumigation, respiratory intensities of *Cedrus deodara*, *Juniperus chinensis* and *Cupressus lusitanica* increased by over 100 percent as compared with controls, while respiration in *Ligustrum lucidum*, *Buxus harlandii*, *Cupressus funebris*, *Euonymus japonicus*, *Thuja orientalis*, and *Juniperus virginiana* increased by 20-60 percent. On the contrary, the respiratory intensity of *Viburnum awabuki* var. (*odoratissimum*) decreased to 40 percent. Response of leaves to Cl_2 varied with leaf age: after treatment for 4 hours, the respiratory intensities of new, young, and old leaves of *Cupressus lusitanica* increased by 29, 138, and 179 percent, respectively; in *J. chinensis*, respiration showed no significant difference (n.s.d.) in new and young leaves but accelerated in old leaves. Increases in leaf respiration were directly related to the severity of injuries caused to the plants by fumigation. Resistant leaves of *J. chinensis* whose respiration was n.s.d. were injured only slightly, whereas the older leaves of *Cedrus deodara* and *J. chinensis*, in which respiration significantly increased, were severely injured. Similar effects were found in *B. hardlandii* and *L. lucidum*.

55. George, M.F.; Carrasquilla, M.L. 1979. **Freezing avoidance in male cones of *Juniperus virginiana*.** Horticultural Science. 14(3): 425.

Freezing avoidance was evaluated by differential thermal analysis, and results were compared with similar properties of living wood cells of *Quercus velutina*.

56. Ginter-Whitehouse, D.L.; Hinckley, T.M.; Pallardy, S.G. 1983. **Spatial and temporal aspects of water relations of three tree species with different vascular anatomy.** Forest Science. 29(2): 317-329. 35 refs.

Root and leaf water potential, and leaf conductance of two trees each of *Quercus alba*, *Juniperus virginiana,* and *Juglans nigra* were recorded in May-October 1979, in a second-growth, mixed broad-leaved stand in Missouri. Measurements were also made of soil moisture (for calculation of water potential), photosynthetic photon flux density, air temperatures, and precipitation. The main factors leading to tree water deficits were decreasing soil moisture and daily evaporative demand. Periods of drought were associated with declining leaf water potential and leaf conductance in all species, but *J. nigra* maintained higher predawn and solar noon leaf water potentials and leaf conductance than the other species. It was suggested that these differences were related to deeper rooting and early leaf abscission in *J. nigra*, which would be likely to result in water conservation and greater water supply to individual leaves. Flow resistance between soil and leaves, and water potential gradients between root and crown were greater in *Juniperus virginiana* than in the others. This was largely attributed to high resistance presented by the xylem, in which only the tracheids permitted axial water flow.

57. Goryaev, M.I.; Dzhalilov, D.R. 1959. **Analysis of the essential oil of Kazakh Juniper.** Trudy Instituta Khimicheskikh Nauk Akademiya Nauk Kazakhskoi SSR. 54: 21. Russian.

Gives details of the essential oils (yields, chemical characteristics, etc.) of *Juniperus communis*, *J. pseudosabina*, *J. sabina*, *J. semiglobosa*, *J. seravschanica*, *J. sibirica*, *J. talassica*, and *J. turkestanica* from Kazakhstan and Central (Soviet) Asia. Excellent results were also obtained for *J. virginiana* cultivated in these regions.

58. Grigor'ev, A.G. 1986. **Bioecological features of gymnosperms introduced into the northern Crimea.** Byulleten Glavnogo Botanicheskogo Sada. 143: 3-8. 6 refs. Russian.

Few conifers are planted in this semiarid region. Data are tabulated on the growth, phenology, and resistance to frost and drought of 34 species and 15 cultivars or varieties up to 22 years old, planted on a clay-loam chernozem site at the Steppe Division (20 km N. of Simferopol) of the Nikita State Botanical Garden. Species recommended for landscape use in this region include *Juniperus virginiana*, *Picea abies*, *P. montigena*, *P. pungens*, *Pinus pallasiana* (*P. nigra* var. *caramanica*), and *P. sylvestris*.

59. Gurina, T.F. 1991. **Seed-bearing of some species of conifers on the Mangyshlak Peninsula.** Byulleten Glavnogo Botanicheskogo Sada. 159: 97-99. 2 refs. Russian.

Studies were made on plantings of *Platycladus orientalis* (*Thuja orientalis*), *Juniperus virginiana,* and *J. sabina* 16-21 years old on the Mangyshlak Peninsula, on the eastern shore of the Caspian Sea (Kazakhstan). Data are tabulated on flowering phenology, seed bearing, and 1,000-seed weight. In these conditions, seed bearing starts much earlier than elsewhere, e.g., at 3 years in *T. orientalis*.

60. Guyette, R.P.; Cutter, B.E.; Henderson, G.S. 1992. **Inorganic concentrations in the wood of eastern redcedar grown on different sites.** Wood and Fiber Science. 24(2): 133-140. 28 refs.

Samples of eastern redcedar (*Juniperus virginiana*) growing in Missouri on soils derived from five parent materials (rhyolite, dolomite, limestone, sandstone, and chert) were analyzed for concentrations of inorganics in sapwood and heartwood. Eighteen elements were detected in the sapwood using inductively coupled plasma optical emission spectroscopy. Neutron activation analysis was also used to determine concentrations of an additional six elements in heartwood. No difference was found between results obtained by the two analytical methods. Conventional wet chemistry techniques were used to determine nitrogen and sulfur concentrations in some samples.

61. Hall, M.T. 1952. **A hybrid swarm in *Juniperus*.** Evolution. 6(4): 347-366. 10 refs.
   Discusses a hybrid swarm between *J. ashei* and *J. virginiana* from Platt National Park in the Arbuckle Mountains of Oklahoma.

62. Hall, M.T. 1952. **Variation and hybridization in *Juniperus*.** Annals of the Missouri Botanical Garden. 39(1): 1-64. 63 refs.
   The existence of hybrid swarms between *Juniperus ashei* and *J. virginiana* led to an investigation of the populations, in order to find the extent and nature of the influence of the two species upon each other. A study of morphological variations was made, and an index was drawn up based on certain morphological characteristics. The index values are plotted on a map, and show the geographical distribution of the population characters. *J. ashei* influences *J. virginiana* by introgression throughout the Ozark Plateau, and probably as far east as the Tennessee River in the vicinity of the 36th parallel. The reciprocal influences are not so common, or so extreme. The introgression was possibly influenced by the fluctuations of the ranges of the two species, following on climatic fluctuations during and after the glacial periods. Differentation in *J. virginiana* as a species is also discussed.

63. Hall, M.T.; Mukherjee, A.; Crowley, W.R., Jr. 1973. **Chromosome counts in cultivated junipers.** Journal of the Arnold Arboretum. 54(3): 369-376. 6 refs.
   Counts are tabulated and discussed for 20 taxa of the sections *Oxycedrus* (*Juniperus communis* var., *J. formosana* and *J. rigida*) and *Sabina* (var. of *J. chinensis*, *J. horizontalis*, *J. scopulorum*, *J. squamata,* and *J. virginiana*). Most of the taxa were diploid (2n = 22), but 3 of the 12 examined in the section *Sabina* were tetraploid (2n = 44).

64. Harper, R.M. 1912. **The diverse habitats of the eastern redcedar and their interpretation.** Torreya. 12(7): 145-154.
   Eastern redcedar occurs in a variety of habitats and is regarded by some authors as almost indifferent to environmental conditions. Its presence and absences in major ecological regions and the impact of fires on its distribution are discussed.

65. Hawley, F.M. 1937. **Relationship of southern cedar growth to precipitation and runoff.** Ecology. 18: 398-405.
   In eastern Tennessee, cedar growth was more closely correlated with annual precipitation than with stream runoff.

66. Henderson, L.T.; Koppe, T.F.; Schoenike, R.E. 1979. **Ten-year evaluation of a seed source study of eastern redcedar in South Carolina.** Tree Planters Notes. 30(3): 3-6. 5 refs.
   Ten-year-old *Juniperus virginiana* grown from seed from 20 sources in 18 states in the central and eastern U.S.A. were examined and measured. Significant differences were found in survival, growth, disease resistance, crown ratio, foliage density, and winter foliage color. Local sources and those from adjacent states are recommended for planting in South Carolina.

67. Hilton, R.J. 1978. **Root growth in the Guelph rhizotron.** In: Riedacker, A.; Gagnaire-Michard, J., eds. Proceedings symposium: Physiologie des racines et symbioses; 1978 September 11-15; Nancy, France. Comptes-rendus: 135-142. 12 refs.
   Thirty-two *Juniperus virginiana* trees were grown in individual compartments in the rhizotron, in which soil treatments to give varying degrees of compaction and restriction of surface permeability were imposed. After 2 years, soil atmosphere components, bulk density, and numbers of new roots emerging did not differ regardless of soil treatment. There was a significant east to west position effect on root emergence but not on growth of aerial organs. Studies of several woody species showed two major flushes of new roots, one peaking in late spring or early summer and the other in late summer or early autumn, the peaks usually occurring during periods when growth of aerial parts is relatively slow.

68. Hinesley, L.E. 1988. **Water relations of cut eastern redcedar Christmas trees.** Horticultural Science. 23(3): 589-591. 12 refs.
   Eastern redcedar (*Juniperus virginiana*) Christmas trees were cut in early December from a plantation near Raleigh, North Carolina. The trees were taken indoors and dried to different xylem pressure potentials (PSI) before the stems were recut and placed in water. Trees dried rapidly, but readily rehydrated even at PSI as low as -6.5 to -7.0 MPa. There was little foliage loss during drying, but trees dried to PSI of Û-4.9 MPa defoliated heavily after rehydration. There was a linear relation between PSI and twig moisture content.

69. Hinesley, L.E.; Pharr, D.M.; Snelling, L.K.; Funderburk, S.R. 1992. **Foliar raffinose and sucrose in four conifer species: relationship to seasonal temperature.** Horticultural Science. 27(5): 852-855.

Foliar raffinose and sucrose concentrations in eastern white pine (*Pinus strobus* L.), eastern redcedar (*Juniperus virginiana* L.), Leyland cypress (x*Cupressocyparis leylandii* Dallim.), and Virginia pine (*Pinus virginiana* L.) were measured monthly over 2 years. During cold weather, foliage of white pine and redcedar contained higher concentrations of raffinose and sucrose than did Leyland cypress and Virginia pine. Raffinose concentrations were highest during winter and were best correlated with the frequency of occurrence of daily minima less than or equal to 1.7° C during the 30 days before sampling. Sucrose concentrations, which also reached maximum levels during the winter, were best correlated with the frequency of occurrence of daily minima less than or equal to 7.2° C in the prior 30 days. Sucrose concentrations were relatively high during fall and spring. Raffinose and sucrose concentrations increased in response to recurring low temperature, with correlations highest for raffinose.

70. Holthuijzen, A.M.A.; Sharik, T.L. 1984. **Seed longevity and mechanisms of regeneration of eastern redcedar (*Juniperus virginiana* L.) in SW Virginia.** Bulletin of the Torrey Botanical Club. 111(2): 153-158. 31 refs.

71. Huang, M.R.; Chen, D.M.; Shi, J.S. 1981. **A preliminary study on the relation between the isozymes pattern and the sex of four conifer species.** Journal of the Nanjing Technical College of Forest Products. 3: 141-146. 4 refs. Chinese.
Peroxidase and esterase patterns of mature needles of male and female individuals were studied in four species: *Sabina* (*Juniperus virginiana*), *S.* (*J. chinensis*), *J. rigida,* and *J. communis.* There were clear differences in numbers and patterns of isozymes between the males and females of each species.

72. Hugo, N.R. 1990. **Eastern red—the cedar that isn't.** American Forests. 96(9/10): 26-28, 65, 67-68.

73. Jack, J.G. 1893. **The fruitification of *Juniperus*.** Botanical Gazette. 18: 369-375.
Juniperus virginiana is simply annual-fruited, flowering about the latter part of April and maturing its fruit in the autumn of the same year.

74. Jackson, L.W.R. 1952. **Radial growth of forest trees in the Georgia Piedmont.** Ecology. 33(3): 336-341. 10 refs.
A comparison of the radial growth of 21 species during a single season showed wide variation in the dates of beginning and relative rapidity of growth, duration of most rapid growth, and date when seasonal growth ended. These data are given graphically for *Pinus echinata*, *P. taeda*, *P. caribaea*, *P. palustris*, *P. ponderosa*, *Taxodium distichum*, *Juniperus virginiana*, *Ulmus alata*, *U. parvifolia*, *Cornus florida*, *Diospyros virginiana*, *Acer rubrum*, *Liquidambar styraciflua*, *Carya tomentosa*, *Liriodendron tulipifera*, *Castanea dentata*, *Fagus grandifolia*, *Quercus alba*, *Q. stellata*, *Q. borealis*, and *Q. falcata*.

75. Kaeiser, M. 1950. **Microscopic anatomy of the wood of three species of Junipers.** Transactions of the Illinois State Academy of Science. 43: 46-50. 6 refs.
Presents, in summarized and tabulated form, data that can be used as criteria for distinguishing the following species: *Juniperus virginiana*, *J. ashei*, *J. monosperma*, *J. virginiana* X *J. ashei,* and *J. procera*.

76. Kakihara, M. 1958. **On the stand composition and the standing volume table of the artificial pencil cedar (*Juniperus virginiana*) forest.** Reports Kyushu University Forests. 1958-9: 29-34. Japanese.
Studies were made in the Ino National Forest. Distribution of trees by d.b.h. and tree height was normal. Increment curves for height, d.b.h., and volume, and a volume table are given. *J. virginiana* showed a more pronounced taper than *Cryptomeria japonica* and *Chamaecyparis obtusa*.

77. Kent, A.H. 1900. ***Juniperus virginiana***. In: Veitch's manual of the coniferae. London: James Veitch and Sons: 192-196.
Presents a botanical description and description of the native range in the United States.

78. Khoshoo, T.N. 1959. **Polyploidy in gymnosperms.** Evolution. 13(1): 24-39. 97 refs.
Reviews the subjects of polyploid seedlings in the progeny of diploid species (recorded for *Pinus densiflora*, *P. radiata*, *Picea abies*), polyploid trees in diploid species (so far recorded once each for *Larix decidua* and *Juniperus virginiana*) and polyploid species. The various hypotheses to explain the rarity of polyploidy in gymnosperms are reviewed.

79. Kim, S.I. 1988. **Taxonomic studies of the genus *Juniperus*.** Journal of the Korean Forestry Society. 77(3): 338-350. 30 refs. Korean.
Reports results of a study based on the morphology and karyotype of *J. chinensis* (including *J. chinensis* var. *sargentii* and four other varieties), *J. virginiana*, *J. rigida*, and *J. coreana* collected in the Korea Republic.

80. King, D.B.; Roberts, E.V.; Winters, R.K. 1949. **Forest resources and industries of Missouri**. Res. Bull. 452. Columbia, MO: University of Missouri Agricultural Experiment Station. 89 p.

The greatest concentration of the eastern redcedar-hardwood forest type is in the White River watershed of the southwestern Ozarks, totaling about 49,200 acres or about 3 percent of Missouri's forest area.

81. Kocon, J. 1984. **Presence and structure of the wart layer in tracheids of some junipers as visualized in the scanning electron microscope.** Acta Societatis Botanicorum Poloniae. 53(2): 141-144. 14 refs.

The wart layer was examined in tracheids from the butt, middle, and apex of the stem and from the roots and branches of two species (*Juniperus communis* and *J. saxatilis*) and from the butt only of four species (*J. sabina*, *J. virginiana*, *J. chinensis*, and *J. squamata*). The wart layer was found to be present on the S3 layer of the secondary wall in all sample tracheids, from both spring and summer growths. It is suggested that the wart layer is an integral part of tracheid structure in juniper wood.

82. Kocon, J. 1987. **Structure and ultrastructure of warty layer in tracheids of some juniper (*Juniperus* L.) species as revealed by scanning electron microscope.** Folia Forestalia Polonica. 29: 135-139. 14 refs.

83. Krusekopf, H.H. 1963. **Forest soil areas in the Ozark region of Missouri**. Res. Bull. 818. Columbia, MO: University of Missouri Agricultural Experiment Station. 28 p.

The upland oak forest type prevails over the entire region, but shortleaf pine and redcedar sometimes are the most important species. Redcedar generally occupies dry uplands that have shallow soil and numerous limestone outcrops. Although redcedar will grow on good soil, it usually is replaced by faster growing species. It is a common invader of glades and old prairie openings.

84. Kuo, M.L.; McGinnes, E.A., Jr. 1973. **Variation of anatomical structure of false rings in eastern redcedar.** Wood Science. 5(3): 205-210. 8 refs.

Describes a study of within-tree variation of false-ring features in a single tree of *Juniperus virginiana* in Missouri, having 37 rings at d.b.h. False rings were found in the early- and late-wood zones. Tangential variation of false-ring features was greatest for increments closest to the bark. Longitudinal variation of false-ring features within annual increments was extensive. It ranged from discontinuity of false rings within increments at certain heights to a transition from the classic cellular features of false-ring structure to false rings composed of tangential bands of parenchyma cells, as false-ring structures were traced from the upper to the lower levels within the stem. Possible causes are discussed.

85. Lassoie, J.P.; Dougherty, P.M.; Reich, P.B.; Hinckley, T.M.; Metcalf, C.M.; Dina, S.J. 1983. **Ecophysiological investigations of understory eastern redcedar in central Missouri.** Ecology. 64(6): 1355-1366. 29 refs.

Juniperus virginiana is a sun-adapted, drought-resistant pioneer species common to pastures, abandoned fields, hedges, and calcareous rock outcrops throughout the eastern USA. In central Missouri, however, it is also a frequent component of the understory in mature oak/hickory (*Quercus/ Carya*) forests, where light intensity is typically less than 10 percent of full sunlight during much of the growing season. This is below the reported optimum for photosynthesis in *J. virginiana*. An analysis of temporal variations in net photosynthesis, transpiration, and xylem pressure potential, and a study of the environmental factors that control these processes suggested that the competitive survival of understory *J. virginiana* was due to it being an evergreen conifer in a deciduous forest. The foliage was able to maintain a positive carbon dioxide balance through much of the year, with maximum net photosynthesis occurring when the overstory canopy was leafless.

86. Lee, P.W.; Eom, Y.G. 1984. **Scanning electron microscopical study on the compression wood and opposite wood formed in branches of *Juniperus virginiana* L.** Wood Science Technology. 12(4): 47-52. 17 refs.

87. Lev-Yadun, S.; Liphschitz, N. 1989. **Sites of first phellogen initiation in conifers.** IAWA Bulletin. 10(1): 43-52. 69 refs.

Sites of first phellogen initiation were studied in *Pinus halepensis*, *P. pinea*, *P. canariensis*, *Cedrus libani*, *Cupressus sempervirens*, *C. macrocarpa*, *C. funebris*, *Thuja orientalis*, *Juniperus oxycedrus,* and *J. virginiana*. The distance from the apex, age, and the tissue from which the first phellogen is initiated were determined. In Pinaceae, the first phellogen arises at a shorter distance from the apex than it does in Cupressaceae. In fast growing leaders or seedlings, suberization appears further from the apex than it does in slow growing branches. The differences between Pinaceae and Cupressaceae are probably related to differences in the contribution of leaf-bearing organs and branches to photosynthesis. These differences represent a compromise between protection by suberization in Pinaceae and an increase in the photosynthetic area in Cupressaceae.

88. Lipa, O.L. 1940. **Supplement to the gymnosperms of gardens and parks in the Ukrainian SSR. (Data for the study of the dendroflora of the Ukrainian SSR).** Botanicheskii Zhurnal. 1(1): 119-126. Russian.

A supplement to the author's Dendroflora of the Ukrainian S.S.R., I. Conifers, published by the

Academy of Sciences of the Ukrainian S.S.R. in 1939. One hundred new records of trees and shrubs are mentioned, indicating for most the environment, growth data, and growth and fruiting characters. Species dealt with include *Ginkgo biloba*, *Abies sibirica*, *A. alba*, *A. balsamea*, *A. nordmanniana*, *A. fraseri*, *A. veitchii*, *A. concolor*, *Pseudotsuga taxifolia*, *Tsuga canadensis*, *Picea abies*, *P. orientalis*, *P. canadensis*, *P. pungens*, *P. engelmanni*, *P. omorica*, *P. jezoensis*, *Larix kaempferi*, *L. sibirica*, *L. decidua*, *Pinus contorta*, *P. ponderosa*, *P. rigida*, *P. sibirica*, *P. excelsa*, *P. strobus*, *Thuja occidentalis*, *T. plicata*, *Chamaecyparis lawsoniana*, *C. pisifera*, *Juniperus sabina*, *J. virginiana*, and *J. communis*.

89. Loudon, J.C. 1838. ***Juniperus virginiana* L., the Virginian juniper, or red cedar**. In: The trees and shrubs of Britain. London, UK: Longman, Orme, Brown, Green, and Longmans; 4: 2495-2498.

Describes the characteristics, varieties, geography, history, propagation, uses, and culture of eastern redcedar.

90. Lupe, I.Z.; Indries, R. 1970. **The wood density of some of the less common exotic tree species cultivated in Rumania.** Industria Lemnului. 21(2): 64-66. 7 refs. Rumanian.

Presents data (with ranges) for the oven-dry density and annual ring width of increment cores taken at d.b.h. from mature specimens of (a) *Sequoia gigantea*, (b) *Chamaecyparis lawsoniana*, (c) *Juniperus virginiana,* and (d) *Pinus nigra* var. *maritima* on a good site at Orsova (Banat). The mean density of (a) was 0.30 and 0.34 in two specimens; values for (b), (c), and (d) were normal. The increment data were promising for (a), good for (c) and (d), and relatively poor for (b). Measurements of density only were made on some species for which previous data were unavailable, viz. *Aesculus* X *carnea*, 0.47 and 0.55; *Tilia* X *euchlora*, 0.50; *Corylus columa*, 0.68.

91. Lysova, N.V. 1980. **Means of adaptation and hardiness of woody plants in the dry steppe of the Volga region.** Byulleten Glavnogo Botanicheskogo Sada. 115: 8-13. 9 refs. Russian.

Gives a general account of observations in the Volgograd arboretum and at Kamyshin in the drought years of 1972 and 1975. Species that survived well in the very severe conditions of 1972 (with dust storms) included junipers (*Juniperus communis*, *J. virginiana*), pines (*Pinus nigra* var. *caramanica*, *P. ponderosa*), lindens (*Tilia amurensis*, *T. cordata*, *T. tomentosa*), oak (*Quercus robur*) and several shrubby species. Data are tabulated for some of the broadleaved species examined (including several *Acer* spp.), showing leaf anatomical characters and foliar water content in May, July, and August 1972 and 1975, and illustrating the more xeromorphic character and better control of water balance in the successful species.

92. McDermott, R.E.; Fletcher, P.W. 1955. **Influence of light and nutrition on color and growth of redcedar (*Juniperus virginiana*) seedlings.** Res. Bull. 587. Columbia, MO: University of Missouri Agricultural Experiment Station. 15 p. 14 refs.

During the 1953 growing season, 1 + 0 seedlings of *J. virginiana* were grown under three light intensities, (a) full sunlight, (b) 1/3 sunlight, and (c) 1/10 sunlight, and varying fertilizer levels of N, Ca, P, and K. At the close of the growing season, it was clear that fertilizers did not affect growth or coloration of foliage at any light intensity. Growth responses in (a) and (b) were the same, but (c) resulted in seedlings that were deficient in both height and top/root weight ratio. During the summer, foliage of (a) seedlings was yellow-green, of (b) pure green, and of (c) blue-green. In the autumn, (a) developed a strong anthocyanin pigmentation and (b) developed a pronounced yellow-green, while (c) remained unchanged. It seems evident that the autumnal coloring of *J. virginiana* is essentially a light phenomenon, though the degree to which red or yellow color is developed is primarily governed by genetic factors.

93. McGinnes, E.A., Jr.; Dingeldein, T.W. 1969. **Selected wood properties of eastern redcedar (*Juniperus virginiana*, L.) grown in Missouri.** Res. Bull. 960. Columbia, MO: University of Missouri Agricultural Experiment Station. 19 p. 6 refs.

Mean moisture content of heartwood of 40 standing trees was 22 percent, with a range of 19-25 percent, over a 9-month period. Sapwood moisture con-tent, acetone-extractable content, specific gravity, and growth rate are given, and their influence on the manufacture of novelty items is discussed.

94. McGinnes, E.A., Jr.; Phelps, J.E. 1972. **Intercellular spaces in eastern redcedar (*Juniperus virginiana* L.).** Wood Science. 4(4): 225-229. 6 refs.

Sections 1 micrometer thick were prepared from the sapwood and heartwood of discs removed from five 24- to 39-year-old trees. Intercellular spaces were found to occupy about 13 percent of the cross-sectional area of the sapwood and 8 percent of the heartwood. When there were only a few spaces, they were generally located near the rays, but when the spaces were frequent they tended towards a random distribution.

95. McGinnes, E.A., Jr.; Kandeel, S.A.; Szopa, P.S. 1969. **Frequency and selected anatomical features of included sapwood in eastern**

redcedar. Wood Science. 2(2): 100-106. 5 refs.

Butt lengths of nine stems, d.b.h. 5-10 inches, all contained many patches of included sapwood extending for 2-10 inches axially and 1-3 growth rings radially; they tended to decrease in number up the tree. The larger ones were often associated with traumatic tissue. In the green condition, included sapwood had a slightly higher moisture content (26-37 percent) than adjacent heartwood (23-30) but much lower than that of normal sapwood (95-170). Separation at the outer boundary of included sapwood commonly occurred, and is attributed to differential moisture-regain properties; it causes damage to lacquer finishes.

96. McGinnes, E.A., Jr.; Szopa, P.S.; Phelps, J.E. 1974. **Use of scanning electron microscopy [SEM] in studies of wood charcoal formation.** In: Proceedings workshop, SEM & Plant Science. Chicago, IL: IIT Research Institute: 469-476. 6 refs.

Describes studies on samples of *Quercus alba*, *Carya ovata*, *Pinus echinata*, and *Juniperus virginiana*. SEM techniques plus small-angle X-ray diffraction procedures indicate that shrinkage during charring resulted from a reduction in overall cell and cell-wall dimensions, accompanied by apparent fusion or merging of adjoining cell-walls in both the radial and tangential planes, plus some longitudinal folding.

97. Mamada, S. 1954. **Wood study on *Juniperus virginiana* L. and *J. chinensis* L.** Bulletin of the Tokyo University of Forests. 46: 225-231. 6 refs. Japanese.

Results of strength tests and a comparison with American results for *J. virginiana* are given in tables.

98. Mark, R. 1965. **Tensile stress analysis of the cell walls of coniferous tracheids.** In: Cote, W.A., Jr., ed. Proceedings, Cellular ultrastructure of woody plants. New York, NY: Syracuse University Press. 40 p.

Describes the application of the theory of elasticity to determine levels of stress in the various components of the unaltered cell-wall when loaded to failure, using late sapwood of *Juniperus virginiana* as test wood. Concludes that maximum shear stress is in the S1 layer, that maximum stress is normal to the direction of microfibrils in the S2 radial area; and that the maximum values for a maximum applied tension of 26.47 kg/mm^2 reach 12.88 kg in shear, 14.23 kg in normal stress, and 224.85 kg in the chain direction of the structural polysaccharides.

99. Mark, R. 1966. **Tensile strength of tracheids of *Juniperus virginiana*.** Forest Products Journal. 16(11): 56.

100. Mathews, A.C. 1939. **The morphological and cytological development of the sporophylls and seed of *Juniperus virginiana* L.** Elisha Mitchell Science Society Journal. 55: 7-62.

101. Medina, J.H.; Pena, C.; Levi-DeStein, M.; Wolfman, C.; Paladini, A.C. 1989. **Benzodiazepine-like molecules, as well as other ligands for the brain benzodiazepine receptors, are relatively common constituents of plants.** Biochemical Biophysical Research Communications. 165(2): 547-553.

The presence of benzodiazepine (BZD)-like molecules as well as of other substances with affinity for the brain BZD-receptors was explored in eight non-flowering plants known to contain biflavonoids, three flowering plants used as sedatives in folkloric medicine, and one plant extensively used in Argentina, Uruguay, Brazil, and Paraguay as a tea substitute. All the plants examined contained substances that bound to the central BZD-receptors, and the majority of them also had BZD-like compounds detected by their specific interaction with a monoclonal antibody against BZDs. In various cases this last type of compound was present in amounts that exceeded trace levels (0.5 - 1.0 ng/g). The biological or clinical significance for humans of all these substances should be explored.

102. Minckler, L.S.; Ryker, R.A. 1959. **Color, form, and growth variations in eastern redcedar.** Journal of Forestry. 57(5): 347-349.

In 1951, 2-year-old seedlings from eight geographical sources of *Juniperus virginiana* were planted in randomized plots (100-400 trees/plot) within replicated blocks on an old field site in southern Illinois. Six years later significant variations in winter foliage color, crown form, growth rate, survival, leaf form, and resistance to cedar-apple rust were noted. The progeny of some large trees in the Lebanon Forest, Wilson County, north central Tennessee, were the largest and the greenest in winter. They showed 92 percent survival after 6 years; had broadly conical crowns with mostly scale-like leaves; were vigorous; and had good characteristics for Christmas trees, lumber, and posts.

103. Monk, R.W.; Wiebe, H.H. 1961. **Salt tolerance and protoplasmic salt hardiness of various woody and herbaceous ornamental plants.** Plant Physiology. 36(4): 478-482. 9 refs.

Salt-hardiness was measured by the plasmolytic and tetrazolium methods. Salt-tolerant species included *Salix alba* var. *vitellina*, *Robinia pseudoacacia*, *Gleditsia triacanthos* var. *inermis*, *Elaeagnus angustifolia*, and *Tamarix gallica*. Among the somewhat salt-tolerant species were *Juniperus virginiana*, *Pinus ponderosa*, and *Fraxinus pennsylvanica* var. *lanceolata*. Among the non-tolerant species were *Picea pungens*, *Juglans nigra*, *Tilia cordata* , and *Pseudotsuga taxifolia*.

104. Muenscher, W.C. 1949. **The red cedar.** Cornell Plantations. 5: 47.

Describes occurrence, distribution, wood qualities, and form.

105. Murphey, W.K. 1961. **Relationship between extractive and durability of six species of wood.** Res. Circ. 96. Columbus, OH: Ohio State University Agricultural Experiment Station. 15 p. 7 refs.

To identify the compounds imparting durability, a study was begun on six species providing relatively durable fence posts: (a) *Robinia pseudoacacia*, (b) *Juglans nigra*, (c) *Catalpa speciosa*, (d) *Juniperus virginiana*, (e) *Morus rubra*, (f) *Maclura pomifera*. Tests were made on *Coniophora puteana*, *Lenzites trabea*, *Merulius lacrymans*, *Polyporus versicolor*, *Poria incrassata,* and *P. monticola*, using extractives obtained with seven solvents. Compounds inhibiting fungus growth were extracted by: alcohol from (c), (e), and (f); benzene/alcohol from (b), (e), and (f); complete extraction from (e) and (f); hot water from (a). No correlation was found between the content of 12 inorganic elements in wood or extractives and the inhibition of test fungi. In the second phase of the study, the isolation of the compound or compounds responsible for natural durability is being attempted.

106. Nagano, K.; Nakamura, M.; Toda, Y. 1991. **Study on the chromosomes of Cupressaceae: VIII. Karyotype of *Juniperus*.** In: Proceedings of the Faculty of Agriculture, Kyushu Tokai University. 10: 75-88. Japanese.

The detailed karyotype analysis on five species of *Juniperus* (*J. virginiana*, *J. rigida*, *J. lutchuensis*, *J. horizontalis*, *J. chinensis*) and four varieties of *J. chinensis* (var. *procumbens*, var. *sargentii*, var. *kaizuku*, var. *jacobiana*) was studied. A comparative karyological study among the species and the varieties through the observation of nucleoli using the Ag-I method was also conducted. The number of chromosomes of *Juniperus* was 2n = 22, except for *J. chinensis* (2n = 44) and its varieties (2n = 44). Karyotype of *Juniperus* in all species observed consisted of satellite chromosome, metacentric chromosomes, and submetacentric chromosome. The relative lengths of each chromosome in all species and varieties observed held no remarkable differences. Also, their sizes decreased from large to small in a gradual manner. For these two reasons, this karyotype was classified as symmetric and gradual. The number of satellite chromosomes of *Juniperus* coincided highly with the maximum number of nucleoli per cell. However, *J. chinensis* var. *procumbens*, which was tetraploid, had four nucleoli, one of which was very small. It was found by the karyotype analysis that var. *procumbens* had only three observable satellite chromosomes.

107. Ormsbee, P.; Bazzaz, F.A.; Boggess, W.R. 1976. **Physiological ecology of *Juniperus virginiana* in old fields.** Oecologia. 23(1): 75-82. 21 refs.

Reports laboratory studies of the effects of irradiance intensity, temperature, and leaf water potential on the rates of apparent photosynthesis and transpiration of *J. virginiana*. Results showed that this species grows well in open fields and faster than associated tree species because it is a sun-adapted, drought-resistant species with a long growing season. It is excluded from mature forests because it is intolerant of shade.

108. Ottley, A.M. 1909. **The development of the gametophytes and fertilization in *Juniperus communis* and *Juniperus virginiana*.** Botanical Gazette. 48: 31-46.

109. Pack, D.A. 1921. **Chemistry of after-ripening, germination, and seedling development of juniper seeds**. Botanical Gazette. 72: 139-150.

Describes physiological and chemical changes in the fats during after-ripening, and the seedling development of eastern redcedar.

110. Pack, D.A. 1925. **Dispersion of lipoids**. Botanical Gazette. 79: 334-338.

As the tissues of eastern redcedar seeds grew active, the lipoids became dispersed.

111. Palma-Otal, M.; Moore, W.S.; Adams, R.P.; Joswiak, G.R. 1983. **Morphological, chemical and biogeographical analyses of a hybrid zone involving *Juniperus virginiana* and *J. horizontalis* in Wisconsin.** Canadian Journal of Botany. 61(10): 2733-2746. 39 refs.

112. Parent, J.; Richard, P.J.H. 1990. **Pollen morphology of Cupressaceae from eastern Canada and northeastern United States applied to the study of Quaternary sediments.** Canadian Journal of Botany. 68(1): 79-89. 32 refs. French

Light microscopy was used to study pollen morphology of *Chamaecyparis thyoides*, *Juniperus communis* var. *depressa* and var. *montana*, *J. horizontalis*, *J. horizontalis* var. *alpina*, *J. virginiana,* and *Thuja occidentalis.* Pollen of *Taxodium distichum* (Taxodiaceae), which is present in the study area, was also studied. Four pollen types were identified: *J. communis / Thuja occidentalis*, *C. thyoides*, *J. horizontalis / J. virginiana,* and *Taxodium distichum.* Five shapes of pollen grains, representing different stages of hydration, were found in all species and could not be used for identification. A key is included for identifying pollen in fossil sediments.

113. Parker, J. 1950. **Germination of eastern redcedar seeds.** Journal of Forestry. 48(4): 255-256. 7 refs.

When seeds of *Juniperus virginiana* are freed of their fruit coats and planted out of doors in a forest soil in midwinter, some germination may be expected. Even if fruit coats are not removed, a few seeds may germinate the first spring and a larger number the second spring. Exposure of seed to a temperature of 41° F or below for 2-3 months appears to be essential for successful germination, though a few seeds may germinate when exposed to room temperature. Scarification of seeds by abrasion, or opening the seeds by cracking the seed coats, resulted in earlier germination, but did not, in the experiments reported, increase total germination.

114. Parker, J. 1950. **The effects of flooding on the transpiration and survival of some southeastern forest tree species.** Plant Physiology. 25: 453-460. 6 refs.

A study was made on potted seedlings of various hardwood and softwood species to discover the injury caused to roots by flooding, as measured by decreases in transpiration rates. Results are given graphically. Substantial similarity between the species in reduction of transpiration rates was shown. *Juniperus virginiana*, *Quercus borealis* var. *maxima*, *Pinus taeda*, *Q. alba*, and *Q. prinus* all responded similarly. *Taxodium distichum* showed an outstandingly high level of transpiration rate after flooding. *Q. lyrata* showed a decline similar to the other oaks in the first few days of flooding, but, unlike them, produced a second crop of leaves. Leaves of *Cornus florida* died shortly after flooding in one experiment, but died only after 3 weeks when the experiment was repeated.

115. Parker, J. 1954. **Available water in stems of some Rocky Mountain conifers.** Botanical Gazette. 115(4): 380-385. 12 refs.

Reports results of a further study in a series on drought-resistance in conifers. Relative amounts of water were investigated in the various tissues supplying the foliage of ponderosa pine, Douglas fir, grand fir, and redcedar. Water content of terminal twigs per dry weight of needles growing above the point of severance was higher in ponderosa pine than in the other three species studied, differences between these being insignificant. For all four species, the water contents of the twigs as a percent of their dry weight were not significantly different and had little meaning for water availability to the needles. In all four species, defoliated branches 6 feet long retained water longer than needle-bearing ones over a period of 3-5 days, as determined by sectioning the branches and determining the water content by oven-drying. Ponderosa pine had the highest average water content in untreated freshly cut branches. Determinations of stem water content showed that heartwood water varied considerably from one species to another, that of ponderosa pine and grand fir being high and that of Douglas fir and redcedar being quite low; total stem water was slightly higher in the two former than the two latter. The water content of stems in Douglas fir and ponderosa pine showed a definite annual cycle of increase and decrease, apparently depending on the weather.

116. Parker, J. 1971. **Heat resistance and respiratory response in twigs of some common tree species.** Botanical Gazette. 132(4): 268-273. 20 refs.

Terminal twigs were taken at monthly intervals for 15 months from (a) *Juniperus virginiana*, (b) *Picea pungens*, (c) *Quercus rubra*, and (d) *Fraxinus americana*, and were heated at 57° C for periods of 1-10 minutes; their respiration was then measured in terms of CO_2 release and the viability of tissue determined by the tetrazolium test. In all species, heat resistance was greatest in winter and lowest in summer; (a) was usually more resistant than (b), and (d) was somewhat more resistant than (c). The post-heating respiratory rate (PHRR) was nearly always higher in (b) than in (a); in autumn the rate was 10 times the normal in (b) and 3 times the normal in (a). In February there was little or no respiratory rise in (a) and (b) after heating. The PHRR was nearly always greater in (c) than in (d). Both (c) and (d) had maximum rates in December in two separate years, and in one year the PHRR of (c) in December was 10 times the normal.

117. Parker, J. 1971. **Unusual tonoplast in conifer leaves.** Nature. 234(5326): 231. 7 refs.

An unusual layer, 0.4-1.0 Êm thick, was observed between the main vacuole and the cytoplasm in leaf chlorenchyma cells of *Picea pungens* and *Juniperus virginiana* (unusual because the tonoplast in higher plant cells is generally recognized to consist of a single membrane). It appeared to have a lipid nature and did not vary much with season. The layer was also found in *Pinus strobus*, *Tsuga canadensis*, *Taxus baccata*, and *Thuja occidentalis* (where, however, it was thinner or often lacking), but not in broadleaved trees such as *Fraxinus americana*, *Ulmus americana*, and *Acer saccharum*. It was never found in a leaf stele. The fact that the layer was thickest in the two most drought-resistant species, *Picea pungens* and *J. virginiana*, suggests that it may be involved in resistance to water stress. When leaves of these two species were slowly dried to 35 percent of fresh weight in 3 days, chloroplastlamellae and mitochondrial cristae often disintegrated or lysed while tonoplasts (including the layer reported here) remained intact.

118. Pestre, M. 1942. **Tests of the physical and mechanical properties of certain exotic woods from the Arboretum of Les Barres.** Ann. Ec. Eaux For. Nancy. 8(2): 280-291. French.

Reports results of tests made in 1942 on wood of the following exotic species grown at Les Barres: *Pinus laricio, P. ponderosa, P. coulteri, Larix decidua, Abies nordmanniana, Cedrus atlantica, Juniperus virginiana.*

119. Read, R.A.; Bagley, W.T. 1967. **Response of tree seedlings to extended photoperiods.** Res. Pap. RM-30. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.16 p.

Eastern redcedar seedlings were grown under 14- and 24-hour photoperiods, and under 14-hour photoperiods with one and two light interruptions in the dark period. Seedlings were usually the tallest and heaviest under continuous light, intermediate under the interrupted dark. Long photoperiod stimulated top growth more than root growth, but did not affect field survival.

120. Rehder, A. 1929. ***Juniperus***. In: Bailey, L.H., ed. Standard cyclopedia of horticulture. New York, NY: Macmillan Press: 1726-1729.

121. Riker, A.J. 1945. **Some possibilities for developing resistance to disease in trees.** American Nurseryman. 81(12): 5-7.

Among the best general means for securing disease resistance are the selection of individuals, of both local and foreign origin, with desirable characters including disease resistance, and inducing variations in them, mainly by cross-pollination and also by treatment with ultra-violet light and with colchicine; the best individuals are again selected and the process continued. The desired result may be obtained more rapidly if the selected plants can be reproduced vegetatively with seeds, a number of successive generations are necessary to stabilize a desired character. Promising work is being done in the United States in the production of disease-resistant strains of chestnut, elm, and white pine, and a rust-resistant strain of redcedar (Berg's rust-resistant variety of *Juniperus virginiana*) has been developed and is available commercially. At the Griffith State Nursery, Wisconsin, 1,000 grafts and 10,000 seedlings of white pine are being tested, the progeny of 163 trees selected for resistance to heavy natural infection of blister rust. Experiments in rooting of cuttings from young white pine have given 40 to 50 percent success, and somewhat better results have been obtained by treating the cuttings with indolebutyric acid, 1:5,000 for 6 hours. Cuttings from rapidly growing, vigorous shoots have been found to root less easily than those from slower growing shoots.

122. Ross, J.G.; Duncan, R.E. 1949. **Cytological evidences of hybridization between *Juniperus virginiana* and *J. horizontalis.*** Bulletin of the Torrey Botanical Club. 76(6): 414-429. 17 refs.

123. Rubanik, V.G.; Zeronkina, T.A. 1969. **Development of cones of *Juniperus virginiana* and *J. communis* in Alma-Ata.** Botanicheskii Zhurnal. 54(3): 464-470. 15 refs. Russian.

Reports results of a comparative phenological and anatomical study.

124. Sargent, C.S. 1895. **The red cedar**. Garden and Forest. 8: 61-62.

125. Sax, K.; Sax, H.J. 1933. **Chromosome number and morphology in the conifers.** Journal of the Arnold Arboretum. 14: 356-375.

126. Schaefer, P.R.; Baer, N.B. 1988. **An eastern redcedar and Rocky Mountain juniper provenance test for windbreak suitability in eastern South Dakota.** Northern Journal of Applied Forestry. 5(2): 129-132. 16 refs.

A regional provenance test of 118 eastern redcedar (*Juniperus virginiana*) and 26 Rocky Mountain juniper (*J. scopulorum*) sources was established in Brookings, South Dakota, U.S.A., in 1980. Eastern redcedar exhibited better combinations of traits, with greater height growth, larger crown spread, a wider branch angle, and a stronger tendency toward producing a single terminal leader than Rocky Mountain juniper. Based on a windbreak suitability index, best performing seedlots collected from natural stands were all eastern redcedar from a large area of the central Great Plains. These results indicate that eastern redcedar should be favored over Rocky Mountain juniper for planting in eastern South Dakota, and sources of eastern redcedar south of central Kansas should be avoided.

127. Schnell, R.L. 1976. **Biomass estimates of eastern redcedar tree components.** Tech. Note B15. Tennessee Valley Authority. 15 p. 5 refs.

Components of the above-ground portions of 31 forest-grown trees of *Juniperus virginiana* from the Tennessee Valley were cut and weighed after determining standing tree measurements. Wood and bark samples were oven-dried to determine moisture content and establish dry weights, and ratios of bark to wood were calculated. Stump weights were obtained at a manufacturing plant. Data are tabulated giving green and dry weights for leaves, wood and bark in branches (more and less

than 1 inch diameter), total crown, merchantable and unmerchantable stem, deadwood, stumps, and whole trees with diameters at breast height of 5 to 20 inches.

128. Schoenike, R. 1969. **Early evaluation of a seed source study in eastern redcedar (*Juniperus virginiana* L.) in South Carolina.** In: Proceedings, 10th Southern forest tree improvement conference: 165-174. 12 refs.

Presents and discusses preliminary data taken from 4- to 9-year-old trees of 21 provenances growing in Clemson Forest, South Carolina. The characters studied are survival, growth, symptoms of disease, color of winter foliage, amount of foliage, and percent of juvenile foliage.

129. Schulman, E. 1944. **Notes on dendrochronologies at the Arnold Arboretum.** Tree Ring Bulletin. 10: 30-32.

Makes some general observations on tree-ring characteristics of the species *Cedrus libani*, *Juniperus virginiana,* and *Tsuga canadensis*.

130. Schultze-Dewitz, G.; Goetze, H. 1992. **Transverse dimensions of softwood tracheids.** Feddes Repertorium. 103(3-4): 195-204.

For 130 years transverse dimensions of softwood tracheids have been the subject of study. Selected references show that diameter and wall thickness of the cells have been more thoroughly studied than lumen diameter. An attempt was made to correlate these three anatomical parameters among each of them and with wood density in 15 coniferous tree species (*Chamaecyparis lawsoniana*, *Juniperus virginiana*, *Thuja plicata*, *Larix decidua*, *Picea abies*, *P. schrinkiana*, *Pinus durangensis*, *P. palustris*, *P. sylvestris*, *P. strobus*, *Pseudotsuga menziesii*, *Tsuga heterophylla*, *Podocarpus nagaia*, *Sequoiadendron giganteum*, *Taxodium distichum*).

131. Schurtz, R.H. 1972. **A taxonomic analysis of a triparental hybrid swarm in *Juniperus* L.** Dissertation Abstracts International, B Sciences and Engineering. 32(11): 6248.

Describes the development and application of a method for analyzing populations of plants derived from at least three species. The method was applied to 634 specimens of *Juniperus* collected in Montana, Wyoming, Idaho, North Dakota, and South Dakota, and 35 characters (including gross morphological and foliage characters) were measured. The data were processed on an IBM 360 computer using three programs, including one designed to determine the bases for character correlations in terms of extremes of character expressions. Analysis of the outputs resulted in the separation of three sets of correlated characteristics, which could be assigned to *J. horizontalis*, *J. virginiana,* and *J. scopulorum*. The majority of the specimens possessed varying proportions of germ plasma attributable to the three taxa, but some appeared to be hybrids of only two species.

132. Seidel, K.W.; Watt, R.F. 1969. **Survival and growth of eastern redcedar seed sources in southwest Missouri.** Res. Note NC-84. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 4 p. 1 ref.

In a trial of nine provenances of *Juniperus virginiana*, the order of superiority (in survival, form, vigor, and height growth) at 5 years was: W. Virginia (Mason County) > local and Arkansas > western and northern provenances, allowing for differences in the planting stock used.

133. Setzer, W.N.; Whitaker, K.W.; Lawton, R.O. 1992. **A chemical ecological study of the components of the essential oil of eastern redcedar (*Juniperus virginiana*) from three habitats in Huntsville, Alabama.** Castanea. 57(3): 209-213.

134. Shirley, H.L. 1945. **Light as an ecological factor and its measurement.** Botanical Review. 11: 497-532.

Pioneer woody species such as redcedar rarely cast shade dense enough to preclude invasion of other species, but their shade and root competition may markedly reduce the growth of all but the most tolerant species.

135. Smith, W.B. 1992. **Determining moisture content in eastern redcedar.** Forest Products Journal. 42(7/8): 67-69. 7 refs.

For 13 eastern redcedar (*Juniperus virginiana*) heartwood and sapwood samples, moisture content was determined by oven drying, toluene extraction distillation, and use of an electronic resistance-type moisture meter. The results show that, due to the presence of volatile organic compounds, oven drying is not a satisfactory method of determining heartwood moisture content. The distillation method proved to be more accurate and can be used to provide correction factors for the convenient, below fiber saturation point, use of resistance moisture meters.

136. Sperry, J.S.; Tyree, M.T. 1990. **Water-stress-induced xylem embolism in three species of conifers.** Plant Cell Environment. 13(5): 427-436. 17 refs.

This mechanism was studied using sample branches collected in Vermont from mature *Juniperus virginiana*, *Picea rubens,* and *Abies balsamea*. Each species exhibited a characteristic relation between xylem tension and loss of hydraulic conductivity by air embolism. *A. balsamea* and *P. rubens* began to embolize at tensions between 2 and 3 MPa, and were completely non-conducting

between 3 and 4 MPa. *Juniperus virginiana* was least vulnerable, beginning to embolize at 4 MPa and still retaining approximately 10 percent conductivity at 10 MPa. Brief perfusion of branch segments with an oxalic acid and calcium solution (10 and 0.1 mol/m^3, respectively) increased vulnerability of xylem to embolism; this was especially pronounced in *A. balsamea.* When hydrated branch segments were injected with air at various pressures and measured for embolism, results supported the air-seeding hypothesis (embolism caused by aspiration of air into functional tracheids from neighboring embolized ones). Structural and experimental evidence suggested that air-seeding occurred through inter-tracheid pit membranes when the thickened torus region of the membrane became displaced from its normal sealing position over the pit aperture. Thus, embolism-inducing tension may be a function of pit membrane flexibility. This tension is of ecological significance because it reflects to some extent the range of xylem tensions to which a species is adapted.

137. Sprackling, J.A.; Read, R.A. 1979. **Tree root systems in eastern Nebraska.** Bull. 37. Lincoln, NE: Nebraska Conservation. 73 p. 10 refs.

Root drawings and data, from a study made between 1939 and 1941, are presented for 39 species of trees or shrubs growing naturally at four locations. Root depth and spread were measured by total excavation of trees 5 years old and younger, and by partial excavation of older trees. A description of tree and site is given for each excavation, and root distribution characteristics contributing to drought-hardiness are noted. Average ratios of root depth/tree height, root spread/tree height, and root depth/root spread are tabulated for 12 of the most common tree species.

138. Stamm, A.J. 1970. **Maximum effective pit pore radii of the heartwood and sapwood of six softwoods as affected by drying and resoaking.** Wood Fiber. 1(4): 263-269. 15 refs.

Maximum effective pit-pore radii (e.p.r.) calculated from the air pressure needed to displace liquid from cross-sections of green sapwood and heartwood, 1/32 to 3 inch thick, and the surface tension of the liquid, were found for *Pseudotsuga menziesii, Libocedrus decurrens, Thuja occidentalis, Juniperus virginiana, Larix laricina,* and *Sequoia sempervirens.* Sapwood (s.w.) showed higher maximum lumen radius and fiber length than heartwood (h.w.), both features being attributed to tree age. E.p.r. was much higher for s.w. than for h.w. Species differed markedly in relative differences in calculated permeability between s.w. and h.w.; *Larix* showed the greatest and *Sequoia* showed the least difference. Air- or oven-drying followed by re-soaking in water rendered the wood less permeable, the effect being rather less when wetting agents were added.

139. Stoeckeler, J.H. 1946. **Alkali tolerance of drought-hardy trees and shrubs in the seed and seedling stage.** Minnesota Academy of Science Proceedings. 14: 79-83.

Redcedar was one of the least alkali tolerant species of the 20 different species tested.

140. Tang, R.C.; Smith, N.D. 1975. **Investigation of anisotropic shrinkage of isolated softwood tracheids with scanning electron microscope. Part I: Longitudinal shrinkage.** Wood Science. 8(1): 415-424. 14 refs.

Presents an illustrated account of the anisotropic shrinkage of early- and late-wood tracheids chemically isolated from *Pinus strobus, P. virginiana, Juniperus virginiana, Abies balsamea,* and *Pseudotsuga menziesii.* The variation of microfibrillar angle, helical diameter, twisting angle, number of twists, and change in cell length were investigated. Results are analyzed and discussed.

141. Tauer, C.G.; Harris, K.D.; VanHaverbeke, D.F. 1987. **Seed source influences juniper seedling survival under severe drought stress.** Res. Note RM-470. Lincoln, NE: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 4 p. 8 refs.

Seedlings of 39 sources of *Juniperus virginiana* and 15 sources of *J. scopulorum,* representing collections from throughout the Great Plains, were planted in 1980 as 2+0 stock in South-central Oklahoma. Extreme drought during 1980 resulted in 77 percent mortality. Survival by source showed a low and negative, but significant, correlation with mean nursery height of seedlings. *J. scopulorum* survived better (32 percent) than *J. virginiana* (20 percent). Seed origin affected survival only of *J. virginiana.*

142. U.S. Department of Agriculture, Forest Service. 1907. **Red cedar (*Juniperus virginiana*).** Circ. 73. Washington, DC: U.S. Department of Agriculture, Forest Service. 4 p.

Discusses tree form, range, growth characteristics, utilization, planting techniques, and cultivation.

143. U.S. Department of Agriculture, Forest Service. 1955. **Eastern redcedar (*Juniperus virginiana*).** Useful trees of the United States 13. Washington, DC: U.S. Department of Agriculture, Forest Service. 4 p.

Describes distribution, growth habits, size, characteristics, uses, and pests.

144. Van Dersal, W.R. 1938. **Native woody plants of the United States.** Misc. Publ. 303. Washington, DC: U.S. Department of Agriculture, Forest Service. 362 p.

Discusses eastern redcedar's suitability for arid sites, use in erosion control, and wildlife food and cover.

145. VanDeusen, J.L. 1979. **Eastern redcedar (*Juniperus virginiana*) seed sources recommended for North Dakota sites.** Res. Note RM-371. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 6 p. 6 refs.

146. VanHaverbeke, D.F.; Comer, C.W. 1985. **Effects of treatment and seed source on germination of eastern redcedar seed.** Res. Pap. RM-263. Lincoln, NE: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 7 p. 24 refs.

Trials of 22 treatments showed that germination of *Juniperus virginiana* seeds was best after soaking in citric acid (10,000 p.p.m.) for 96 hours followed by moist warm (24° C) stratification for 6 weeks and moist cold (5° C) stratification for 10 weeks. Seed from different sources in the Great Plains (South Dakota, Nebraska, Kansas, and Oklahoma) differed in their responses to the treatments.

147. VanHaverbeke, D.F.; King, R.M. 1990. **Genetic variation in Great Plains *Juniperus*.** Res. Pap. RM-292. Lincoln, NE: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 10 p.

148. VanHaverbeke, D.F.; Read, R.A. 1976. **Genetics of eastern redcedar.** Res. Pap. WO-32. Lincoln, NE: U.S. Department of Agriculture, Forest Service. 17 p. 110 refs.

Mainly reviews the literature, with sections on sexual reproduction, asexual reproduction, genetic variation, resistance to diseases, and improvement programs. *Juniperus virginiana* shows a high degree of geographical variation in several characters, and it is suggested that research should be carried out on provenance variation (particularly in the eastern range of the species), controlled breeding, and resistance to pests and diseases.

149. Vasiliauskas, S.A.; Aarssen, L.W. 1992. **Sex ratio and neighbor effects in monospecific stands of *Juniperus virginiana*.** Ecology. 73(2): 622-632.

150. Vimmerstedt, J.P. 1968. **Root cation-exchange capacity and the mineral nutrition of eastern white pine and eastern redcedar.** Soil Science Society of America. 32(2): 289-292. 10 refs.

Greenhouse experiments were made with seedlings grown on natural soils (fertile limestone (a) or poor sandstone (b)) or artificial soils (crushed quartz and various amounts of kaolinite with exchange sites occupied by either K, Ca, or Al) to test the hypothesis that, in accordance with the Donnan theory of cation uptake and findings for agricultural plants, the species with the lower monovalent-to-divalent cation ratio (MDCR) would have the higher root cation-exchange capacity (CEC). A field study had shown that foliage of *Juniperus virginiana* had a lower MDCR than that of *Pinus strobus*. However, on natural soils in the laboratory, neither MDCR nor CEC of the seedlings differed significantly between the species. The influence of the clay content natural soils, and clay cation of the artificial soils on the dry weight, Ca, K and Mg content, and the K/Ca + Mg ratio in seedlings of both species is tabulated or graphed. Cation content and cation ratio of the soil had a strong influence on cation ratio and cation content of foliage.

151. Vinutha, A.R.; VonRudloff, E. 1968. **Gas/liquid chromatography of terpenes. Part XVII. The volatile oil of leaves of *Juniperus virginiana* L.** Canadian Journal of Chemistry. 46(23): 3743-3750. 16 refs.

Sabinene was found to be the main component, but a number of other substances were also isolated. The similarity of most of the components with those found in *J. horizontalis* and *J. scopulorum* indicates a close phylogenetic relationship. Quantitative aspects were studied with a view to future studies of chemosystematic relationships. Leaf oils of different trees of *J. virginiana* from Texas and Ontario were found to give wide quantitative variations of the individual components.

152. VonRudloff, E.; Irving, R.; Turner, B.L. 1967. **Reevaluation of allopatric introgressions between *Juniperus ashei* and *J. virginiana* using gas chromatography.** American Journal of Botany. 54(5): 660.

Introgression across a broad front has been postulated for the allopatric species *J. ashei* and *J. virginiana*. Evidence for gene flow of a subcontinental magnitude in these species is based primarily on inferences drawn from morphology. Such data, however, are difficult to gather and to interpret. Preliminary tests show that the terpenes as characterized by gas chromatography are particularly useful, since 80-90 of these compounds are found in the two species and 10 are common to each. Preliminary results also indicate that introgression as an explanation of the intergradation and seemingly clinal change in certain morphological features of the species seems to have been grossly overemphasized.

153. Williamson, M.J. 1957. **Silvical characteristics of eastern redcedar (*Juniperus virginiana*).** Misc. Rel. 15. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 14 p. 55 refs.

154. Williamson, M.J. 1965. **Eastern redcedar (*Juniperus virginiana* L.).** In: Silvics of forest trees of the United States. Agric. Handb. 271. Washington, DC: U.S. Department of Agriculture, Forest Service: 212-216.

155. Wyman, D.D. 1947. **Giant red cedars - Virginia vs. Bay State.** Horticulture. 25: 74.
Describes the dimensions of several redcedars of exceptional size.

156. Yeager, A.F. 1935. **Root systems of certain trees and shrubs grown on prairie soils.** Journal of Agricultural Research. 51: 1085-1092.
In North Dakota, in an area with 22.4 inches of rainfall per year, planted redcedars had roots up to 22 feet long at age 25 years. The greatest depth of roots was more than 12 feet.

157. Zheronkina, T.A. 1974. **Structure of the seed-coat of Juniper and its role in germination.** Byulleten Glavnogo Botanicheskogo Sada. 91: 67-72. 10 refs. Russian.
In continued work on sowing of unripe seed of *Juniperus communis* and *J. virginiana*, an illustrated account is given of the structure of the seed-coat of seeds of these two species collected in May, June, July, and October; the process of the deposition of lignin in the seed-coat is described. In Kazakhstan, the seeds are best able to germinate in early August (*J. communis*) and late September/early October (*J. virginiana*) when the lateral suture of the seed-coat is open. When the berry is morphologically ripe, the seeds enter deep dormancy, with closure of the suture, deposition of lignin in the stone cells, and lignification of the parenchyma.

NURSERY PROPAGATION

158. Abrahamson, L.P. 1983. **Herbicides, an important component of the weed control program at Oklahoma State (Norman) Nursery. Screening and demonstration projects for *Pinus taeda*, *Pinus nigra*, *Juniperus virginiana*, includes phytotoxic effects.** Tech. Publ. R8-1983-4. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Region 8: 171-191.

159. Abrahamson, L.P.; Burns, K.F. 1979. **Herbicide screening for weed control in western forest nurseries - Great Plains segment.** AFRI Res. Rep.-41. New York, NY: State University, Applied Forest Research Institute. 15 p. 9 refs.
Twelve herbicides were applied either after seeding or after germination to seven conifers and five broadleaved species in six nurseries. Weeds were collected from nursery plots and weighed. Survival and height of treated tree seedlings are tabulated as a percent of control values; phytotoxicity was variable. Post-seeding treatments were usually more effective.

160. Afanasiev, M.M. 1955. **Storage of after-ripened seed of eastern redcedar.** Tree Planters Notes. 21: 28-30. 1 ref.
Tests showed that storage of stratified *Juniperus virginiana* seed in ice at + 20° F for as long as 3 months does not impair its viability if germination does not occur in storage. Seed with radicles protruding through the endosperm showed injury after storage at + 20° F; storage at + 4° F and lower killed most of the seed. It is concluded that after-ripening and germination can be arrested by storing stratified but ungerminated seed at 15-20° F.

161. Afanasiev, M.M.; Cress, M. 1942. **Producing seedlings of eastern redcedar (*Juniperus virginiana* L.).** Bull. B-256. Stillwater, OK: Oklahoma State University, Agricultural Experiment Station. 21 p.
The authors report on a satisfactory method of handling seed of *Juniperus virginiana* and on some of the experimental work on which the method is based. Information is presented on the collecting, storing, cleaning and treatment of seed and on the growing of seedlings from after-ripened seed. Delayed germination in seed of *J. virginiana* is caused by a dormant embryo; the seed requires stratification at low temperatures to complete after-ripening, the length of time required to complete this process varying with the individual seed. For the material reported on, after-ripening was completed after 70 days at a temperature of 41° F. Drying of after-ripened seed caused reversion to a secondary dormancy, which was overcome by stratification for a relatively short period. Temperature had a marked effect on germination of after-ripened seed of *J. virginiana,* the optimum temperature being 50° F with only a slight reduction in germination at 60° and 70° F. One year of storage of cleaned seed of *J. virginiana* at low temperature (41° F) and of dry berries at room temperature (70-90° F) did not reduce the viability of the seed. Germination was not affected markedly by the reaction of the medium when the pH of the latter varied between 4.4 and 8.4. The highest germination was obtained at a pH of 6.2.

162. Blomme, R.; Vanwezer, J. 1987. **The grafting of conifers - VII.** Verbondsnieuws voor de Belgische Sierteelt. 31(9): 591, 593, 595. Dutch.
Details are given of the recommended grafting techniques for 12 blue- and golden-leaved cultivars of *Juniperus* X *media* var. *J. chinensis*, *J. chinensis*, *J. scopulorum,* and *J. virginiana*. Propagation of the

blue-leaved cultivars could be carried out from August to spring, but for the golden-leaved cultivars the summer months were unfavorable. Side-grafting gave the best results on rootstocks of *J. virginiana* or *J. chinensis* cv. *Hetzii* raised from cuttings. The optimum temperature for grafting was 16° C, and the use of supplementary lighting gave good results only for *J.* X *media* cv. *Plumosa aurea*. The age of the mother plant made little difference, but scions from vigorous plants gave the best results. The propagation period for all cultivars was 6 weeks, and greater than 90 percent success was achieved with most cultivars.

163. Box, B.H.; Beech, L.C. 1968. **Vegetative propagation trials of eastern redcedar and Arizona cypress in the greenhouse.** Tree Planters Notes. 19(3): 1-2.

A 5-second dip treatment in IBA and NAA (10,000 p.p.m.) produced a greater percent of rooted cuttings of *Juniperus virginiana* than untreated controls (82 vs. 55). *Cupressus arizonica* cuttings did not root effectively with any hormone treatment. Best results were obtained with the above-mentioned 5-second dip treatment, which produced roots on 25 percent of cuttings (vs. 0 on controls).

164. Buckley, A.R. 1957. **The grafting of *Juniperus virginiana* varieties on rooted cuttings**. Plant Propagator. 7: 81-83.

165. Burley, J. 1964. **Effect of gibberellic acid on seed germination of Sitka Spruce.** Forest Science. 10(2): 206-208. 14 refs.

Concentrations of 0.1, 1.0, and 10 p.p.m. of gibberellic acid caused no significant differences in germination rate or capacity compared with distilled water. A solution of 100 p.p.m. significantly reduced germinative capacity at 35 days. A table summarizes the conflicting results obtained by 14 authors on the effects of gibberellin (stimulatory, nil, inhibitory) on the germination rate and capacity of *Pinus* spp. (7), *Picea* spp. (3), *Cryptomeria japonica*, *Chamaecyparis obtusa*, *Juniperus virginiana*, *Larix leptolepis*, and *Pseudotsuga taxifolia*.

166. Burns, R.M. 1960. **Response of selected coniferous seeds to gibberellic acid.** Pap. 1. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 13-16. 8 refs.

In tests on unstratified seeds (450 per species) with gibberellic acid as 10 percent K salt in concentrations of 0, 75, 150, 225, and 300 mg/liter in various forms, with or without a supplement, response was erratic within and between species. None of the seeds of *Juniperus virginiana* germinated, but 62 percent of the seeds recovered at the conclusion of the experiment, after 90 days, were apparently viable. The effect on germination of *Pinus palustris* was not significant, but responses appeared to increase with concentration, and distilled water appeared to be the best carrier. For *P. taeda*, germination rate, total germination, and height growth were significantly improved, being greatest at 150 mg/liter. In a second series, in which *P. taeda* seed was stratified at 34° F for 1-4 days in peat soaked with aqueous solutions of gibberellic acid in strengths from 6 to 200 mg/liter, germination was not significantly affected, but height growth responded positively to concentration and duration of treatment, with a maximum for 3 days at 150 mg.

167. Chylarecki, H. 1985. **Planting coniferous trees and shrubs in the urban environment.** Arboretum Kornickie. 30: 201-223. 47 refs. Polish.

Surveys potential species and varieties suitable for urban situations in Poland where conifers have generally been little used. Species from the Cupressaceae and Taxaceae tend to be more suited than Pinaceae. Some 51 suitable species/varieties are listed, notably *Juniperus chinensis* var. *Columnaris*, *J. sabina* var. *Tamariscifolia*, *J. virginiana* var. *Tripartita*, *Taxus baccata* var. *Elegantissima*, var. *Overeinderi* and var. *Imperialis*, *Thuja orientalis* var. *Stricta*, *Thuja occidentalis* var. *Fastigiata*, var. *Mastersii* and var. *Umbraculifera*, and the hybrids *Juniperus* X *media* var. *Pfitzeriana* (*J. chinensis* X *J. sabina*), *Taxus* X *media* var. *Hicksii'* (*T. baccata* X *T. cuspidata*) and *Thuja* X *plicatoides* (*T. occidentalis* X *T. plicata*). *Picea pungens*, dwarf varieties of *P. abies*, *Abies concolor*, *Pinus cembra*, and several *Pinus nigra* varieties are fairly resistant to industrial air pollution, and many of these are used in Silesia. A further 142 species are under trial in different urban situations.

168. Cobb, G.S. 1983. **Medium pH and growth of two woody ornamentals as influenced by liming rate.** Res. Rep. Auburn, AL: Auburn University, Alabama Agricultural Experiment Station. May: 6-7.

169. Cossitt, F.M. 1948. **Mineral spirits weed conifer seedbeds.** American Nurseryman. 88: 7, 14, 57.

Further experiments have been made with dry-cleaning fluid as a weedkiller in U.S. southern nurseries. Very weedy beds with weeds overtopping 2-inch seedlings require upwards of 120 gal/acre; smaller weeds, about the size of the seedlings, were eliminated by one application at the rate of 40 gal/acre. The use of a large spray outfit, capable of pressures of 200 pounds and covering 18 feet at one time, and having nozzles that produce a flat fan-shaped pattern, is considered best. Under certain conditions, not fully understood, some damage has been done to the foliage of seedlings. Apparently a correlation exists between the age of the seedlings, soil moisture, temperature, and the amount of spray. Seedlings less than a month old were sprayed in early May without any apparent damage; selected beds of the same seedlings sprayed in June with the temperature about 93° F showed a 30 percent loss; sprayings later in the same day at slightly lower temperatures caused no loss. On the other hand, heavy sprayings of 150 gal/acre on seedlings 4-7 months old, with the thermometer at 102° F, caused no serious damage or loss. Trials were made on *Pinus palustris*, *P. caribaea*, *P. taeda*, *P. echinata,* and *Juniperus virginiana*. All hardwoods sprayed were killed or seriously injured. Studies are now in progress to determine the effect of spraying on the survival of treated seedlings when planted out in forest areas.

170. Cotrufo, C. 1963. **Citric acid stimulates seed germination.** Plant Physiology. 38: Suppl. xiv.

Pinus taeda and *Taxodium distichum* seed responded to citric acid similarly to that of eastern white pine; *Pinus echinata* seed showed less response. The most striking results were obtained with seed of *Juniperus virginiana*. Total germination at 30 days was increased from 22 percent for untreated seed to 92 percent for seed soaked for 4 days in a 10,000 p.p.m. solution of citric acid (c.a.). With all these species, soaking in concentrations of 100 to 10,000 p.p.m. gave the best results. Concentrations greater than 100,000 p.p.m. showed toxic effects, viz., reduced and retarded germination. The c.a. pretreatment appears to complement the stratification requirements of these seeds. Studies are now in progress to elucidate the role of c.a. in increasing both speed of, and total, germination.

171. Cotrufo, C. 1963. **Stimulation by citric acid of germination of eastern redcedar (*Juniperus virginiana* L.).** Nature. 199(48): 92-93. 5 refs.

Of several species tested *J. virginiana* showed the best response. In a factorial experiment using various chemical treatments, soaking and stratification periods, and temperatures on fresh seed, a 4-day soak in 10,000 p.p.m. citric acid before 90 days' stratification (one of the best treatments) gave 93 percent germination in 30 days vs. 73 percent for pre-soaking in water and 23 percent for no soaking.

172. Daigneault, L.; Chong, C. 1985. **Rooting cuttings of thirteen woody ornamental species in response to willow extract and auxin.** Plant Propagator. 31(4): 12-14. 11 refs.

Leafy cuttings of 13 species were treated with combinations of crude willow extract (1.6-10.0 g/ 100 ml water of freeze-dried powder from twigs of *Salix alba* var. *tristis*); 5,000 p.p.m. each of IAA, IBA and/or NAA; and/or 0.4 percent IBA in talc. Willow extract application increased rooting in three of four deciduous shrubs (*Cornus alba* cv. *Elegantissima*, *Philadelphus coronarius* cv. *Aureus,* and *Ribes alpinum*), in one of five evergreens (*Juniperus chinensis* cv. *Mountbatten*) but in none of four deciduous trees. Auxin application increased rooting in all evergreen species treated (*J. chinensis* cv. *Mountbatten*, *J. virginiana* cv. *Sky Rocket*, *Pinus mugo* subsp. *mugo*, *P. sylvestris,* and *Taxus media*). Auxin application inhibited rooting in the three above-named deciduous shrubs.

173. Dayharsh, V.J. 1934. **Stratification vs. scarification for cedar seed**. Plant Quart. 3. Washington, DC: U.S. Department of Agriculture, Forest Service: 15-16.

174. DeBoer, S. 1951. **Tests with growth substances, soil mixtures etc. for rooting cuttings.** Jaarboek Proefstation voor de Boomkwekerij Boskoop: 27-59. Dutch.

Experiments were made on plants from 39 genera, including *Acer palmatum* var. *atropurpureum*, *Ilex opaca*, *Juniperus virginiana* var. *glauca*, *Picea abies* var. *nidiformis*, *P. abies* var. *repens* and *P. omorika* var. *nana*, *Populus canescens*, *Quercus robur* and *Q. sessiliflora*, *Taxus cuspidata* var. *nana*, *Thuja occidentalis* var. *pyramidalis* var. *compacta*, and *Ulmus carpinifolia* var. No. 62 'Bea Schwarz'. Results are tabulated.

175. Doran, W.L. 1952. **Effects of treating cuttings of woody plants with both a root-inducing substance and a fungicide.** American Society of Horticultural Science Proceedings. 60: 487-491.

Combined hormone and fungicidal treatment resulted in a maximum of 83 percent rooting of redcedar cuttings in 200 days.

176. Drori, A.; Meirowitz, A.; Ben Jaacov, J. 1983. **Grafting junipers.** Hassadeh. 63(10): 2138-2139. Hebrew.

The grafting of *Juniperus virginiana* cv. *Grey Owl* onto rootstocks of *Cupressus sempervirens* and *Callitris cupressiformis* in March and July is reported. The successful take was 70 percent, and plant development was normal over the 9 months of observation. The advantages of grafted as opposed to own-rooted *Juniperus* are discussed.

177. Ealy, R.P. 1960. **The effect of a combined fungicide-hormone treatment on the propagation of redcedar (*Juniperus virginiana* L.) by cuttings.** Process. Ser. P-367. Stillwater, OK: Oklahoma State University. 5 p. 4 refs.

Cuttings of *J. virginiana* were treated with (a) a fungicide, Phygon XL (2,3-dichloro-1, 4-naphthaquinone 50 percent, in $MgSO_4$) at 1 part to 3 parts talc; (b) a growth regulator, Hormodin III (0.8 percent IBA in talc); (c) equal parts of these two preparations; and (d) nothing. The highest percent of rooting occurred with (c). There were four times as many rooted cuttings with this treatment as with (d), indicating a probable synergistic effect; (a) and (b) produced little better rooting than (d).

178. Eastman, R.E. 1911. **Care of the seed of red cedar.** Forest Quarterly. 9: 173-174.

Stratification of seeds for approximately 17 months in sandboxes buried in soil or mulched with leaves, straw, or grass improved germination.

179. Engstrom, A. 1955. **Polyethylene film for seedbed mulch.** Tree Planters Notes. 21: 26-27.

Good germination of *Juniperus virginiana* seed in Oklahoma was obtained by applying ca. 1 inch of sawdust to the seedbeds after sowing, watering well, and then laying polyethylene film over the beds. Burlap is laid over the polyethylene, and both are pegged down. Sowing is in December and germination is usually complete by the middle of March, when the coverings are removed. The burlap is then laid over a lath shade for a further 10 days to provide shelter from sun and frost.

180. Gil Albert, F.; Boix, E. 1978. **Effect of treatment with IBA on rooting of ornamental conifers.** Acta Horticulturae. 79: 63-77.

Cuttings of *Chamaecyparis*, *Juniperus*, *Thujopsis*, *Sequoia*, *Sequoiadendron*, *Thuja,* and *Taxus* spp. and cvs were taken at different times of year. They were given a basal dip in an IBA solution and inserted in a mixture of 60-70 percent peat and 30-40 percent perlite. The best rooting was obtained as follows: (1) For *C. pisifera* and *C. lawsoniana* cvs, cuttings taken in July and treated with 8,000 p.p.m. IBA; (2) for *Juniperus* spp. in general, cuttings taken in November-December and treated with 4,000 p.p.m.; species responded differently and *J. chinensis*, *J. communis*, *J. horizontalis*, *J. sabina,* and *J. squamata* were far easier to root than *J. scopulorum* and *J. virginiana*; (3) for *Thuja occidentalis* and *T. plicata* cvs, cuttings taken in November and either treated with less than 4,000 p.p.m. or left untreated; *T. orientalis* varieties rarely rooted; (4) for *Thujopsis dolabrata* cv. *variegata*, cuttings taken in November-December and treated with 4,000 p.p.m.; (5) for *Sequoiadendron giganteum*, cuttings taken in July-August and treated with 4,000 p.p.m.; and (6) for *Taxus baccata*, cuttings taken in September-October and treated with 20,000 p.p.m. Regardless of treatment, virtually no cuttings of *Sequoia sempervirens* rooted.

181. Hall, T.J.; Bowes, S.A. 1984. **Mycorrhizas and container-grown hardy ornamental nursery stock (HONS) production.** In: 1982 annual report of the Glasshouse Crops Research Institute. West Sussex, UK: Littlehampton: 113-114.

Plants of *Juniperus virginiana* cultivar Skyrocket inoculated with a VA mycorrhiza, probably *Glomus fasciculatus* (*G. fasciculatum*), were 39 percent taller than non-mycorrhizal plants after 14 months when grown with half the recommended rate of slow-release fertilizer (2 g/l) and 14 percent taller than uninoculated controls receiving 4 g of fertilizer. With *Magnolia soulangiana*, the mean total stem length of VA-inoculated plants was 43 percent greater than that of control plants receiving 4 g of fertilizer.

182. Henry, P.H.; Blazich, F.A.; Hinesley, L.E. 1992. **Vegetative propagation of eastern redcedar by stem cuttings.** Horticultural Science. 27(12): 1272-1274. 13 refs.

Eastern redcedar (*Juniperus virginiana*) is gaining popularity as an ornamental tree. Seedling populations are very variable in phenotype, and vegetative propagation would allow the cloning of high quality trees for the ornamental and forestry industries. Studies were conducted on the effects of season, IBA application, genotype, crown position, type of cutting (straight vs. heel), cutting length, and stock plant age upon adventitious rooting of stem cuttings. Genotype had a strong influence on percentage rooting, root count, and root length of cuttings from 4-year-old trees. With trees of this age, percentage rooting was maximized (87 percent) with hardwood cuttings taken in January and treated with 5,000 p.p.m. IBA. Crown position from which cuttings were collected did not influence rooting. Straight cuttings, with or without a light wound, had a significantly higher rooting percentage (78 percent) than heel cuttings (52 percent). With 30-year-old trees, cuttings from the lower third of the crown had a significantly higher rooting percentage (67 percent) than cuttings from the middle third (43 percent). Better rooting was obtained with straight (68 percent) than with heel (47 percent) cuttings. Cutting length affected rooting, with root count and length being greater in longer cuttings. Increased tree age reduced rooting, although cuttings from 40-year-old trees retained substantial rooting capacity.

183. Henry, P.H.; Blazich, F.A.; Hinesley, L.E. 1992. **Nitrogen nutrition of containerized eastern redcedar. I. Growth, mineral nutrient concentrations, and carbohydrate status.** Horticultural Science. 27(4): 563-567. 24 refs.

Containerized seedlings of eastern redcedar (*Juniperus virginiana*) were fed weekly for 175 days with a solution containing 50 p.p.m. K, and either 0, 5, 10, 20, 40, 80, 160, 320, or 640 p.p.m. N. Plant height, stem diameter, and shoot and root DW increased asymptotically with applied N; 640 p.p.m. N was supraoptimal. Growth after 175 (height, stem diameter) and 180 (shoot and root DW) days was optimal (90 percent of maximum) at N concentrations of 115, 155, 230, and 105 p.p.m., respectively. Plant growth in terms of height was optimum at a foliar N concentration of 1.5 percent. Foliar concentrations of N, P, and K increased in treated plants over the duration of the experiment, while Ca, Mg, and Mn decreased or remained constant. Starch concentration of fertilized plants decreased sharply after initiation of the experiment, but controls showed little change during the first 120 days. Sucrose concentration remained constant over the summer but increased sharply in late autumn. At 180 days, foliar concentrations of starch, sucrose, hexose, N, P, K, and B increased asymptotically with applied N; concentrations of Ca, Mg, and Mn decreased.

184. Henry, P.H.; Blazich, F.A.; Hinesley, L.E. 1992. **Nitrogen nutrition of containerized eastern redcedar. II. Influence of stock plant fertility on adventitious rooting of stem cuttings.** Horticultural Science. 27(4): 568-570. 20 refs.

Hardwood stem cuttings of eastern redcedar (*Juniperus virginiana*), taken from containerized stock plants fed weekly with 0, 5, 10, 20, 40, 80, 160, 320, or 640 p.p.m. N, were treated with 7,500 p.p.m. IBA and placed under intermittent mist for 12 weeks. Foliar starch and sucrose concentrations within cuttings at the time of excision were significantly correlated with percentage rooting and root length, respectively. Of the mineral nutrients analyzed (N, P, K, Ca, Mg, Mn, and B), only B and K were significantly correlated with rooting response. A threshold N level (20 p.p.m.), applied weekly, maximized rooting; higher concentrations decreased response. Although N fertilization of stock plants affected adventitious rooting, there were no significant correlations between foliar N levels and measurements of rooting response.

185. Hess, C.E. 1954. **Black mold (*Chalaropsis thielavioides*) appears on evergreens (*Cryptomeria japonic, Juniperus virginiana, Thuja* spp.).** American Nurseryman. 100(8): 36-37.

This mold fungus, not previously recorded on Coniferae, caused serious loss of grafts in U.S. nurseries in the 1954 season.

186. Hildebrand, D.M.; Dinkel, G.B. 1988. **Evaluation of methyl bromide, Basamid granular, and solar heating for pre-planting pest control for fall-sown eastern redcedar at Bessey Nursery.** Gen. Tech. Rep. RM-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 13 p.

187. Hulea, A.; Radu, S.; Cucuian, E. 1962. **Establishing a technique of nursery practice for some exotic coniferous species.** Revista Padurilor. 77(9): 519-525. Rumanian.

Describes techniques employed in Rumania for raising nursery stock of *Abies cephalonica, A. faxoniana, A. nordmanniana, Cephalotaxus drupacea, Chamaecyparis lawsoniana, Cryptomeria japonica, Juniperus virginiana, Larix leptolepis, Pinus strobus, Pseudotsuga taxifolia, Taxodium distichum, Thuja occidentalis, T. orientalis, T. plicata, Thujopsis dolabrata,* and *Tsuga canadensis.*

188. Jesinger, R.; Hopp, R.J. 1967. **The effect of season on the propagation of conifers from cuttings.** Gartenwelt. 67(15): 309-311. German.

Tsuga canadensis, Abies concolor, Pinus mugo, Juniperus virginiana and ornamental varieties of *Juniperus, Thuja occidentalis, Picea glauca,* and *P. pungens* were tested in a propagating house at Burlington, Vermont, at soil temperatures of 20 or 26° C and with various concentrations of IBA. Rooting behavior and optimum season for taking cuttings varied greatly. Season was more important than soil temperature (the majority of species preferred 26°) and concentration of IBA (increases beyond 0.8 percent had little effect). Maximum rooting percentages exceeded 50 except for *P. mugo, J. virginiana,* and *P. pungens.*

189. Jorgensen, P.E.; Eriksen, E.N. 1978. **Investigations of air content in root medium and root quality in the overwintering of container plants at different drainages in open frame (*Juniperus virginiana*).** Acta Horticulturae. 79: 153-159.

190. Kalmar, S. 1973. **Conifer propagation by cuttings.** Kertgazdasag. 5(4): 67-69. 2 refs. Hungarian.

This is a first report from Hungary of the successful use of IBA and NAA for rooting *Chamaecyparis lawsoniana, Picea abies 'Conica', Thuja occidentalis 'Columna', T. plicata,* and *Juniperus virginiana.* For a 1-minute dip the best concentration of both substances was 3,000 p.p.m., and for 4 hours soaking the best concentrations were 200 or 400 p.p.m. IBA and 400 or 600 p.p.m. NAA.

191. Keen, R.A. 1951. **Cutting grafts of juniper: a progress report.** American Society of Horticulture Proceedings. 58: 298-300.

Cutting grafts, in which the stock was an unrooted cutting, were used for the propagation of junipers. While the percentage of success was low, the process was considered satisfactory.

192. Korac, M. 1973. **A method of rooting cuttings.** Gartenwelt. 73(4): 83-84. German.

The number of cuttings of *Pinus sylvestris* and *Juniperus virginiana* rooted was greatly increased when the cuttings were taken from lignified long shoots that had been treated 2-2 1/2 months earlier with IAA after ring-barking and had formed callus while still on the mother plant.

193. Kostevic, Z.K. 1964. **Propagation of some exotic conifers by cuttings.** Byulleten Glavnogo Botanicheskogo Sada. 53: 44-47. 5 refs. Russian.

Gives results of experiments in rooting cuttings of *Picea pungens* cv. *argentea*, *Abies concolor*, *Chamaecyparis pisifera* cv. *plumosa*, *Thuja occidentalis* cv. *ericoides*, and *Juniperus virginiana* in open boxes and in greenhouses. Planting of cuttings in winter or early spring generally gave the best results.

194. Locklear, J. 1987. ***Juniperus virginiana* 'Taylor'.** Swarthmore, PA: Garden Journal of the American Association of Botanical Gardening and Arboriculture. 2(1): 16 p.

195. Lokvenc, T. 1979. **Problems of deformation of roots at containerized plants.** Communicationes Instituti Forestalis Cechosloveniae. 11: 33-47. Czech.

Field observations were made on the root systems of various coniferous species that were container-planted in Czechoslovakia up to 14 years earlier, i.e., since the introduction of container planting. Evaluation was mainly subjective and visual owing to problems in obtaining numerical data. Some data are tabulated for the cross-sectional area of horizontally and vertically growing roots of Norway spruce at 2 and 11 years old. Containers restricting the growth of roots, such as polyethylene bags, caused marked and generally persistent deformation of roots, whereas paper pots (without bottoms) and Jiffy pots, which give little or no restriction of root growth, resulted in nearly natural root systems. Norway spruce tolerated polyethylene bags better than the other species, since the deformed roots died off and were replaced by adventitious roots from above the container. Scots pine and *Juniperus virginiana* grown in bags or Kopparfors tubes became increasingly unstable with age owing to inadequate development of lateral roots.

196. Lorenzi, R.; Tognoni, F. 1977. **Cuttings propagation of *Picea-Abies excelsa Ohlendorffii* and *Juniperus virginiana Skyrocket* changes of natural and induced rooting capacity.** Rivista della Ortoflorofruttic Italiana. 61(3): 181-197. Italian.

197. Luban, E. 1960. **Vegetative propagation of conifers by grafting.** Revista Padurilor. 75(3): 149-151. Rumanian.

Gives results of experiments made at Bucharest with a number of ornamental conifers. No success was obtained with *Abies*, *Pinus* or *Picea*, but varying degrees of success were obtained with *Chamaecyparis lawsoniana* (65-75 percent), *Cryptomeria japonica* (58 percent), *Juniperus virginiana* (34 percent), *J. sabina* (41 percent), *J. communis* (94 percent), *Taxus baccata* (82 percent), and *Thuja occidentalis* (45-88 percent).

198. Lumis, G.P.; Johnson, A.G. 1980. **Transplanting method influences survival and growth of bare-root coniferous nursery stock.** Journal of Arboriculture. 6(10): 261-268. 12 refs.

Ornamental conifers were transplanted either bare-root, using several methods to reduce moisture loss, or as conventional balled and burlapped (BB) plants. Treatment with a foliar antidesiccant, Wilt-Pruf (an organic polymer of B-pinene), prior to lifting and followed by plant storage in a polyethylene bag before transplanting proved most satisfactory. All bare-root transplanted bushes of *Juniperus virginiana* cv. *Grey Rock* (60-70 cm), stored for 5 days, and *J. chinensis* cv. *Keteleeri* (1.5-1.75 m), stored for 16 days, survived and grew as well as the controls (BB). A more difficult-to-transplant subject, *Taxus* X *media* cv. *Andersoni* (50-60 cm), treated with Wilt-Pruf and/or enclosed in polyethylene bags and stored for 5 days showed foliar injury (needle loss and shoot dieback) no more severe than that of controls; however, plants treated with a sodium alginate root antidesiccant alone suffered more damage. Bare-root plants of *Picea abies* (1.25-1.5 m) treated with Wilt-Pruf and stored for 14 days in polyethylene bags were of equal quality to controls, but foliar injury and poor shoot growth were evident on untreated bare-root plants. *Thuja occidentalis* cv. *Pyramidalis* (1-1.25 m) stored for 14 days and transplanted bare-root were of unacceptable quality, regardless of treatment.

199. Mahlstede, J.P. 1951. **Further developments in weed control in established nursery stock.** Research Report of the 8th Annual North Central Weed Control Conference. 110 p.

The following species were tolerant to spring and summer applications of Crag Herbicide 1 (sodium 2,4-dichlorophenyl-ethylenedioxysulphate) at a rate of 4 and 6 lb/acre, and to Stoddard solvent at 75 gal/acre: *Juniperus virginiana*, *J. procumbens* (3rd and 4th year), *Syringa* sp., and *Philadelphus* sp. (2nd year).

200. Mahno, G.F. 1967. **Raising conifers in the Khorezm oasis.** Lesnoe Khozyaistvo. 4: 42-44. Russian.

Describes experience since 1951 in direct sowing and planting of *Juniperus virginiana* and *Thuja orientalis* at the Kara Kum research station, stressing the special measures such as flushing irrigation that are imposed by the conditions there.

201. Meines, M.K. 1965. **Juniper (*Juniperus virginiana*) germination simplified.** Tree Planters Notes. 70: 6-7. 1 ref.

Advocates, where possible, the sowing of fresh seed from berries gathered in September. This usually germinates in the following spring. Stored seed needs long and variable periods of stratification.

202. Meyer, J. 1981. **The saga of eastern redcedars *Juniperus virginiana*, bonsai.** Bonsai Journal, American Bonsai Society. 15(3): 62-64.

203. Minckler, L.S.; Downs, A.A. 1946. **Machine and hand direct seeding of pine and cedar in the Piedmont.** Tech. Note SE-67. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 10 p.

This is a guide to direct sowing of *Pinus echinata*, *P. taeda*, and *Juniperus virginiana* in the Piedmont region of Virginia and Carolina. It briefly reviews the results of experimental and pilot-plant trials of both hand and mechanical methods of direct sowing and describes in detail the recommended methods.

204. Oesterbye, U.; Eriksen, E.N. 1971. **Propagation of conifers by cuttings: treatments with growth substances and planting methods.** Tidsskrift for Planteavl. 75(6): 799-806. 6 refs. Danish.

Describes experiments in which cuttings of two cultivars of *Chamaecyparis lawsoniana*, two of *Juniperus virginiana,* and one of *C. obtusa* were treated with NAA and/or IBA at four concentrations from 1,000 to 8,000 p.p.m. under controlled mist or under plastic. Reactions varied, but mist propagation tended to produce higher rooting percents and higher numbers of roots per cutting than plastic covers. NAA tended to stimulate the number of roots most, but at the higher concentrations tested it caused many losses. IBA stimulated rooting in all concentrations and caused little damage. NAA/IBA behaved more like IBA than NAA. However, overall improvement in rooting percent by growth substances was only 12-13 percent compared with untreated controls.

205. Over, G.; Bunemann, G. 1983. **Re-use of water in nurseries.** Deutsche Baumschule. 35(9): 341-345. German.

Re-use of irrigation water applied to plants of seven genera (*Chamaecyparis lawsoniana*, *Juniperus virginiana*, *Cotoneaster congestus*, *Hypericum patulum*, *Prunus laurocerasus*, *Pyracantha crenato-serrata,* and *Ulmus carpinifolia*) grown in 3-liter containers on plastic sheeting is discussed. The necessity for an adequate (900 m^3/ha) plastic-lined reservoir covered with floating black plastic to control algal growth is stressed. Monitoring of salt concentrations by electrical conductivity measurement and by water analysis is essential, particularly when herbicides are used. Fertilizer application should be reduced in relation to the nutrient level in the re-used water. Tap water may have to be used where there is excess salt, herbicide residue, excess N late in the season, or spread of fungi. Water re-use allows economy of nutrients but involves expense on water analysis and algal control.

206. Panova, L.N. 1985. **Propagation of junipers in southern steppe conditions in the Ukraine.** Lesnoe Khozyaistvo. 12: 34. Russian.

In the Askaniya-Nova Botanical Park in the Ukraine, seeds of *J. virginiana* and *J. scopulorum* are scarified with sand and sown in autumn, or are stratified at 0-5° C and sown in spring. Other species, especially ornamental species and forms of *J. communis* and *J. sabina*, are propagated by cuttings in a cold frame under plastic; callus forms in 45-50 days, and roots form in 75-80 days. The best time for planting cuttings is late March, and the optimum length of cuttings is 8-15 cm. Some details are given of the growth rates of seedlings and rooted cuttings, and of the ages at which they can be planted out.

207. Pavlenko, F.A. 1959. **Standards for *Juniperus virginiana* seedlings.** Lesnoe Khozyaistvo. 12(4): 73. Russian.

Measurements of 4,000 seedlings showed that survival and increment after transplanting are closely related to the seedling's dimensions. On this basis, two size-grades of seedlings are proposed for the steppe and forest-steppe zones of the U.S.S.R., the better being: stem length 12 cm, root collar diameter 3 mm, root length 22-30 cm (for 1- to 2-year plants).

208. Pinney, J.J. 1970. **A simplified process for grafting Junipers.** American Nurseryman. 131(10): 7, 82-84.

Describes the use of polythene-lined, heated greenhouses for the propagation of ornamental junipers by side-grafting (usually on *Juniperus virginiana* stocks). Newly grafted plants in saturated pots are plunged to the tops of the unions in moist peat on benches kept at ca. 70° F by thermostatically controlled electric coils laid beneath cloth under the peat. By watering the floors and spraying the tops of the plants through mist nozzles, ca. 100 percent humidity is maintained without watering the plants; the risk of water entering the grafts and preventing callusing is thus eliminated.

209. Pounders, C.; Gilliam, C.H. 1983. **Propagation of upright juniper.** Res. Rep. Auburn, AL: Auburn University, Alabama Agricultural Experiment Station. 23 p.

210. Pounders, C.; Gilliam, C.H. 1985. **Propagation of upright junipers in Alabama.** Plant Propagator. 31(1): 8-9.

Cuttings of *Juniperus virginiana* cultivars *Hillspire*, *Skyrocket,* and *Silver Spreader*, *J. chinensis* cv. *Blue Point,* and *J. scopulorum* cv. *Cologreen* were treated with (1) IBA + NAA liquid dips with or without dimethyl sulphoxide or dimethyl formamide solvents or (2) a Hormodin No. 3 (IBA) talc dip and rooted in a bark-peat-shale medium. Rooting was scored on a scale of 1 (no callus) to 5 (well rooted). All cultivars showed equivalent response trends to treatments. Blue Point showed consistently lower root scores than the other cultivars for all treatments and was the only cultivar that benefited from the addition of a solvent, especially dimethyl formamide.

211. Prjahin, M.I. 1960. **Evergreen trees and shrubs at Leninabad (Tadzhikistan).** Botanicheskii Zhurnal. 45: (4): 588-592. Russian.

Leninabad lies in the dry subtropical zone, but winter temperatures occasionally drop to -20° C. Several species of evergreens possibly suitable for roadside, park, and green-belt planting have been tried since 1955 in the Leninabad Botanical Garden (in the open, but sometimes with various degrees of shelter in the winter). Notes are given on the performance of *Phyllostachys aureus*, *Euonymus japonicus*, *Ligustrum lucidum*, *Rubus* spp., *Cupressus arizonica*, *C. sempervirens*, *C. lusitanica*, *Laurus nobilis*, *Prunus laurocerasus*, *Elaeagnus pungens*, *Magnolia grandiflora*, *Juniperus virginiana*, *Nerium oleander*, *Pyracantha coccinea*, *Pittosporum viridiflorum*, *Pinus brutia*, and *Zanthoxylum alatum*.

212. Przeradzki, D.; Starck, J.R. 1984. **Influence of mineral fertilization on the root system of conifer cuttings.** Annals of Warsaw Agriculture University. SGGW AR, Horticulture. 12: 17-20. 10 refs. Polish.

In trials with *Chamaecyparis pisifera* cv. *Squarrosa*, *Juniperus virginiana* cv. *Tripartita,* and *Taxus* X *media* cv. *Hicksii*, heel cuttings treated with Seradix-2 (IBA) were struck in a 1:1 sphagnum peat: sand mixture on 12 April. Immediately after root initiation (25 June) the cuttings received foliar or soil-applied N, P, K, Ca, and Mg in different ratios. No significant differences were observed between the treated and control plants, indicating the low nutritional requirements of the three species during rooting.

213. Read, R.A.; Bagley, W.T. 1967. **Effect of gibberellic acid spray on seedlings of eastern redcedar, bur oak, and red oak.** Res. Note RM-82. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 2 p.

A 30-p.p.m. solution of gibberellic acid, sprayed onto potted seedlings of (a) *Juniperus virginiana*, (b) *Quercus macrocarpa,* and (c) *Q. rubra* two or three times per week, greatly increased height increment of (b) and (c), but only slightly increased that of (a).

214. Skroch, W.A. 1983. **Weed control in newly planted conifers.** Southern Weed Science Society. 36: 176.

In over-the-top applications of glyphosate to first-year plantings of *Abies fraseri*, *Pinus virginiana*, *P. strobus*, *Tsuga canadensis*, *Picea abies,* and *Juniperus virginiana*, *T. canadensis* was most tolerant shortly after bud break and *P. abies* and *A. fraseri* became more tolerant after the new candles hardened. All species showed good tolerance to oryzalin and napropamide, except for considerable damage to *T. canadensis* by oryzalin. At 2 oz/acre, Oust (sulfometuron-methyl) gave excellent control of *Digitaria sanguinalis*, *Setaria* sp., and *Ambrosia* sp. for more than 100 days; on Lakeland Sand at 4 oz/acre and on 3.5 percent organic matter and in a clay loam at 7 oz/acre, Oust caused some damage to *P. strobus* and *A. fraseri*, respectively. At 1 lb/acre + 1 percent crop oil, sethoxydim and fluazifop-butyl did not damage the conifers or control a 6- to 8-inch-high Secale cereal cover crop, but they controlled grass species very well.

215. USDA Forest Service. 1963. **Nematode damage to nursery conifers controlled with chemicals.** Res. Rep. 18. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Root-lesion nematodes (*Pratylenchus penetrans*) on *Juniperus virginiana*, *Picea glauca,* and *P. pungens* in Nebraska were controlled with Dowfume MC-2 and Vapam. Dowfume was better for spring planting, and Vapam was better for summer or autumn planting.

216. VanElk, B.C.M. 1964. **Potting soil for stocks.** Jaarboek Proefstation voor de Boomkwekerij Boskoop: 74-75. Dutch.

Includes a table showing the relative success in grafting various cultivars onto stocks of *Acer* *palmatum, Betula pubescens, Fagus sylvatica, Juniperus virginiana, Picea abies,* and *Quercus robur* grown in various mixtures of peat and sand.

217. VanElk, B.C.M. 1969. **New experiments on conifer propagation.** Gartenwelt. 69: 303-304. (Horticulture Abstracts. 40(1): 1731.) German.

Describes further experiments on the propagation by cuttings of ornamental species and cultivars (*Chamaecyparis lawsoniana, C. nootkatensis, Juniperus chinensis, J. squamata, J. virginiana,* and *Tsuga canadensis*), with the aid of various combinations of soil heating, growth substances, and captan fungicide.

218. VanHaverbeke, D.F. 1984. **Clonal and sexual variation in initial graft take of *Juniperus virginiana* L.** Canadian Journal of Forest Research. 4(3): 473-474. 13 refs.

Grafts of 44 clones revealed significant differences in initial take among clones and between ovulate and staminate clones. Consistent year-to-year successes of individual clones indicated the presence of clonal variability.

219. Wagner, G. 1967. **Vegetation propagation techniques.** Plant Propagator Society. 17: 113-138, 289-343. 71 refs.

Speeding production of hard-to-root conifers (e.g., *Juniperus virginiana* is side-grafted onto cuttings of an easy-to-root Juniper variety before these are placed in the rooting medium).

220. Webster, C.B.; Ratcliffe, G.T. 1942. **A method of forcing quick germination of *Juniperus virginiana* L. seed.** Journal of Forestry. 40: 268.

Seeds collected in late November were depulped and placed in dry storage until early February when they were treated as follows: Soaked 20 minutes in a lukewarm sodium (soda) lye solution, 3 tablespoons to 1 gallon of water; washed in fresh running water for 1 hour; soaked in fresh water for 8 hours; stratified in sand from February 4 to March 29. Seedlings averaged over 2 inches high by June 11.

221. Westervelt, D.D.; Keen, R.A. 1960. **Cutting grafts of Junipers II: Stionic effects.** Horticultural Science. 76: 637-643. 3 refs.

Comparisons were made of grafts, using as root stock seedlings of *Juniperus virginiana*, and also unrooted cuttings of *J. horizontalis* var. *plumosa* (Andorra Juniper) and *J. chinensis* (Hetz Juniper). The scions used were two clones of *J. virginiana* var. *Canaert* and *Nevins Blue*. The grafts were made on three dates in the first week of February and also on February 17 and on March 3. The grafted plants were planted out on May 30. Time of grafting had an effect on success of grafting and on height growth during the second season, but not in field survival or height growth in the field during the first season. It is important that the cuttings should be taken late enough in winter to root readily, but early enough to allow the grafts to become established before transplanting. The kind of scion used did not affect the success of the grafting operation, the rooting of the cuttings, or the field survival of the juniper grafts. The Nevins Blue grafts had a greater height growth than the Canaert Juniper on all stocks in the first growing season, and on the Andorra Juniper in the second season. The kind of root stock used had no effect on the success of the graft or upon rooting, but both field survival and height growth were greater in plants on *J. virginiana* rooted stock. The two groups of grafts on cuttings showed no differences during the first growing season, though significant differences between all the different combinations used appeared during the second. There was no established interaction between time of grafting, type of root stock, or scion. It seems that cutting grafts can be used to produce commercial stock, but final recommendations must await further experiments.

222. Wooten, T.E.; Helms, R.S. 1981. **Paper mulches for vegetation control in Christmas tree plantations.** For. Bull. 23. Clemson, SC: Clemson University, Department of Forestry. 7 p.

One-year-old seedlings of (a) eastern white pine (*Pinus strobus*) and (b) eastern redcedar (*Juniperus virginiana*) were planted in an abandoned field in South Carolina in February 1979, and mulched with paper sheets 30X30 inches and 0.08 or 0.04 inches thick made of half newsprint and half corrugating medium and anchored with two pegs, or black polythene sheets 30X30X0.04 inches pegged at the corners. Control plots were mown as necessary. Soil moisture content showed no difference between treatments, probably because of the relatively wet summer. Mulching had little effect on the height growth of (a) measured in October 1979, but significantly improved that of (b) with no significant difference between mulch types. Mulching slightly reduced survival of (a) but had little effect on that of (b). Polythene-mulched plots had the lowest survival rate for both species. Pegging of paper mulch sheets appeared to be unnecessary.

223. Wright, R.D.; Hinesley, L.E. 1991. **Growth of containerized eastern redcedar amended with dolomitic limestone and micronutrients.** Horticultural Science. 26(2): 143-145. 17 refs.

One-year-old nursery transplants of *Juniperus virginiana* were planted on 29 November 1988 in 20-liter pots containing a 5:1 mixture of aged pine bark and sand amended with 3 kg triple superphosphate and 1.5 kg gypsum/m^3 and factorial combinations of 0 and 3 kg ground dolomitic limestone and 0, 0.5, 1.0, and 1.5 kg Micromax micronutrients/m^3. Pots were placed outdoors on gravel beds with overhead irrigation and topdressed with 30 g Osmocote (18:2.8:10) on 4 April and 20 May. Foliage samples were collected on 16 May, 25 July, and 3 October for chemical analysis. The nutrient status of the growing medium was also monitored on these dates. The experiment was terminated in early November. Adding trace elements to the growing medium reduced shoot growth, especially in the absence of limestone, and root growth was greatest when neither limestone nor trace elements were added. It was suggested that the inhibitory effect of trace elements on growth could be due to trace element toxicities at the low pH of the growing medium without dolomitic limestone (pH <4.0), but this was not confirmed by foliar or growing medium analysis.

224. Wycoff, H.B. 1961. **Redcedar (*Juniperus virginiana*) seeding practices.** Tree Planters Notes. 47: 3-4.

At the Mason State Tree Nursery, Topeka, Illinois, standard practice is to drill clean dry seed from refrigerated storage during the first half of September. The seed is stored at 34° F for several years. Early sowing (before fresh seed is available) secures a period of warm "stratification" in the soil followed by a period of cold.

225. Wycoff, H.B. 1964. **Redcedar (*Juniperus virginiana*) seed extraction.** Tree Planters Notes. 66: 14-15. 1 ref.

Describes the use of small portable electric powered concrete mixers for extracting seeds from the berries of *J. virginiana*.

226. Zheronkina, T.A. 1971. **Growing Junipers from unripe seeds.** Byulleten Glavnogo Botanicheskogo Sada. 78: 57-62. 4 refs.

Berries of *Juniperus communis* and *J. virginiana* were collected (in Alma-Ata) at intervals between June or July and October, and the seeds were extracted and sown. For *J. communis,* results were best (90 percent germination) with seeds collected in early August, i.e., from berries that were yellow with a brown tinge. For *J. virginiana,* results were best (41 percent germination) with seeds collected at the end of September or early October, i.e., when 70-80 percent of the berries on the south side of the crown were black.

REGENERATION/PLANTING

227. Afanasiev, M.M. 1949. **A study of red cedar plantations in North Central Oklahoma.** Bull. T-34. Stillwater, OK: Oklahoma State University Agricultural Experiment Station. 16 p. 8 refs.

Two plantations of *Juniperus virginiana* have been established and maintained successfully on sites that would commonly be classed as poor. Survival was generally satisfactory (about 80 percent in 4 years) when 1-1 planting stock was used. The use of 1-2 planting stock resulted in comparatively heavy mortality. Most losses occurred during the first year after planting. High clay content of the soil had a detrimental effect on height growth. Heavy thinning failed to accelerate height growth during the first 2 years after treatment. Direct sowing was a failure.

228. Afanasiev, M.M. 1949. **Cedar (*Juniperus virginiana*) and pine (*Pinus echinata, P. ponderosa, P. nigra* var. *austriaca, P. sylvestris, P. densiflora, P. thunbergii*) as farm trees for Oklahoma.** Bull. B-331. Stillwater, OK: Oklahoma State University Agricultural Experiment Station. 18 p.

229. Afanasiev, M.M.; Engstrom, A.; Johnson, E.W. 1959. **Effects of planting dates and storage [of stock] on survival of eastern redcedar in Central and Western Oklahoma.** Bull. B-527. Stillwater, OK: Oklahoma State University Agricultural Experiment Station. 19 p.

Reports an attempt, based on the results of planting *Juniperus virginiana* during 3 consecutive years from 1955, mainly to determine (1) the existence and extent of an optimum planting period, and (2) the effects of practical short-term storage of stock from the nursery. In addition, the effects of some elements of weather and soil on plant mortality were studied, and a comparative evaluation of the use of potted stock in field planting, and of stock planted the same day as lifted, was made. Using the slit method of planting in all cases, thirty 2-year seedlings were planted 1 foot apart in three random 10-tree lots 2 days after being lifted in the nursery; a second 30 plants remained packed in waterproof paper and sphagnum moss for 1 week before planting. This procedure was followed at four sites. The optimum periods of planting proved to be between mid-December and mid-March, though this did not preclude successful results before and after those dates, and high survival was observed in individual lots planted in the dormant season. The wide variation of soil and weather conditions precludes the fixing of specific dates for field planting but, in general, planting in January and February is more successful than earlier or later. The mean survival rates of trees planted on arrival and after a week's storage were 71 and 70 percent, respectively, but, despite the very slight difference, packaged stock should be kept moist and well sheltered to avoid injury from drying or temperature extremes. During the low-precipitation seasons of 1956 and 1957, the combined mean survival of potted plants was 96 compared with 70 percent for bare-rooted stock.

This advantage was not apparent for the good-rainfall year, when 94 percent of bare-rooted stock survived. Survival for stock planted straight after lifting was 10 percent greater than that for stock planted 2 days after lifting or after 7 further days of storage.

230. Anonymous. 1943. **The shelterbelt.** Chronica Botanica. 7: 430-431.

The program begun in 1934 for the establishment of shelterbelts in an effort to reclaim the agricultural region of the Great Plains of the United States from wind erosion has met with outstanding success. The 190,000,000 trees planted by the Forest Service and the Work Projects Administration up to the end of 1941 already give protection to 4,000,000 acres of farm land, and there has been a marked increase of wildlife in the area, particularly of game and insectivorous birds. The shelterbelts are not of fixed width or orientation, but are varied to suit local conditions. The species used also vary according to the locality. Some of the more common shrubs and trees planted in the shelterbelt areas are buffaloberry, golden currant, American plum, chokecherry, golden willow, white willow, boxelder, American elm, bur oak, green ash, cottonwood, black locust, black walnut, Osage orange, sycamore, Texas walnut, blue spruce, western white spruce, jack pine, shortleaf pine, Rocky Mountain juniper, and eastern redcedar. In most cases 8 1/2 acres of shelterbelt are sufficient to protect a 160-acre farm.

231. Bagley, W.T.; Loerch, K.A. 1956. **Diuron for weed control in new windbreak plantations.** Proceedings, 13th Annual North Central Weed Control Conference: 66-67.

The effects were studied of late April sprays of 10, 20, and 40 lb/acre 80 percent diuron on freshly planted trees. *Elaeagnus angustifolia* was easily injured, while *Ulmus pumila* and *Celtis occidentalis*, though also easily injured, showed some ability to recover after low concentrations. *Juniperus virginiana* and *Pinus ponderosa* were moderately resistant to injury. *Gleditsia triacanthos* and *Fraxinus pennsylvanica* were highly resistant. Weed control was excellent at 20-40 lb/acre, and satisfactory at 10 lb/acre.

232. Borovikov, V.M. 1949. **The Sochi Arboretum and its role in park arboriculture and mountain forestry (on the Black Sea coast of the Caucasus).** Botanicheskii Zhurnal. 34(2): 203-204. Russian.

This is a brief note on this arboretum, which is regarded as an important trial area for exotics, especially subtropical species that are likely to do well in the Black Sea coast regions, since it lies near the northern limit of the subtropical zone. The arboretum belongs to the Sochi Research Station for Subtropical Forestry and Arboriculture (NILOS), which is also conducting experiments on exotics suitable for the montane forests of the region. Of these trials, in the Krasnaya Polyana and Loosk forests, the most interesting is said to be a 10-year-old trial in the former locality, at 550 m elevation, of *Pseudotsuga taxifolia* spp. *mucronata*, *Chamaecyparis lawsoniana*, *Cedrus deodara*, *Cryptomeria japonica*, *Libocedrus decurrens*, *Taxodium distichum*, *Juniperus virginiana*, *Liquidambar styraciflua*, *Liriodendron tulipifera*, *Carya pecan*, *C. ovata*, *Ailanthus altissima*, and others. Results are said to be successful, but no further indication is given of the performance of the individual species.

233. Bunger, M.T.; Thomson, H.J. 1938. **Root development as a factor in the success or failure of windbreak trees in the Southern High Plains**. Journal of Forestry. 36: 790-803.

234. Bunusevac, T.; Antic, M. 1951. **Effect of afforestation with various tree species on edaphic conditions in the Deliblato Sands area.** Glasnik Sumske Fak., Beograd. 3: 129-160. 5 refs. Serbo-Croatian.

The Deliblato Sands in the Vojvodina (northeast Yugoslavia) have an area of 24,854 ha and are characterized by a series of parallel dunes in the direction northwest-southeast. The highest points reach nearly 200 m. The annual precipitation is 653 mm, the bulk of which falls in May-August. The mean annual temperature ranges from 9.5 to 11° C. Late frosts persist until the second half of June, and autumn frosts start in early October. A dry southeast wind blows during the colder half of the year, not seldom for 2-3 weeks on end. Afforestation began in 1808 when F. Bachoffen worked out the first plan. The following species have been used: (1) *Pinus sylvestris*, (2) *P. nigra*, (3) *Robinia pseudoacacia*, (4) *Juniperus virginiana*, (5) *Fraxinus americana*, and also *F. excelsior*, *F. ornus*, *Pinus strobus*, *P. banksiana*, *P. jeffreyi*, *Sophora japonica*, *Populus nigra*, *P. alba*, *P. canescens*, *P. canadensis*, *P. bachofeni*, *Ailanthus altissima*, *Acer saccharum*, *Prunus serotina*, *P. mahaleb*, *Gleditsia triacanthos*, and *Morus alba*. Stands of the first five species mentioned were the object of investigation, based on the assumption that all stands observed had the same climatic and soil conditions. Besides mensurational data for the stands, the following pedological determinations were made: $CaCO_3$, pH (in water), humus, assimilable P_2O_5, and assimilable K_2O; soil profiles were also analyzed. The $CaCO_3$ content of the soil varies within very wide limits (e.g., 4-15 percent). The pH value for the top layer of soil varies within relatively small limits (6.94 for (3), and 7.81 for one stand of (2)). The humus content was 21 percent for (3); and for two stands each of the following: 20 and 19 percent (5); 17 and 13 percent (2); and 11 and 9 percent (1). Soil under (3) was the richest of all in P_2O_5 and K_2O, figures for the latter being 29.8 mg. K_2O/100 g for (3), compared with 11.3 mg for one stand of (2). No marked effect of stands on soil particle size could be detected.

235. Clark, F.B. 1954. **Forest planting on strip-mined land in Kansas, Missouri, and Oklahoma.** Tech. Pap. CS -141. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 33 p. 10 refs.

In a species-suitability test, results 6 years after planting suggest that *Fraxinus pennsylvanica* var. *lanceolata*, *Juglans nigra*, *Juniperus virginiana*, *Platanus occidentalis*, *Quercus macrocarpa*, *Robinia pseudoacacia*, *Populus deltoides,* and *Prunus serotina* will do well in suitable conditions. Mortality was insignificant after the first growing season. Survival was poorest in bottoms and on ridge-tops and best on north- and east-facing slopes. The average survival of all species after the first growing season was best in areas where 41-60 percent of the ground was covered with natural vegetation and poorest where less than 20 percent was covered. Acidity is of primary importance, and areas with toxic acidity (pH 4.0) must be avoided. Areas with a high percent of small soil particles are more subject to erosion and should be allowed to stabilize 2-5 years before planting. Survival, growth, and moisture relations were better on undisturbed than on graded banks. Tentative recommendations are made on spacing and planting methods, post and Christmas tree plantings, and mixed plantings.

236. Comis, D.L. 1983. **Living fences keep snow off the road [Use of eastern redcedar trees, windbreaks used for prevention of snow-drifts closing highways].** Washington, DC: U.S. Department of Agriculture, Soil Conservation Service. Soil Water Conservation. 4(9): 8-9.

237. Costin, E. 1956. ***J. virginiana* a suitable species for the afforestation of degraded soils.** Revista Padurilor. 71(4): 214-221. 10 refs. Rumanian.

On the basis of experimental data from Rumania and elsewhere, recommends the use of this species as a soil improver to prepare degraded soils for later planting with more valuable conifers.

238. Costin, E. 1964. **Ecological conditions of forest crops on littoral sands of the Danube delta.** Institutul de Cercetari Forestiere. Bucharest. 154 p. 82 refs. Rumanian.

Describes in detail the soil and climate, with particular reference to soil water regime. Some account is then given of the requirements and performance of the species that have been used for the afforestation of these sands (*Populus* X *euramericana*, *P. alba*, *P. canescens*, *Alnus glutinosa*, *Robinia pseudoacacia*, *Gleditsia triacanthos*, *Acer negundo*, *Elaeagnus angustifolia*, *Hippophae rhamnoides*, *Taxodium distichum*, *Pinus nigra*, and *Juniperus virginiana*).

239. Deitschmann, G.H. 1950. **Seedling survival and height growth on graded and un-graded strip-mined land in southern Illinois.** Sta. Notes CS-62. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 2 p.

Experimental plantings were made of 17 species on leveled and unleveled spoil sites. An examination after 2 years showed that all species except black locust had made slightly more height growth on the unleveled sites. The third year confirmed this result and revealed little difference between survival on leveled or unleveled sites for the species (green and white ash, black locust, sweet gum, loblolly pine, eastern redcedar, and shortleaf pine) most often used in afforesting spoil areas in Illinois.

240. Dickerson, J.D.; Woodruff, N.P. 1975. **Establishing windbreaks (*Juniperus virginiana, Pinus sylvestris*) in semiarid areas by altering the microclimate or supplying additional water.** Washington, DC: U.S. Department of Agriculture, Agricultural Research Service. 22: 302-309.

241. Dickerson, J.D.; Woodruff, N.P.; Banbury, E.E. 1976. **Techniques for improving tree survival and growth in semiarid areas.** Journal of Soil and Water Conservation. 31: 2, 63-66. 38 refs.

Describes studies in 1971 to evaluate seven systems for supplying additional water to, or altering the microclimate of, *Juniperus virginiana* and *Pinus sylvestris* planting sites in northwest Kansas. Water-collecting treatments (construction of ridges round cleared, leveled areas of 50 x 100 or 50 x 50 feet to concentrate run-off on the tree rows), drip irrigation, and protection by snow fences increased growth of *J. virginiana* by up to 40 percent and increased survival; a shade treatment increased survival, but not growth. *P. sylvestris* responded less than *J. virginiana* to the treatments; survival and growth of this species were best with protection by a snow fence or drip irrigation. In the control planting, none of the *P. sylvestris* trees and only 70 percent of the *J. virginiana* trees survived. It is suggested that effective windbreaks may be established more rapidly in semi-arid zones by such measures.

242. George, E.J. 1939. **Tree planting on the drier sections of the Northern Great Plains.** Journal of Forestry. 37: 695-698.

Eastern redcedar often reproduces from seed carried by birds.

243. George, E.J. 1965. **Methods of improving conifer survivals.** Tree Planters Notes. 71: 6-13. 9 refs.

Reviews long-term tests of methods of establishing conifers (chiefly in shelterbelts) in the northern Great Plains, where low rainfall is accompanied by low humidity and high evaporation. The results show that good stands can be established in these conditions. Five species (*Pinus ponderosa*, *Picea pungens*, *P. glauca* var. *densata*, *Juniperus virginiana*, and *J. scopulorum*), planted on 82 plots that received no treatment, had 80-100 percent survival on 65 plots and 50-79 percent on the other 17. The importance of careful handling of stock from the time of lifting in the nursery is emphasized. Recommended methods include application of water/wax emulsion and potting for 1 year before planting out.

244. Gordienko, I.I. 1962. **Results of the introduction of certain plants on the Olesskij sands (Lower Dnieper).** Botanicheskii Zhurnal. 19(3): 85-92. 7 refs. Russian.

By autumn 1960, only six of the 25 tree and shrub species introduced on quartz sandhills (devoid of humus) over the previous 9 years were surviving, viz., *Juniperus virginiana*, *Maackia amurensis*, *Alnus incana*, *A. hybrida*, *Pinus mugo*, and *P. pinaster*. Of these, the four last-named, as well as *A. glutinosa*, are held to be of great practical importance for afforestation of sandy areas.

245. Gorshenin, N.M. 1940. **Results of investigations in 1938 by the All-Union Research Institute for Rural Melioration with the Aid of Forestry (VNIALMI).** Goslestekhizdat. Moscow. 1940. 172 p. Rumanian.

Reports on the investigations of the Institute, in various parts of the U.S.S.R., on shelterbelts, the melioration of sands, erosion control, nursery practice, treatment and storage of seed, sowing, mechanization of silvicultural work, forest protection, and the acclimatization and selection of trees. Narrow shelterbelts, open in their lower part and consisting of only two rows of trees—so-called avenue belts, since the trees are usually planted on either side of a road—were again shown to have a beneficial effect on the distribution of the snow cover and on wind velocity in the adjacent fields. Observations in the Rostov region confirmed the view that on the dry sands there it was advisable to use conifers (*Pinus sylvestris*, *P. banksiana*, *Juniperus virginiana*, etc.) in the formation of shelterbelts, and to confine oak, poplar, and other broadleaved windbreaks to low ground where ground water is found near the surface of the soil. In 1938, a year of drought, it was observed that 5-year-old hybrids of Siberian and Japanese Larch were highly drought-resistant. These hybrids are also frost-resistant.

246. Gruschow, G.F. 1948. **A test of methods of planting eastern redcedar in the Virginia Piedmont.** Journal of Forestry. 46(11): 842-843.

Juniperus virginiana 1-0 stock planted out by seven different methods (holes with scalped spots 12 inches and 24 inches diameter, the latter with and without lime; mattock slit with and bar slit without a scalped spot; bar slit in contour furrows with and without lime) showed poor survival at the end of 4 years, with no significant differences between different methods.

247. Jiang, G.Y.; Liu, D.S. 1985. **A preliminary report of a planting trial with *Juniperus virginiana* on rocky mountains.** Forestry Science and Technology, Linye Kexue Tongxun. 7: 12-13. Chinese.

In 1978, 2-year-old seedlings were planted on a rocky hillside in Xiao County, Anhui Province, with *Platycladus orientalis* for comparison. A survey made in autumn of the current year showed that the survival rate of *J. virginiana* was 95 percent while that of *P. orientalis* was 62 percent. Further investigation in 1983 showed that the average tree height of *J. virginiana* at the top, middle, and foot of the hill was 1.6, 2.71, and 2.85 m, respectively, and average collar diameter was 5.7, 7.9, and 7.9 cm respectively, which were 2X those of *P. orientalis*.

248. Lindbo, M.T.; Heintz, R.H.; Lana, E.P. 1972. **A survey of growth and survival of shelterbelts in the Douglas Creek recreation area.** Res. Rep. 38. Fargo, ND: North Dakota State University Agricultural Experiment Station. 14 p. 23 refs.

Reports results of a survey of 20 shelterbelts planted in 1951-1956 in North Dakota. Condition, percent survival, height, d.b.h., and diameter growth are given for *Ulmus americana*, *U. pumila*, *Fraxinus pennsylvanica*, and *Elaeagnus angustifolia*. Damage by insects and infection by disease were widespread in the elms, particularly *U. americana*. *Acer negundo*, *Populus deltoides*, *Celtis occidentalis*, and *Juniperus virginiana* were also planted, but did not show adequate growth or survival. Some possibilities for developing the shelterbelts for recreational purposes are discussed.

249. Lorio, P.L., Jr. 1963. **Tree survival and growth on Iowa coal-spoil materials.** Dissertation Abstracts International, B. Science and Engineering. 23(10): 3583-3584.

Studies were made on 13 species planted 7-8 years ago. Green ash showed the highest survival, but cottonwood grew more than twice as high; both species appeared suitable for a wide range of spoil materials. Eastern redcedar proved best adapted to calcareous sites. Pines were adapted to dry, strongly to moderately acid sites; Virginia, jack, and pitch pine did best. Results of regression analyses on the relationships of tree growth to chemical and other characteristics of the materials are summarized for the different species.

250. Lowry, G.L. 1960. **Conifer establishment on coal spoils as influenced by certain site factors and organic additions at planting time.** Soil Science Society of America. 24(4): 316-318. 6 refs.

Eight conifer species were planted on Ohio spoil banks at five locations of widely different site characteristics. At any one location, five tree species and three root mulch treatments were tried. Mulch treatments were (a) no treatment, (b) steam-sterilized sawdust, and (c) unsteamed sawdust. One pint of mulch was placed in the tree root zone at planting time. Results of 2-year measurements indicated significant survival differences between tree species on all areas where average survival was more than 10 percent. On acid spoils, pitch pine appeared best in terms of both survival and total height. Jack pine, white pine, and ponderosa pine were intermediate, while shortleaf pine was consistently poor. On mildly acid clay spoils, northern white cedar was best, while eastern redcedar, ponderosa pine, and jack pine were intermediate. Significant differences due to mulch treatments were noted, especially on very strongly acid sandy soils where (c) showed a 90 percent increase in survival over (a); (b) resulted in some increase in survival on sandy areas, but a decrease in survival when used on areas high in silt and clay. No height differences resulted from these treatments. Certain site and soil factors were studied to determine their effect on survival. Of the factors studied, only moisture equivalent, sand content, and reaction were significant. A prediction equation for survival is given.

251. Lypa, A.L. 1949. **Decorative town and roadside plantings in the Don Basin.** Priroda. 38(1): 48-58. 30 refs. Russian.

Contains lists of recommended trees and shrubs for planting in streets, squares and parks, on roadsides, etc. A special list is given of species tolerating gases and smoke, for planting in mining and factory areas, including the following trees: *Thuja occidentalis*, *T. orientalis*, *Juniperus virginiana*, *Acer negundo*, *Tilia* var.*Crimean*, *T. tomentosa*, *Populus canadensis*, *P. simonii*, *P. nigra*, *P. nigra* var. *italica*, *P. laurifolia*, *Robinia pseudoacacia*, and *Gleditsia*.

252. Malureanu, S. 1968. **Natural regeneration from seed of some forest tree species in the arboretum of Mihaesti.** Revista Padurilor. 83(1): 15-18. 2 refs. Rumanian.

Presents notes on natural regeneration at 430 m alternates in Rumania of *Abies alba*, *A. nordmanniana*, *Tsuga canadensis*, *Juniperus virginiana*, *Juglans nigra*, and *Robinia pseudoacacia*.

253. Mamyuk, I.S. 1946. **Reclamation of the Chir sands.** Moscow: Sel'khozgiz: 125-142. Russian.

These sands, covering 900,000 ha along the left bank of the Chir (a tributary of the Don) in Rostov Province, form three terraces with very complex soils, of which the most common are (a) alluvial meadow solonets, with a humified layer 30-40 cm thick over days with a low water table (over 3 m deep) on the first terrace; (b) sandy-loam leached southern chernozem, with a humified layer 40-60 cm thick and a water table at 5 m or deeper on the second terrace; (c) sandy-loam southern chernozem, with a humified layer 50-60 cm thick and ground water at 1-15 m deep on the third terrace. Eroded sandy soils and soils buried in sand drifts are common especially on the second and third terraces. Trials of tree species in plantations and shelterbelts have been in progress since 1907. *Juniperus virginiana* has grown almost as well as *Pinus sylvestris*, has shown a wide soil tolerance and excellent drought resistance, and can be grown in pure stands.

254. Meade, F.M. 1954. **Growth and survival of shortleaf pine and eastern redcedar in North Arkansas.** Fayetteville, AR: University of Arkansas, Arkansas Farm Research. 3(2): 4.

Comparative plantations of *Pinus echinata* and *Juniperus virginiana* were established on an abandoned field at the Livestock and Forestry Branch Station, Batesville, in 1948. On half the plots, competing vegetation was removed from an area 2 feet square round the transplant; on the other half, it was not. One-year-old stock was used, at 6 X 6 feet. Survival in both species was much better on prepared plots, but there was no appreciable difference in height growth under the two treatments. Average height of the pine at the end of the third season was 2-1/2 times that of the cedar, and it is therefore much better able to compete with coppicing hardwoods. The pine also survived a fire in 1950, which killed the cedar.

255. Meade, F.M. 1955. **Converting low-grade hardwood stands to conifers in the Arkansas Ozarks.** Bull. 551. Fayetteville, AR: University of Arkansas Agricultural Experiment Station. 26 p. 7 refs.

Pinus taeda, *P. echinata*, and *Juniperus virginiana* were planted on experimental plots in

mixed hardwoods under different degrees of overstory. *J. virginiana* was unable to compete with hardwoods in any conditions. *P. taeda* did better than *P. echinata*. Survival of pines was not significantly affected by amount of overstory. Cleaning would be necessary to release pine from hardwood regrowth and weeds.

256. Miller, D.R.; Rosenberg, N.J.; Bagley, W.T. 1975. **Wind reduction by a highly permeable tree shelterbelt (*Populus deltoides, Juniperus virginiana, Pinus sylvestris*).** Agricultural Meteorology. 14(3): 321-333.

257. Minckler, L.S.; Ryker, R.A. 1959. **Partial conversion of poor hardwood stands to conifers by planting.** Tech. Pap. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 9 p.

From experiments in planting *Pinus echinata* and *Juniperus virginiana* in clear-felled, partially cleared, and untouched poor hardwood stands in the Kaskaskia Experimental Forest, southern Illinois, necessary conditions for success were seen to be: (1) confining planting to the poorest ridges and upper slopes where hardwoods grow slowly; (2) killing the hardwood brush with 2,4,5-T before planting (either the entire stand for total conversion, or creating openings of not less than 1 1/2 to 2 times the height of the overstory for partial conversion). Subsequent release may be on a crop-tree basis, covering an area at least twice the height of competing hardwoods. Observations indicate that conifers should be released when competing hardwoods begin to shade the upper half of the crowns.

258. Mulhern, D.W.; Robel, R.J.; Furnes, J.C.; Hensley, D.L. 1989. **Vegetation of waste disposal areas at a coal-fired power plant in Kansas.** Journal of Environmental Quality. 18(3): 285-292. 25 refs.

In field trials over a 3-year period to determine if vegetative cover could be established without first adding topsoil to waste disposal sites, *Agropyron elongatum* (*Elymus elongatus*), *Festuca arundinacea, Melilotus officinalis, Echinochloa crus-galli, Lespedeza stipulacea, Phragmites australis, Polygonum lapathifolium, Populus deltoides, Juniperus virginiana, Alnus glutinosa, Acer ginnala, Acer rubrum,* and *Robinia pseudoacacia* were sown/planted on scrubber sludge and bottom ash sites amended with NPK fertilizer and hay, woodchips, or cattle manure. Bottom ash sites could not support vegetative growth even after amendment. *Agropyron elongatum, F. arundinacea, M. officinalis,* and *E. crus-galli* grew well on scrubber sludges, as did *Populus deltoides* and *J. virginiana*. Generally, the herbaceous plants grew best on scrubber sludge to which manure and fertilizer were added, and the trees survived and grew best on sludge amended with woodchips and fertilizer.

259. Munns, E.N.; Stoeckeler, J.H. 1946. **How are the Great Plains shelterbelts?** Journal of Forestry. 44(4): 237-257.

The Prairie States Forestry Project was in operation from 1934 to 1943. During that period, nearly 19,000 miles of shelterbelts were planted on about 33,000 farms. A survey of the plantings, made in 1944, covered 1,079 belts or a random sample of 3.6 percent of all belts planted. The project was a success in meeting the main purpose for which the belts were established, that of protection against the wind. For the area as a whole, 78 percent of the belts were rated as good or better, and only 10 percent were rated as unsatisfactory. Tree survival was generally good, ranging from 39 percent for ponderosa pine, the poorest, to 85 percent for boxelder (*Acer negundo*), the best. There was a direct relation between quality of belts, based on survival and growth, and the annual precipitation and quality of sites. Growth rate in the areas of better rainfall was 30-50 percent greater than in the more arid areas. The best planting sites were generally the deep sandy loam or loamy sand soils with deep moisture penetration. There was a striking differential in survival and growth rate in favor of sandy as opposed to heavy soil for many species. The most striking feature of the belts is their rapid height growth. They average about 7 years in age, and in North Dakota are 16 feet high, in Nebraska 20 feet, and in Texas 24 feet. In the southern Great Plains, a number of belts 7-10 years old are 25-40 feet high and are already very effective in reducing wind erosion. Annual growth rate is 2.9 feet for cottonwood (*Populus* sp.), 2.3 feet for Siberian elm (*Ulmus pumila*) and black locust (*Robinia pseudoacacia*), and about 1.3 feet for slower growing hardwoods such as green ash (*Fraxinus pennsylvanica*). Conifers such as ponderosa pine (*Pinus ponderosa*) and redcedar (*Juniperus virginiana*) are making from 0.6 to 0.9 feet per year. Shrubs are growing at an average rate or 1.1 foot per year. Most of the belts 5-10 years old have complete stand closure in that part of the belt where the species are fast growing. A forest condition, with leaf mulch 1/2-1 inch deep, is developing in these rows. The chief problems are inadequate cultivation of many of the belts under 4 years of age (owing to shortage of labor) and cattle damage to 8.1 percent of all belts. Great need is now developing for silvicultural treatments, but no information is available on how to proceed without reducing the effectiveness of the belts. Research is needed on this and on management and replacement, development of hardier strains of planting stock, planting on more difficult soils and sites, and the formation of belts for special services.

260. Papadopol, V.; Pirvu, E.; Papadopol, C.S. 1964. **The possibility of growing conifers in the Baragan plain.** Revista Padurilor. 79(2): 60-63. Rumanian.

Gives data on survival and growth, 6-10 years after establishment, of *Abies alba*, *A. concolor*, *Picea abies*, *P. pungens*, *Larix decidua*, *Pinus nigra*, *P. banksiana*, *P. strobus*, *Thuja plicata,* and *Juniperus virginiana*, in the steppe conditions at Baragan research station.

261. Parker, J. 1951. **Natural reproduction from redcedar.** Journal of Forestry. 49(4): 285.

Observations in Duke Forest, North Carolina, where *Juniperus virginiana* regenerates naturally, showed that birds remove the fruit in winter, especially when snow is on the ground. In a mild winter the fruit remains on the trees till February and then drops to the ground, where some of it apparently germinates. Experiments by the author showed that seeds fed to doves were entirely destroyed by digestive action. Seeds swallowed by berry-eating birds such as thrushes, starlings, and waxwings, on the other hand, are not destroyed, but show improved germination. The redcedar reproduction that often occurs in hardwoods adjacent to opengrown redcedars is undoubtedly due to the action of such birds.

262. Parker, J. 1952. **Establishment of eastern redcedar (*Juniperus virginiana*) by direct seeding.** Journal of Forestry. 50(12): 914-917. 14 refs.

Direct sowing of *J. virginiana* on two different soils showed no differences between soils, better survival under open than under closed canopy, and much better establishment where litter was removed than where it was left undisturbed.

263. Pascovski, S. 1938. **Notes on some exotic trees.** Anal. Inst. Cerc. Exp. For. Serv. 1(4): 210-230. Rumanian.

Presents notes on *Juniperus virginiana* L., *Platanus acerifolia* Willd., and *Gymnocladus dioica* K. Koch, in the light of Rumanian experience.

264. Randel, G.L. 1959. **Coniferous windbreak species and spacing tests at the Big Spring Field Station.** Misc. Publ. 360. College Station, TX: Texas A&M University, Texas Agricultural Experiment Station. 2 p.

Tests started in 1932 were evaluated in 1958. *Cupressus arizonica* was best in survival and growth, with *Juniperus virginiana* a good second, *Thuja orientalis* and *Juniperus scopulorum* intermediate, and *Pinus ponderosa* and *P. nigra* failures (no drought resistance). Spacing at 12 feet within rows and 24 feet between rows gave better survival and slightly less height growth than 6 X 12.

265. Sander, D.H. 1970. **Soil water and tree growth in a Great Plains windbreak.** Soil Science Society of America. 110(2): 128-135. 11 refs.

In the context of maintaining the effectiveness of existing shelterbelts by replanting some of the rows, measurements of soil moisture to a depth of 11 feet and the basal area increment of nine tree species (*Juniperus virginiana* and eight broadleaved species) in a 10-row, east-west shelterbelt (planted in 1940) in Nebraska were made at monthly intervals in 1960-1963. Tree roots removed soil water to a suction of 15 bars throughout the (chestnut soil) profile measured, except from the B horizon, which had a higher clay content and bulk density and lower available P than the remainder. Snow accumulation was the major source of water; this was utilized early in the growing season. *Populus deltoides* showed the greatest basal area and height growth. Soil water supply is considered adequate for the establishment of young trees where old rows have been removed, but in the more arid areas to the west, replanting may need to be confined to years of abundant snowfall.

266. Seidel, K.W.; Brinkman, K.A. 1962. **Mixed or pure walnut plantings on strip-mined land in Kansas?** Tech. Pap. 187. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 10 p. 3 refs.

Survival, growth, and form of *Juglans nigra*, 10 years after planting, were better in pure stands than in mixture with *Robinia pseudoacacia*; but when planted with *Quercus macrocarpa*, *Juniperus virginiana*, *Platanus occidentalis,* and *Fraxinus pennsylvanica*, *J. nigra* grew almost as well as in pure stands. Plantings in mixture with these species are recommended.

267. Steavenson, H.A.; Gearhart, H.E.; Curtis, R.L. 1943. **Living fences and supplies of fence posts.** Journal of Wildlife Mangement. 7: 257-261.

Some of the advantages of living hedges as opposed to wire fences are pointed out. Observations in Illinois suggest that insect damage is definitely reduced in areas where shelter exists for birds and parasitic insects. Formerly, Osage orange (*Maclura pomifera*) was the principal species used in fencing the prairies, and many data support the view that the beneficial effects of tall-growing Osage as a windbreak will offset the apparent sapping effect of the trees on crop yield. From the point of view of erosion control, plant barriers are also more satisfactory than wire fencing. The Asiatic rose, *Rosa multiflora*, although an exotic species, shows the greatest promise of fulfilling the requirements of a living fence. It has excellent cover qualities, produces quantities of fruit that persist during the winter and serve as a food reserve for birds, and compares favorably in survival and growth performance with any other shrub tried in Missouri or Illinois. In addition, it is less subject to leaf disease than the native *Rosa setigera*. Redcedar (*Juniperus virginiana*) has also been used with success as a living fence. Thrifty hedgerows of this species may become a profitable farm crop. Data from several hedge-post harvests in northern Missouri showed a close correlation between the yield of posts and firewood and the character of the subsoil. Large yields were generally obtained from soils with a porous, friable, well-oxidized subsoil.

268. Stoeckeler, J.H. 1966. **Trees for the Coulee Region.** Wisconsin Conservation Bulletin. 31(1): 14-16.

In 1961 and 1962, 40,000 trees of 13 species (both conifers and hardwoods) were established on abandoned farmland and pastures on steep slopes in the Coulee Region, southwest Wisconsin. On sites with deep soil, *Pinus strobus*, *P. resinosa*, and *Larix decidua* were outstandingly successful. *P. sylvestris*, *P. ponderosa*, and *P. nigra* var. *austriaca* showed fair to good survival and growth (height 3-6 feet 4 years after planting), but the sites would be more profitably used for the more successful species. *Picea abies*, *P. glauca*, *Juglans nigra*, *Fraxinus americana*, and *Quercus rubra* survived well, but growth was slow and they proved sensitive to late spring frosts. On a steep, exposed, limestone-strewn, prairie-soil slope that had never carried high forest, *Pinus nigra* var. *austriaca*, *P. ponderosa*, *P. sylvestris*, and *P. banksiana* showed a survival of 52-78 percent in the third year. *Juniperus virginiana* is also a possibility for such sites. Transplants 3-4 years old, particularly of *P. resinosa* and *P. strobus*, survived better than seedlings where there was heavy weed, alfalfa, or clover growth. Planting in furrows 12 inches wide gave best survival on all sites.

269. Szonyi, L. 1957. **The role of introduced species in the afforestation of sand areas in Hungary.** Erdeszeti Kutatasok: 49-64. Hungarian.

Among the natural tree growth of these areas, the establishment of stands of *Robinia*, Scots and Austrian pine, and, as an understory to poplar, *Celtis australis*, should be considered. For single-stem and group mixtures, the *viridis*, *caesia*, and *glauca* varieties of Douglas fir, *Pinus jeffreyi*, the valuable poplars, some *Salix* species, *Platanus orientalis*, *Gleditsia triacanthos*, *Elaeagnus angustifolia*, *Maclura pomifera*, *Juniperus virginiana*, and *Prunus serotina*, promise good results. At the leeward base of the dunes, Scots pine with a well-developed understory of *Prunus serotina* is a dominant feature. On the driest slopes, a mixture of Scots pine and *Robinia* is the only possibility. The leeward slopes generally carry natural tree clumps, and in the most favorable sites here all the species mentioned may be planted.

270. Tuzson, J. 1943. **Trials of some exotics for afforestation on the Great Plain of Hungary.** Erdeszeti Lapok. 82(3, 4): 113-119, 151-162. Hungarian.

Presents notes and recommendations on numerous exotics, tried in the past at various places in the Great Hungarian Plain, and in the Mitra, many by the author himself, including: strongly recommended - *Juniperus virginiana*. The seed must be collected quickly in October-November to forestall migratory birds, which can strip a tree in a few hours. The wind scatters it easily too. Nursery sowings germinate only in the second year. Although the young trees are not delicate and develop well, careful transplanting with a ball of earth is necessary at 4-5 years old. Recommended for drift-sand and marshy wastes on the Plain and for parks.

271. USDA Forest Service. 1951. **Underplanting.** Rep. SO-22. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 4-6.

Underplanting tests have been made in poor upland hardwoods with loblolly, Virginia, slash, shortleaf and longleaf pines, and eastern redcedar. Second-year survival has been good for both seedlings released immediately after planting and those left unreleased, but released seedlings made nearly double the height growth. All species except longleaf pine and redcedar were attacked by *Rhyacionia frustrana* and *Tetralopha robustella*. Underplanting of valuable hardwoods has also given good results.

272. USDA Forest Service. 1952. **Underplanting: North Mississippi.** Rep. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 9-11.

Average height growth and survival for five species of pine and eastern redcedar planted under lowgrade upland hardwoods were greater during the second and third growing seasons for released than for unreleased seedlings. Damage by *Rhyacionia frustrana* was greater on released and that by *Tetralopha robustella* was greater on unreleased plots. Third-year height growth and survival of six hardwoods used in underplanting were also greater on released than on unreleased plots. Release before or immediately after planting is desirable.

273. USDA Forest Service. 1957. **Survival of plantings in coastal plain bottomlands.** Rep. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 63-64.

In a 3-year study in South Carolina on the underplanting of rundown bottomland hardwood sites, both with and without removal of shade, *Quercus shumardii* and *Q. falcata* var. *pagodaefolia* did well under all test conditions. Loblolly pine grew well on cleared bottoms and terraces, while *Liriodendron tulipifera* and *Juniperus virginiana* survived best on terrace sites. One year of shade tended to improve early survival of all planting stock except loblolly.

274. USDA Forest Service. 1958. **Species tests on old fields (in S. Illinois).** Rep. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station: 2-3.

Four conifer and three hardwood species were planted in badly eroded upland old fields in 1947. After 11 years, all the conifers had a survival of not more than 84 percent, and average heights ranged from 9.5 feet for eastern redcedar to 23.9 feet for loblolly pine, with shortleaf and white pine intermediate. Survival of the hardwoods (tulip tree, white ash, and black walnut) ranged from 35 to 66 percent, and the average height ranged from 3.5 to 8 feet. In these, but not in the conifers, height and survival were related to the soil depth, and these hardwoods are not recommended for planting on badly eroded sites.

275. Ustinovskaja, L.T. 1952. **The Staro-Berdyansk plantations.** Priroda. 41(1): 112. Russian.

These cover 927 hectares in the droughty steppes bordering the Sea of Azov, the soil being loamy sand, sandy loam, and sand. Oak stands make up 70 percent of the area, the oldest being 45 years old. Some 35-year-old oak stands reach 17 m in height. In mixed oak/pine stands, oak at 18 years grows better than pine. Ash gives satisfactory results only on the lower sites. The introduction of *Gleditsia* is not warranted. The 75-year-old stands of *Juniperus virginiana* have an average height of 8 m, average diameter of 16 cm, and maximum diameter of 26 cm. This species is drought-resistant and frost-hardy.

276. VanHaverbeke, D.F. 1973. **Renovating old deciduous windbreaks with conifers.** Journal of Soil and Water Conservation. 28(2): 65-68. 15 refs.

Reports a study on the feasibility of removing several outer rows of a 10-row deciduous shelterbelt (established in Nebraska 30-40 years ago as part of the Great Plains Shelterbelt Project) and replacing them with conifers. Four rows on the south side of the shelterbelt were felled in 1963, and the stumps were sprayed to prevent coppice growth before machine planting 2 + transplants in four rows (from north to south) consisting respectively of *Juniperus virginiana*, *Pinus nigra*, *P. ponderosa*, and *J. virginiana* between the stumps in 1964. Competing vegetation was controlled by various treatments involving mechanical cultivation, mowing or chemical spraying, repeated at intervals during the 5-year period after planting. Data are tabulated for seedling mortality, and the percent replacement necessary, by treatment and species. Mortality was heaviest during the first year after planting for all treatments and species; mortality of *P. nigra* remained high, due mainly to extremely dry conditions near the residual shelterbelt trees and to damage by rabbits. The results are evaluated and effects on the residual trees are discussed. Recommendations include the planting of *Pinus nigra* not less than 30 feet from residual trees, and planting of *J. virginiana* to form the innermost and outermost rows of the new planting.

277. VanHaverbeke, D.F. 1977. **Conifers for single-row field windbreaks.** Res. Pap. RM-196. Lincoln, NE: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 38 refs.

Each of five species combinations: (a) *Pinus ponderosa*, (b) *P. ponderosa* and *Juniperus virginiana*, (c) *P. sylvestris*, (d) *P. sylvestris* and *J. virginiana*, and (e) *J. virginiana* were planted in north central Nebraska with 2+1 seedlings at spacings of 4, 6, and 8 feet and were either fertilized after planting or left unfertilized. Survival after 12 growing seasons was over 95 percent for all treatments. Height increment of all species was best at the 4-foot spacing. Combinations (c), (d), and (e) had the best height increment. Fertilizers had no effect on survival or growth. The most suitable species was *J. virginiana*, followed by *P. sylvestris*, then *P. ponderosa*. Recommendations are made for species combinations, spacings, and thinning regimes for the early establishment and sustained effectiveness of shelterbelts.

278. VanHaverbeke, D.F.; Boldt, C.E. 1968. **Vigor and density of shelterbelt conifers can be improved.** Journal of Forestry. 66(3): 187-192. 7 refs.

Rows of *Pinus ponderosa* and *Juniperus virginiana* were released after nearly 20 years of suppression by hardwoods in five Nebraska shelterbelts. Diameter and height increment, foliage density, and occurrence of mortality were correlated with degree of release. Release caused a reduction of incidence of *Dothistroma pini* and of damage by *Rhyacionia frustrana* on pine, and an increase of *Gymnosporangium juniperi* rust.

279. Volovink, S.V. 1979. **Eastern redcedar (*Juniperus virginiana*), the oldest planting in the southern part of the USSR.** Priroda Moskva. Nauka. (5). 121 p. Russian.

280. Wells, C.G. 1961. **Underplanting tests in pine stands.** Res. Note SE-160. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 2 p.

In a trial of underplanting a 19-year loblolly pine plantation, recently thinned to 119 ft^2/acre, with 1-year seedlings of *Liriodendron tulipifera*, *Quercus rubra*, *Fraxinus pennsylvanica,* and *Juniperus virginiana*, survival of the hardwoods after one growing season was excellent, but not that of *J. virginiana.* Despite fertilizing with N and P, *L. tulipifera* showed deficiency symptoms even on the highest-dosage plots.

281. Williston, H.L. 1962. **Conifers for conversion planting in north Mississippi.** Tree Planters Notes. 54: 5-7.

In February 1949 a study was established near Oxford, Mississippi, to compare the survival and growth of *Pinus taeda*, *P. palustris*, *P. echinata*, *P. elliottii*, *P. virginiana*, and *Juniperus virginiana* underplanted in low-grade upland hardwoods, with and without release before planting. Ten-year results are reported. *P. taeda* appears to be the best species for this purpose; where released, it has survived better and has outgrown the other five conifers. It has also proved surprisingly tolerant of overhead competition.

282. Williston, H.L.; Huckenpahler, B.J. 1958. **Response of six conifers in North Mississippi underplantings.** Journal of Forestry. 56(2): 135-137.

Seedlings (age not stated) of *Pinus echinata*, *P. taeda*, *P. palustris*, *P. elliottii*, *P. virginiana* and *Juniperus virginiana* were underplanted separately in 1/10-acre sub-plots in low-grade upland stands of *Quercus marilandica*, *Q. stellata,* and *Carya* sp., with and without release. The average survival and height of the different conifers at 5 years are tabulated, and the effects of release, rainfall, soil type, and insect and animal damage on height and survival are discussed. Results showed that conifer seedlings given immediate release from hardwood competition were almost three times as tall as those on unreleased plots. *P. taeda* was the best species for dry loess ridges; *P. echinata* and *P. virginiana* gave good site protection and survived better than *P. taeda* on droughty sites. *P. palustris* and *P. elliottii* are not recommended for planting in northern Mississippi. *J. virginiana* is useful for soil improvement but gets severely browsed by deer.

283. Wright, E.; Wells, H.R. 1948. **Tests on the adaptability of trees and shrubs to shelterbelt planting on certain Phymatotrichum root rot infested soils of Oklahoma and Texas.** Journal of Forestry. 46(4): 256-262. 6 refs.

Six years of study on a number of soil types showed that only a few of the tree and shrub species used were markedly resistant to root rot and none were immune. Most resistant were *Celtis occidentalis*, *Sapindus drummondii*, *Chilopsis linearis*, *Juniperus virginiana*, and *J. scopulorum*; *Ailanthus altissima* was somewhat less resistant. The following species were highly susceptible and should not be planted on infected soils: *Ulmus americana*, *U. pumila*, *Gleditsia triacanthos*, *Gymnocladus dioicus*, *Maclura pomifera*, *Elaeagnus angustifolia*, and *Populus sargentii.* Shelterbelts on freely permeable sandy soils lost much less to root rot than similar nearby plantations on less permeable soils. Indications were that use of a checker board or alternate arrangement of planting, rather than rows all of one species, might still further reduce losses from root rot even for resistant species.

284. Zhang, J.L. 1980. **Introduction and acclimation of *Juniperus virginiana* from North America, Canada.** Forest Technology Newsletter, Peking. 5: 8-9. Chinese.

285. Zohar, Y.; Brandle, J. 1978. **Shelter effects on growth and yield of corn in Nebraska.** La-Yaaran. 28: 1-4, 11-20, 46. 12 refs. Hebrew.

Plots (a) protected or (b) unprotected by *Populus deltoides* / *Juniperus virginiana* windbreaks were studied during summer 1976. Soil and plant moisture content, xylem water potential of roots, vegetative growth, and average yields per plant and per unit area were higher in (a); flowering started 1 week earlier in (a).

PESTS

Bagworms

286. Barrows, E.M. 1974. **Some factors affecting population size of the bagworm, *Thyridopteryx ephemeraeformis* (*Lepidoptera*: *Psychidae*).** Environmental Entomology. 3(6): 929-932. 10 refs.

Some factors that affect the size of the population of *Thyridopteryx ephemeraeformis* (Haw.) were studied in Kansas by inspection of larvae cases collected from the field in winter. It was found that the average fecundity, frequency of reproductive females, percentage of females, parasitism, and predation varied significantly among samples from different plants and among samples from trees of *Juniperus virginiana*, all in the same grove. Mortality from unknown causes was significantly dependent on plant species. The frequency of reproductive females was density-dependent in populations feeding on *J. virginiana.* Groups of bagworms might escape parasites and other causes of mortality by colonizing fresh plants.

Females that fed on *Acer palmatum atropurpureum* did not reproduce. If a 1:1 sex ratio can be assumed to occur at birth, males, on the average, suffered higher mortality than females.

287. Bishop, E.J.; Helms, T.J.; Ludwig, K.A. 1973. **Control of bagworm with *Bacillus thuringiensis.*** Journal of Econonmic Entomology. 66(3): 675-676. 3 refs.
Sprays of Biotrol XK (a wettable-powder formulation of spores and crystals of *Bacillus thuringiensis* var. *kurstaki* containing 3.4 X 109 International Units/lb and at least 12 X 109 viable spores/g formulation) gave effective control of larvae of *Thyridopteryx ephemeraeformis* (Haw.) on eastern redcedar (*Juniperus virginiana*) in plantings within the city of Lincoln, Nebraska, in 1972. Treatment at all rates (0.5-4 lb/100 US gal water) during June and August significantly reduced Psychid populations; treatment at all rates except 0.5 lb during June and early July gave nearly 100 percent control, while treatment at 4 and 2 lb during late July gave significantly better control than lower rates. Although the presence of pupae in samples affected the results, populations were significantly reduced during August and September.

288. Cox, D.L.; Potter, D.A. 1986. **Aerial dispersal behavior of larval bagworms, *Thyridopteryx ephemeraeformis* (*Lepidoptera:Psychidae*).** Canadian Entomologist. 118(6): 525-536. 19 refs.
Seasonal and daily patterns of ballooning, and behavioral processes involved in aerial dispersal, were studied in larvae of *Thyridopteryx ephemeraeformis* (a polyphagous pest of forests and ornamental trees and shrubs) on a cultivar of *Juniperus virginiana* in Kentucky in 1983. The aerial dispersal period began in mid-May and lasted about a month. About 75 percent of dispersing larvae ballooned after making a bag. Settling velocities were determined for larvae with and without bags and trailing various lengths of silk; a model was then developed that predicts dispersal distance for a particular wind speed and departure height. Most aerial dispersal is probably short-range. The bag reduced potential dispersal distance, but larvae with bags survived for about 2 days longer than those without bags when exposed to abiotic factors off a host-plant. Larvae without bags ballooned mostly in the morning, whereas 80 percent of the larvae dispersing with a bag ballooned in the afternoon. These patterns may be related to the diel periodicity of emergence of newly hatched larvae from old female bags, and the subsequent behavior of first-instar larvae before dispersal. A large proportion of each cohort emigrated regardless of host condition.

289. Cox, D.L.; Potter, D.A. 1988. **Within-crown distributions of male and female bagworm (*Lepidoptera:Psychidae*) pupae on juniper as affected by host defoliation.** Canadian Entomologist. 120(6): 559-567. 18 refs.
The within-crown distributions of male and female pupae of the sesiid *Thyridopteryx ephemeraeformis* were examined on *Juniperus virginiana* in Kentucky, as a function of prior defoliation. Differential stratification of the sexes occurred irrespective of degree of defoliation and despite the fact that competition was apparently greatest at the top of moderately and severely defoliated trees. There was no relationship between height of pupation and risk of parasitism for either sex. Female larvae were four times as likely as males to abandon a low-lying host, upon which they had fed, and to ascend the trunks of nearby trees before pupating. It is suggested that enhancement of larval dispersal by females is the most plausible explanation for the stratified distribution of pupae within trees.

290. Cox, D.L.; Potter, D.A. 1990. **Aerial dispersal behavior of the bagworm.** Journal of Arboriculture. 16(9): 242-243. 2 refs.
Results of studies into larval behavior, seasonal dispersal patterns, and the relations between host plant and dispersal are briefly reported following observations made in Kentucky, USA, on the bagworm (*Thyridopteryx ephemeraeformis*), which defoliates juniper (*Juniperus virginiana*) as well as other woody plant species. Larvae, drifting downwind, were capable of being dispersed 150 to 245 feet, and could survive 1.5 to 3.5 days off a host plant. Bagworm larval dispersal in Kentucky took place in mid-May to mid-June, and is the principal source of new infestations; larvae dispersed regardless of host plant condition. The implications of these results for management of bagworm infestations are noted.

291. Cronin, J.T. 1989. **Inverse density-dependent parasitism of the bagworm, *Thyridopteryx ephemeraeformis* (*Lepidoptera:Psychidae*).** Environmental Entomology. 18(3): 403-407. 36 refs.
Parasitism of *Thyridopteryx ephemeraeformis* by the *Ichneumonid Itoplectis conquisitor* was studied on eastern redcedar (*Juniperus virginiana*) in Virginia during 1986. Parasitoid foraging behavior indicated that two spatial scales were appropriate: individual trees and small patches of trees. Parasitoids showed a highly significant preference for male (61 percent parasitism) to female hosts (10 percent), and percentage parasitism by *I. conquisitor* declined significantly as the density of female psychids on trees increased. Although mathematically possible, this inverse density-dependent response was considered to be too vague to promote the stability of this system. Other factors that may be involved in the regulation of populations of *T. ephemeraeformis* are discussed.

292. Cronin, J.T.; Gill, D.E. 1989. **The influence of host distribution, sex, and size on the level of parasitism by *Itoplectis conquisitor* (*Hymenoptera*: *Ichneumonidae*).** Ecological Entomology. 14(2): 163-173. 48 refs.

Parasitism of the sesiid *Thyridopteryx ephemeraeformis* on redcedar (*Juniperus virginiana*) was studied in Virginia during 1986. Fifteen parasitoids, including five hyperparasitoids, attacked the pupal stage of the sesiid. *Itoplectis conquisitor* accounted for 58 percent of the parasitised pupae. Parasitism by this species was inversely related to host size, but independent of host distribution within a tree. Male hosts were parasitised more frequently than females, probably because of their relative sizes. The ovipositor length of *I. conquisitor* was insufficient to penetrate large hosts (greater than 57 mm) and, as host size increased, the proportion of the parasitoid population capable of penetrating the pupa declined abruptly. It is suggested that mechanical difficulties with oviposition, and perhaps the defensive capabilities of larger hosts, are responsible for the relationship between host size and percentage parasitism.

293. Gross, S.W.; Fritz, R.S. 1982. **Differential stratification, movement and parasitism of sexes of the bagworm, *Thyridopteryx ephemeraeformis,* on redcedar *Juniperus virginiana*, *Itoplectis conquistador*, natural control, Virginia.** Ecological Entomology. 7(2): 149-154.

294. Haseman, L. 1912. **The evergreen bagworm.** Bull. 104. Columbia, MO: University of Missouri Agricultural Experiment Station: 309-330.

295. Jones, F.M.; Parks, H.B. 1928. **The bagworms of Texas.** Bull. 382. College Station, TX: Texas Agricultural Experiment Station. 36 p.

296. Lagoy, P.K.; Barrows, E.M. 1989. **Larval-sex and host-species effects on location of attachment sites of last-instar bagworms, *Thyridopteryx ephemeraeformis* (*Lepidoptera:Psychidae*).** Proceedings of the Entomological Society of Washington. 91(3): 468-472. 19 refs.

Case attachment behavior of final-instar larvae of *Thyridopteryx ephemeraeformis* on redcedar (*Juniperus virginiana*), white pine (*Pinus strobus*), and black locust (*Robinia pseudoacacia*) was studied in the field in Virginia during September-October 1983 and 1984. On the deciduous *R. pseudoacacia*, males most frequently attached their cases to leaves, while females tended to attach their cases to branches. On *P. strobus*, both sexes tended to attach their cases to branches rather than leaves. The diameters of branches used as case-attachment substrates were significantly related to sex and tree species.

297. Rudd, B.; Ashdown, D.; Sanders, D.P. 1985. **Selected effects of sublethal dosages of three insecticides on the bagworm.** Journal of Arboriculture. 11(7): 207-209. 8 refs.

Juniperus virginiana trees in Texas were sprayed with sublethal doses of diazinon (1/8th recommended dose), Sevin (carbaryl - at 1/16th recommended dose), toxaphene [camphechlor] (1/16th recommended dose), or left untreated. After 8 hours, test populations of 100 bagworm larvae (*Thyridopteryx ephemeraeformis*), 35 days old, were placed on the test trees and confined in bags. In the autumn all bags were removed and contents examined. Female pupae were dissected for egg counts and measurement. Treatments did not significantly affect survival, egg number or viability, or emergence patterns. Populations on trees treated with diazinon produced significantly greater numbers of pupae. Camphechlor treatment resulted in significantly larger eggs than controls, and carbaryl treatment produced significantly smaller eggs.

298. Smith, M.P.; Barrows, E.M. 1991. **Effects of larval case size and host plant species on case internal temperature in the bagworm, *Thyridopteryx ephemeraeformis* (Haworth) (*Lepidoptera:Psychidae*).** Proceedings of the Entomological Society of Washington. 93(4): 834-838.

299. Stannard, L.J., Jr. 1964. **Secondary bagworm injury.** Journal of Economic Entomology. 57(1): 176. 2 refs.

Describes damage to *Juniperus virginiana* by winds breaking off distal twigs weakened by constrictions made by the supporting bands of the bagworms, 95 percent of which had been killed in the previous year by carbaryl treatment. *Thyridopteryx ephemeraeformis* is one species responsible.

300. Ward, K.E.; Ramaswamy, S.B.; Nebeker, T.E. 1990. **Feeding preferences and their modification in early and late instar larvae of the bagworm, *Thyridopteryx ephemeraeformis* (*Lepidoptera:Psychidae*).** Journal of Insect Behavior. 3(6): 785-795.

301. Ward, K.E.; Ramaswamy, S.B.; Nebeker, T.E. 1990. **Influence of host type and host switching on nutritional performance of the bagworm, *Thyridopteryx ephemeraeformis* Haworth (*Lepidoptera: Psychidae*).** Tech. Bull. 170. Starkville, MS: Mississippi State University, Mississippi Agricultural Forest Experiment Station: 13-20.

302. Ward, K.E.; Ramaswamy, S.B.; Nebeker, T.E. 1991. **Nutritional performance of first and penultimate-final instar bagworm larvae on two unrelated hosts as influenced by host of origin.** Entomologia Experimentalis et Applicata. 60(1): 71-81. 21 refs.

Nutritional performance of early- and late-instar larvae of *Thyridopteryx ephemeraeformis* was investigated as a function of origin and type of food plant, using two taxonomically distant wild plants, *Salix nigra* and *Juniperus virginiana*. First-instar growth and survival were higher on *S. nigra*; overall performance was similar on the two tree species in penultimate-final instars. There was no evidence for differentiation associated with food plant with respect to nutritional performance. There were, however, significant genotype X environment interactions for several characters studied, suggesting that the potential for food plant-associated differentiation exists.

Rusts

303. Berg, A. 1940. **A rust-resistant red cedar.** Phytopathology. 30: 876-878.

Trees selected in an eastern (*Juniperus virginiana*) grove for susceptibility and resistance to *Gymnosporangium juniperi-virginianae* Schw., and left in position for 16 years, maintained these characters throughout the period. Scions were taken from the most promising trees and propagated by grafting, being transferred when well established to an apple orchard where maximum rust infection occurred practically every year. After 4 years of such exposure, the scions from one tree show consistently high resistance to the fungus, and it may be assumed that under natural conditions this tree would never become severely infected with the rust prevalent in this region. Since, however, there is a possibility that the tree might not be resistant to all strains of the fungus, stock is now being propagated for distribution and testing in other regions.

304. Brown, H.I.; Orcutt, D.M.; Drake, C.R. 1977. **Lipid composition of hydrated and unhydrated telial structures of *Gymnosporangium clavipes* and *Gymnosporangium juniperi-virginianae* as compared to that of the host, *Juniperus virginiana*.** Proceedings of the American Phytopathological Society. 4: 214.

305. Cafley, J.D.; Huntly, J.H. 1961. **Control of the cedar-apple rust on redcedar.** Bi-monthly Progress Report of the Forest Entomological Pathology Branch, Department of Forestry, Canada. 17(2): 1.

Experiments indicate that *Gymnosporangium juniperi-virginianae* on ornamental trees of *Juniperus virginiana* can be controlled by a single application of Acti-dione spray at a concentration of 100 p.p.m. in water with detergent soap as an emulsifier.

306. Canada. 1942. **Twenty-first annual report of the Canadian plant disease survey 1941.** Ottawa, CA: Department of Agriculture, Division of Botanical Plant Pathology. 102 p.

Reports fungi that cause diseases on forest trees, including *Juniperus-Gymnosporangium* spp. on *J. virginiana*; *G. clavipes* on *J. communis*.

307. Crowell, I.H. 1935. **The cedar apple rust and its control.** Eleventh Natural Shade Tree Conference Proceedings: 80-83.

308. Cutter, V.M. 1959. **Studies on the isolation and growth of plant rusts in host tissue cultures and upon synthetic media. I. *Gymnosporangium*.** Mycologia. 51(2): 248-295. 49 refs.

Tissue and synthetic cultures were successfully established from the telial galls of *G. juniperi-virginianae* produced on *Juniperus virginiana*. After several years, all strains isolated proved capable of reinfecting their alternate hosts (*Crataegus* spp.), and some were also capable of infecting *J. virginiana*.

309. Dodge, B.O. 1931. **A destructive red-cedar rust disease.** Journal of the New York Botanical Garden. 32: 101-108.

310. Hahn, G.G. 1920. ***Phomopsis juniperovora*, a new species causing blight of nursery cedars.** Phytopathology. 10: 249-253.

311. Hahn, G.G. 1926. ***Phomopsis juniperovora* and closely related strains on conifers.** Phytopathology. 16: 899-914.

312. Hahn, G.G. 1930. **Life-history studies of the species of *Phomopsis* occurring on conifers.** British Mycology Society Transactions. 15: 32-93.

313. Hahn, G.G. 1947. **Berg's rust-resistant red cedar susceptible to *Phomopsis juniperovora* in greenhouse tests.** Phytopathology. 37: 530-531.

314. Hahn, G.G.; Hartley, C.; Pierce, R.G. 1917. **A nursery blight of cedars.** Journal of Agricultural Research. 10: 533-539.

315. Hansborough, J.R. 1952. **Cedar-apple rust.** In: Important tree pests of the northeast. Concord, NH: Society of American Foresters, New England Section: 89-99.

316. Hartley, C. 1910. ***Fomes annosus* and two species of *Gymnosporangium* on *Juniperus virginiana*.** Science. 31: 639.

317. Hartley, C. 1913. **Bark rusts of *Juniperus virginiana***. Phytopathology. 8: 249.

318. Hartley, C. 1913. **The blights of coniferous nursery stock**. Bull. 44. Washington, DC: U.S. Department of Agriculture. 21 p.

319. Heald, F.D. 1909. **The life history of the cedar rust fungus**. Ann. Rep. 22. Lincoln, NE: Nebraska Agricultural Experiment Station: 105-113.

320. Laundon, G. 1977. ***Gymnosporangium globosum* (American hawthorn rust, also on apple, pear, Sorbus, *Juniperus virginiana*).** Mycology Institute. 55(546): 1.

321. Laundon, G. 1977. ***Gymnosporangium juniperi-virginianae* (American apple rust, *Juniperus virginiana*).** Mycology Institute. 55(547): 2.

322. Livingston, J.E. 1946. **Cedar apple rust**. Ext. Circ. 1806. Lincoln, NE: Nebraska Agriculture College. 4 p.

323. Long, W.H. 1945. **Notes of four eastern species of *Gymnosporangium*.** Journal of the Washington Academy of Science. 35(6): 182-188.

Reports investigations conducted by the author in the District of Columbia and vicinity in 1912 and 1913 on the local occurrence of *Gymnosporangium clavipes* Cke. & Pk., *G. nidus-avis* Thaxt., *G. effusum* Kem., and *G. juniperi-virginianae* Sch.; on the lesions produced by them on eastern redcedar (*Juniperus virginiana* L.); and on inoculations with *G. effusum*.

324. Marshall, R.P. 1941. **Control of cedar-apple rust on redcedar.** Transactions of the Connecticut Academy of Arts and Sciences. 34: 85-118. Ukrainian.

Although the most effective way of eradicating cedar-apple rust (*Gymnosporangium juniperi-virginianae*) is by the complete removal of one or other of the alternate hosts (eastern redcedar and apple), house owners and the commercial tree experts who serve such owners have demanded control methods that will permit the growing of susceptible species of both hosts in close proximity. In order to meet this demand, experiments with fungicides for the control of the disease were undertaken at Stamford, Connecticut, during the period 1930-1940 inclusive. Results indicate that approximately 80 percent control may be obtained through a single application of a modified Bordeaux spray (Bordeaux No. 180) applied in early spring. Where a higher degree of control is demanded for the sake of appearance, it can be obtained by additional applications of the same spray or by hand-picking any galls that appear after spraying. Bordeaux No. 180 has a high copper/lime ratio and contains arsenites. It is non-injurious to eastern redcedar and does not make the trees unsightly.

325. Miller, P.R. 1939. **Pathogenicity, symptoms, and the causative fungi of three apple rusts compared**. Phytopathology. 29: 801-811.

Three distinct rusts affect apples in the United States: *Gymnosporangium juniperi-virginianae*, *G. globosum*, and *G. clavipes*. Comparative symptomatology of the three diseases and the morphological characters of their causative fungi are tabulated.

326. Mims, C.W. 1981. **Ultrastructure of teliospore germination and basidiospore formation in the rust fungus *Gymnosporangium clavipes* (on *Juniperus virginiana*).** Canadian Journal of Botany. 59(6): 1041-1049. 23 refs.

327. Mims, C.W.; Glidewell, D.C. 1978. **Some ultrastructural observations on the host (*Juniperus virginiana*)-pathogen relationship within the telial gall of the rust fungus *Gymnosporangium juniperi-virginianae*.** Botanical Gazette. 139(1): 11-17.

328. Neely, D. 1983. **Chemical control of cedar-apple and cedar-hawthorn rusts.** Journal of Arboriculture. 9(3): 85-87. 3 refs.

Rust caused by *Gymnosporangium juniperi-virginianae* attacking ornamental crabapple (*Malus* spp.) or hawthorn (*Crataegus* spp.) in the U.S.A., is usually only a problem where native redcedar (*Juniperus virginiana*) or other susceptible junipers are found within 1 mile. Seven fungicides were applied in April or May of 1980, 1981, or 1982 to infected *M. ioensis* and *C. mollis* that were growing within 100 feet of *J. virginiana* in the Illinois Natural History Survey arboretum. Disease severity was recorded in late June or early July using a leaf lesion index. Bayleton, Baycor (biteranol), and Vangard gave effective control, but Daconil (chlorothalonil), Manzate (maneb), Difolatan (captafol), and captan were only partially effective.

329. Palmiter, D.H. 1952. **Three rust diseases of apples and fungicide treatments for their control**. Bull. 756. Albany, NY: New York Agricultural Experiment Station: 1-26.

330. Pammel, L. H. 1905. **Cedar apple fungi and apple rust in Iowa.** Ag. Mechan. Arts 84. Ames, IA: Iowa State University Agricultural Experiment Station. 36 p.

331. Pearson, R.C.; Aldwinckle, H.S.; Seem, R.C. 1977. **Teliospore germination and basidiospore formation in *Gymnosporangium juniperi-virginianae*: a regression model of temperature and time effects.** Canadian Journal of Botany. 55(22): 2832-2837.

332. Pearson, R.C.; Seem, R.C.; Meyer, F.W. 1976. ***Gymnosporangium juniperi-virginianae* basidiospore liberation under field conditions.** Proceedings of the American Phytopathological Society. 3: 283.

Branches of redcedar (*Juniperus virginiana*) bearing galls of cedar/apple rust (*G. juniperi-virginianae*) were placed in water around a spore trap, and hourly observations were made of relative humidity, leaf wetness, temperature, rainfall, and spore concentration, from 23 April to 15 June, 1975. Spore release was initiated by rainfall and continued as long as relative humidity was near 100 percent. On most occasions, relative humidity and leaf wetness correlated with log 10 spore catch, accounting for nearly 40 percent of the variation, but sometimes spores were released after rain regardless of these factors.

333. Pearson, R.C.; Seem, R.C.; Meyer, F.W. 1980. **Environmental factors influencing the discharge of basidiospores of *Gymnosporangium juniperi-virginianae*.** Phytopathology. 70(3): 262-266. 17 refs.

Discharge of basidiospores of *G. juniperi-virginianae* (cedar apple rust of apple) was studied in the field for three growing seasons. Cut branches of *Juniperus virginiana* bearing rust galls were arranged around a spore trap. Discharge usually began within a few hours of the start of rain; continued throughout the rain period; and ceased when rain ended, leaves dried, and relative humidity dropped below 85 percent. The duration of the spore release period was most highly correlated with hours of relative humidity more than or equal to 85 percent. Generally, environmental parameters had higher correlation coefficients with the duration of spore discharge than with spore numbers. Delays in discharge following the start of rainfall were not significantly correlated with any of the parameters. Multiple regression equations were developed to predict the amount and duration of spore discharge. On several occasions after a rain-induced discharge, basidiospore release resumed 12-24 hours later in the absence of rain or leaf wetness. This phenomenon was highly correlated with hours of relative humidity more than or equal to 85 percent.

334. Smits, B.L.; Peterson, W.J. 1942. **Carotenoids of telial galls of *Gymnosporangium juniperi-virginianae*, Lk.** Science. 96: 210-211.

In an investigation of the pigments of the telial galls of the common rust fungus *Gymnosporangium juniperi-virginianae* Lk beta- and gamma-carotenes were shown to be the only carotenoids present, with the gamma-isomer predominating. The identification of gamma-carotene was based on its more characteristic properties, behavior on an adsorbent, and its absorption spectra. Neither free nor esterified xanthophylls were present, and only traces of chlorophyll. The leaves of the Juniper (*Juniperus virginiana*), besides containing chlorophyll, showed the presence of alpha, beta, and gamma-carotene.

335. Strong, F.C. 1948. **Redcedar-apple and hawthorn rust disease control by spraying redcedars in the spring.** Quarterly Bulletin of the Michigan Agricultural Experiment Station. 30(3): 283-288. 3 refs.

The use of Bordeaux 180 as a spray to control *Gymnosporangium juniperi-virginianae* and *G. globosum* on redcedar (*Juniperus virginiana*) and its alternate hosts (species of Hawthorn and apple) was very successful and caused no injury to foliage.

336. Strong, F.C.; Cation, D. 1940. **Control of cedar rust with sodium dinitrocresylate.** Phytopathology. 30: 983.

Single sprayings with sodium dinitrocresylate (Elgetol), applied on 8 May to one group of host plants and on 16 May to another, inhibited telial column extension and teliospore germination from rust galls of *Gymnosporangium globosum* and *G. juniperi-virginianae* on *Juniperus virginiana*, and of *G. clavipes* and *G. clavariaeforme* on *J. communis.* A 1 percent solution of Elgetol regular was the most effective. Exceptionally thorough spraying was necessary for positive results. No foliage injury was later apparent on *J. virginiana,* and only a trace of injury was apparent on some of the badly infected *J. communis.*

337. Strong, F.C.; Klomparens, W. 1955. **The control of redcedar apple and hawthorn rusts with Acti-dione.** Plant Disease Reporter. 39(7): 569.

Prevention of germination of the teliospores and resultant sporidia production of *Gymnosporangium juniperi-virginianae* was achieved by a single application of cycloheximide (Actidione) at 100 p.p.m. to galls on *Juniperus virginiana* in the spring. Further tests with lower concentrations in summer grade fuel oil (50 p.p.m. or 25 p.p.m. in 0.5 percent oil, applied in April), proved to be equally effective. No injury to foliage was observed.

338. Von Schrenk, H. 1900. **Two diseases of red cedar, caused by *Polyporus juniperinus* N. sp. and *Polyporus carnes* Nees**. Bull. 21. Washington, DC: U.S. Department of Agriculture. 29 p.

339. Waite, M.B. 1927. **Apple trees attacked by cedar rust.** Yearbook. Washington, DC: U.S. Department of Agriculture: 145-151.

340. Weimer, J.L. 1917. **The origin and development of the galls produced by two cedar rust fungi**. American Journal of Botany. 4: 241-251.
Galls produced by *Gymnosporangium juniperi-virginianae* and *G. globosum* on *Juniperus virginiana* originate as modified leaves. The vascular systems of the galls are composed of the enlarged and modified leaf-trace bundles.

Blights

341. Butin, H.; Paetzholdt, M. 1974. **Injuries to *Juniperus virginiana* by *Phomopsis juniperovora*.** Nachrichtenblatt des Deutschen Pflanzenschutzdienstes. 26(3): 36-39. 12 refs. German.
Reports this disease for the first time in Germany and describes attacks in Holstein nurseries. Infection tests showed a very high pathogenicity, even to intact shoots, especially in infections initiated by spores.

342. Caroselli, N.E. 1957. **Juniper blight and progress on its control**. Plant Disease Reporter. 41: 216-218.
Juniper blight, caused by the fungus *Phomopsis juniperovora* Hahn, is a serious disease of 1- and 2-year-old trees. Treatment by several chemicals is effective.

343. Dai, Y.S. 1986. **A nursery blight of *Sabina* (*Juniperus*) *virginiana*.** Journal of Nanjing Institute of Forestry. 2: 37-46. 7 refs. Chinese.
A fungus producing pycnidia on dead shoots and leaves of seedlings in nurseries in Jiangsu, China, was identified as *Phomopsis juniperovora* and described. Seedlings of *S. chinensis* var. *Juniperus chinensis* cv. *pyramidalis Fokienia hodginsii*, *Cupressus funebris,* and *C. gigantea* were infected as well as *J. virginiana*.

344. Davis, W.C.; Latham, D.H. 1939. **Cedar blight on wildling and forest tree nursery stock.** Phytopathology. 29: 991-992.
Considerable loss of nursery stock of *Juniperus virginiana* in the central and eastern United States is caused by *Phomopsis juniperovora*. This fungus was observed on wildling redcedar seedlings in natural stands in Virginia, North Carolina, and Tennessee during 1937 and 1938, and was isolated from diseased redcedar nursery stock in 1938. While applications of ammonium sulphate and 4-10-4 commercial fertilizer stimulated the early growth of transplants, by the end of the growing season the loss of transplants due to cedar blight was nearly twice as great on fertilized as on unfertilized plots. Spraying with Bordeaux and roguing to produce blight-free stock cost 40 cents per 1,000 seedlings.

345. Fiedler, D.J.; Otta, J.D. 1977. **Control of Phomopsis blight of eastern redcedar with benomyl.** Proceedings of the American Phytopathological Society. 4: 126.
Phomopsis blight (*P. juniperovora*) in potted seedlings of eastern redcedar (*Juniperus virginiana*) in the greenhouse was significantly controlled by foliar sprays of benomyl (a.i. 600 p.p.m.) applied three times before and three times after inoculation, and also by drenches of benomyl (40-60 mg/liter pot); the minimum concentration of benomyl necessary to control the disease was 3 mu g/g plant tissue. In nursery-grown 2+0 plants, some control (significantly fewer trees with pycnidia and percent pycnidia with spores) was achieved with 2-weekly (1.1 kg/ha), monthly (2.8 kg/ha), or 6-weekly (5.6 kg/ha) applications of benomyl despite the low concentration (less than 3 mu g/g) in the plants.

346. Hahn, G.G. 1940. **Distribution and hosts of cedar blight in the United States. Reports of cedar blight in 1939.** Plant Disease Reporter. 24(3): 52-58.
Redcedar (*Juniperus virginiana*) blight, caused by *Phomopsis juniperovora*, is now known to occur in 25 States of the American Union and in the District of Columbia. New hosts include *J. japonica*, *J. chinensis* var. *mas*, *J. horizontalis* var. *douglasii*, and *J. asheі*, while *J. virginiana* var. *pyramidiformis hilli* has given evidence of resistance in recent tests. During 1939 the blight was destructive in Minnesota and Wisconsin, but in the western states—Nebraska, Kansas, Oklahoma, and Texas—it has been of little importance in recent years. In Nebraska and Kansas, where it was previously virulent, the succession of dry seasons may have contributed to the lack of serious infection.

347. Hahn, G.G. 1941. **Reports of cedar blight in 1940 and notes on its previous occurrence in nurseries.** Plant Disease Reporter. 25: 186-190.
In recent years, *Phomopsis juniperovora* has become a difficult problem in nurseries of the Mississippi Valley States where cedars are propagated, and the disease is regarded as

particularly serious in this area since *Juniperus virginiana* is locally popular for windbreak plantings. In two nurseries in Iowa and Missouri, the disease was less active in July, 1940, than at any time in the previous 3 years, apparently owing to a very dry spring. Towards the end of July, however, an epidemic developed in two Iowa nurseries and became more severe than outbreaks in 1937 and 1938. In a 2 acre area planted with *J. virginiana,* all of 2,000 seedlings examined were infected. Spread became greatly reduced in the first week of September, when dry weather set in. Between 20 July and 1 September, the whole stock was rogued three or four times, with a total loss of about 30 percent. The disease was quiescent during the dry, cold spring, but became rampant when exceptionally wet, cool weather developed in July and August. In eastern Nebraska, infection was worse during 1940 than at any other time in recent years. At Fremont *J. scopulorum* was as badly infected as *J. virginiana.* In Minnesota and Wisconsin, infection was light. During the year the first authenticated record of the disease as a nursery problem in Oklahoma was received. In Texas nurseries, only one case appears to have occurred; this was in 1929, when the fungus was identified on *J. chinensis* seedlings introduced from Illinois. Infection in a nursery in Virginia and one in North Carolina was less serious than in the previous 2 years. Thin stands appeared to be a controlling factor, as in South Carolina, where the disease has not yet been recorded.

348. Hahn, G.G. 1943. **Taxonomy, distribution and pathology of *Phomopsis occulta* and *P. juniperovora.*** Mycologia. 35(1): 112-119.

In wound inoculation tests carried out during 1941 in an unheated greenhouse at the Marsh Botanical Garden, Yale University, monospore cultures of *Phomopsis occulta* failed to infect any of the 14 wildling eastern redcedar (*Juniperus virginiana*) saplings inoculated, whereas inoculations with *P. juniperovora* were entirely successful in all seven saplings used. Saplings of a bluish-green color were girdled and killed, whereas those of a lighter and brighter green showed some resistance. *P. occulta* is stated to be widely distributed on conifers both in western Europe and throughout North America, while its perfect stage, *Diaporthe conorum,* though common in Europe, is very rare in the Western Hemisphere. In the course of the author's investigations in Great Britain from 1926 to 1929, fruiting bodies of *D. conorum* were obtained experimentally on twigs of *Ulmus procera* from monopycnidiospores of the fungus originally isolated from cultures of monoascospores from Douglas fir (*Pseudotsuga taxifolia*). *P. occulta* is considered to be a secondary invader of cedars following some injury to the host plant, although some forms were found to be weakly parasitic on the coast form of Douglas fir. The pathogenic species, *P. juniperovora,* the Diaporthe stage of which is as yet unknown, is stated to be parasitic under natural conditions only on hosts of the Cupressaceae, a revised list of which is given. Under experimental conditions, saplings of the coast form of Douglas fir were found to be highly susceptible to this fungus, but nursery stocks of this host were never observed to be attacked. The fungus is stated to occur as a nursery parasite on hosts of the Cupressaceae family both in Europe and in the United States.

349. Hahn, G.G. 1949. **Junipers previously reported blight resistant now proved susceptible to *Phomopsis juniperovora.*** Plant Disease Reporter. 33(8): 328-330. 5 refs.

Reports inoculation tests on *Juniperus virginiana* var. *hilli* and two specimens of *J. virginiana* previously reported to show resistance to cedar blight. All three proved susceptible under experimental conditions.

350. Hodges, C.S.; Green, H.J. 1960. **Survival in the plantation of eastern redcedar seedlings infected with *Phomopsis juniperovora* in the nursery.** Phytopathology. 50(9): 639.

Survival rates of *Juniperus virginiana* seedlings that had 0, 1-10, 11-50, and more than 50 percent of their tops killed by the blight when planted out were 84, 23, 6, and 3 percent, respectively, after 2 years. In another trial, survival ranged from 81 to 15 percent after 1 year. Most of the originally infected, but few of the originally healthy, seedlings had new infections at the beginning of the second growing season. Viable conidia of *P. juniperovora* were found on material dead as long as 18 months.

351. Hodges, C.S.; Green, H.J. 1961. **Survival in the plantation of eastern redcedar (*Juniperus virginiana*) seedlings infected with Phomopsis blight in the nursery.** Plant Disease Reporter. 45(2): 134-136.

352. Otta, J.D. 1974. **Benomyl and thiophanate methyl control Phomopsis blight of eastern redcedar in a nursery.** Plant Disease Reporter. 58(5): 476-477. 8 refs.

Reports trials in which 2-year-old seedlings of *Juniperus virginiana* were treated with each of the two systemic fungicides and a phenylmercuric compound to control blight caused by *Phomopsis juniperovora* in a nursery in South Dakota. Benomyl (0.5 lb a.i./acre) and thiophanate methyl (0.7 lb a.i./acre) both gave satisfactory control, and none of the treatments were phytotoxic.

353. Otta, J.D. 1978. **Alpha and beta spore occurrence in *Phomopsis juniperovora* (blight) pycnidia on *Juniperus virginiana***

and in culture. Canadian Journal of Botany. 56(7): 727-728.

354. Otta, J.D.; Fiedler, D.J.; Lengkeek, V.H. 1980. **Effect of benomyl on *Phomopsis juniperovora* infection of *Juniperus virginiana*.** Phytopathology. 70(1): 46-50. 19 refs.

Presents results of a series of experiments. In vitro growth of *P. juniperovora* on agar was reduced by 0.1-0.25 mg/liter benomyl. Benomyl applied as a foliar spray to 2-year-old potted trees of *J. virginiana* in the greenhouse (suspension of 600 mg/liter weekly for 4 weeks), and to 3-year-old trees in a nursery in South Dakota (0.6 kg/ha a.i. in 190 liters water), significantly reduced severity of disease developing after inoculation. In the nursery trees (also sprayed with chlorothalonil, triphenyl tin hydroxide, and captafol, which were ineffective in preventing disease development), percent trees and amount of diseased tissue with pycnidia, and percent pycnidia with spores were significantly less than in untreated trees. Benomyl applied as a spray was not translocated to protected portions of the foliage, but when applied as a soil drench to 2-year-old potted trees in the greenhouse, it was translocated and protected against disease when the concentration in new growth exceeded 3 mu g/g. *J. virginiana* in the nursery was susceptible to infection by *P. juniperovora* throughout the growing season, but not after dormancy began in late August and September.

355. Pero, R.W. 1970. **Juniper diffusates: their composition and effect on *Phomopsis juniperovora* spores.** Dissertation Abstracts International, B. Science and Engineering. 31(1): 13.

356. Pero, R.W.; Howard, F.L. 1969. **Activity of foliar diffusate from *Juniperus virginiana* on *Phomopsis juniperovora* spore germination.** Phytopathology. 59(4): 402.

Aqueous diffusates from foliage of *J. virginiana* susceptible and resistant to *P. juniperovora* were all found to give active stimulation of spore germination and germ-tube elongation. Two biologically active components were isolated.

357. Pero, R.W.; Howard, F.L. 1970. **Activity of Juniper diffusates on spores of *Phomopsis juniperovora*.** Phytopathology. 60(3): 491-495. 17 refs.

358. Peterson, G.W. 1965. **Field survival and growth of Phomopsis-blighted and non-blighted eastern redcedar planting stock.** Plant Disease Reporter. 49(2): 121-123. 2 refs.

Tabulates and discusses the results of comparative trials in eastern Nebraska, confirming the results of previous tests in North Carolina, and indicating that blighted stock of *Juniperus virginiana*, even if only slightly damaged, should not be planted out.

359. Peterson, G.W. 1973. **Infection of *Juniperus virginiana* and *J. scopulorum* by *Phomopsis juniperovora*.** Phytopathology. 63(2): 246-251.

Young leaves of both *J.* spp. were highly susceptible to *P. juniperovora*, but no lesions developed on old leaves. Infection occurred at 12-32° C, with greater intensity at 24-28° C. Small, light colored lesions developed in 3-5 days. Disease was more severe when high (32°) post-inoculation temperatures prevailed. Infection took place in 7 hours at 100 percent relative humidity and 24° C. Pycnidia with viable spores were present 3 weeks after inoculation. The optimum temperature for germination, germ-tube development, and growth in culture was 24° C, exposure to -22° and +43° C did not prevent germination. Spores also germinated following hydration, desiccation, and the return to favorable conditions. Light had no effect on germination, growth, or infection.

360. Peterson, G.W. 1977. **Control of juniper blight caused by *Cercospora sequoiae* var. *juniperi* (*Juniperus virginiana*, *Juniperus scopulorum*).** American Nurseryman. 145(12): 13, 50-51.

361. Peterson, G.W. 1977. **Epidemiology and control of a blight of *Juniperus virginiana* caused by *Cercospora sequoiae* var. *juniperi*.** Phytopathology. 67(2): 234-238. 6 refs.

In eastern Nebraska, spores of *C. sequoiae* var. *juniperi* were trapped as early as late April, but dispersal was not abundant until late May or early June and it extended into October. Spores were dispersed only during rainy periods. There was no evidence of long-distance dispersal; no spores were collected in volumetric traps 2 m from infected trees. Germination of spores began within 6 hours and after 24 hours was more than 90 percent over the range 16-28° C. Germ tube growth was optimal at 24-26° C. First infection of spur leaves of *J. virginiana* occurred during the period 14-28 July in 1971 and 21 June-5 July in 1972. Symptoms on spur leaves were first observed on 8 August in 1971, 19 July in 1972, and 21 July in 1973. Only the previous year's spur leaves and both current and previous years' juvenile leaves became infected. Whip leaves, the characteristic foliage of extremities of long shoots on secondary and tertiary branches, were not infected. Results provide a sound basis for determining when protective fungicides should be applied.

362. Peterson, G.W. 1986. **Resistance to *Phomopsis juniperovora* in geographic seed sources of *Juniperus virginiana*.** Gen. Tech. Rep. WO-50. Washington, DC: U.S. Department of Agriculture, Forest Service: 65-69.

363. Peterson, G.W.; Nuland, D.; Weihing, J.L. 1960. **Tests of four fungicides for control of cedar blight.** Plant Disease Reporter. 44(9): 744-746. 2 refs.

Treatments tested on *Juniperus virginiana* seedlings attacked by *Phomopsis juniperovora* in an eastern Nebraska nursery were: (1) Puratized Agricultural Spray at 1 1/2 pints/55 gal water; (2) Kromad (5 percent Cd sebacate; 5 percent K chromate; 1 percent malachite green; 0.5 percent auramine; 16 percent thiram) at 0.2 lb/10 gal water; (3) Dodine (Cyprex 65-W) (65 percent NU-dodecylguanidine acetate) at (a) 0.2 lb/10 gal water and (b) 0.1 lb/10 gal water; (4) Acti-dione RZ (1.3 percent cycloheximide (beta[2 -(3,5 - di methyl - 2 - oxocyclohexyl)- 2 - hydroxyethyl]-glutarimide); 75 percent pentachloronitrobenzene) at (a) 1.6 oz/10 gal water and (b) 0.11 oz/10 gal water. (1) Gave very good control on 1 + 0 and 2 + 0 seedlings. Blight incidence in (2) was lower than in controls but much higher than in (1). (4a), (4b), and (3a) proved toxic to the plants. (3b) was not toxic but less effective than (1) and (2). Blight incidence in the 3 + 0 seedlings was too slight to give any significant results.

364. Peterson, G.W.; Otta, J.D. 1979. **Controlling *Phomopsis* blight of junipers.** American Nurseryman. 149(5): 15, 75-82. 9 refs.

The fungus *Phomopsis juniperovora* (*juniperivora*) attacks *Juniperus virginiana* and *J. scopulorum* as seedlings in nursery beds. The life cycle and characteristics of the fungus are reported, and symptoms of infection in juniper are described and distinguished from attack by the lesser cornstalk borer (*Kabatina juniperi*) and blight caused by *Cercospora sequoiae*. Control of *Phomopsis* can be achieved by several simultaneous actions: weekly fungicide (mercury compounds, benomyl) application, weekly roguing of all seedlings with dying foliage, and proper location of seedling beds (away from older stands, on well drained sites). As the fungus is most likely to infect seedlings in moist conditions, irrigation and shading should be planned so that leaves do not remain wet for long periods. After transplanting, fungicide application to the early and late flushes of growth is a practical means of retaining control. The blight rarely kills older trees.

365. Peterson, G.W.; Sumner, D.R.; Norman, C. 1965. **Control of Phomopsis blight of eastern redcedar seedlings.** Plant Disease Reporter. 49(6): 529-531. 3 refs.

Of five treatments tested on *Juniperus virginiana* seedlings attacked by *Phomopsis juniperovora* in an eastern Nebraska nursery, only Puratized Agricultural Spray, (1, 1 1/2, or 2 pints/100 gal water), gave good control at the rates used. Control was not improved by addition of two spreader-stickers.

366. Scheld, H.W., Jr.; Kelman, A. 1963. **Influence of environmental factors on *Phomopsis juniperovora*.** Plant Disease Reporter. 47(10): 932-935. 11 refs.

In cultures, optimum mycelial growth occurred at 26° C on a solid medium and at 28° C in a liquid medium. Optimum temperature for germination of conidia was 20° C. Light was essential to obtain fertile pycnidia. Maximum infection developed within the range of temperatures optimum for spore germination and mycelial growth. In overwintering studies in the field, both mycelium and conidia in pycnidia survived the winter on live, infected seedlings of *Juniperus virginiana*; conidia in pycnidia also survived the winter on surface debris. Neither spores nor mycelium remained viable throughout the winter in tissues of seedlings buried in the soil.

367. Slagg, C.M.; Wright, E. 1943. **Control of cedar blight in seedbeds.** American Nurseryman. 78(7): 22-25.

All species of *Juniperus* are susceptible to attack by the cedar blight fungus (*Phomopsis juniperovora*), but the disease is usually most severe on eastern redcedar (*J. virginiana*), especially in the seedbed stage. Experiments carried out during an epidemic of the blight in 1941 revealed that under Kansas conditions thinly sown seedbeds are more severely attacked than thickly sown beds; and in a preliminary experiment, it was observed that considerably less disease occurred in a section of a seedbed watered by ditch irrigation than in an adjacent section watered by an overhead sprinkler. All the standard fungicides tested reduced the amount of infection, but Special Semesan gave the greatest degree of control. Lime-sulphur, wettable sulphur, and arsenic compounds all produced more or less serious burning of foliage, while the soils of plots treated with bordeaux mixture became strongly alkaline. It is believed that weekly spraying between June 1 and October 1 will furnish adequate protection to young seedlings. Sanitary measures, in particular the removal of blighted seedlings, will increase control. A combination of roguing and spraying reduced seedling loss from blight to 1.44 percent with bordeaux mixture, 1.63 percent with Cuprocide, and 0.55 percent with Special Semesan.

368. Wheeler, M.M.; Wheeler, D.M.S.; Peterson, G.W. 1975. **Anthraquinone pigments from**

the phytopathogen *Phomopsis juniperovora* Hahn. Phytochemistry. 14(1): 288-289.

369. Wright, E.; Slagg, C.M. 1942. **Some tentative conclusions resulting from plot analyses of Phomopsis-blighted Juniper seedlings in Great Plains nurseries during 1941.** Phytopathology. 32: 19.

One-year-old seedlings of *Juniperus virginiana* from Kansas seed proved no more resistant to infection by *Phomopsis juniperovora* than those from Nebraska seed. *J. scopulorum*, previously not sprayed because it was considered highly resistant, was so severely infected that spraying will be necessary in the future. Infection of seedlings generally began at the edge of the seedbeds, later working inwards, and appeared to be directly associated with water splashing. Seedlings watered by overhead irrigation were more severely attacked than those watered by ditch irrigation; dense stands, presumably because they reduce splashing, tended to retard rather than to increase the percentage of infection. Roguing of diseased plants was not significantly beneficial, except where infection was comparatively light. Of various sprays used, commercial bordeaux (5-5-50) gave most promise for control.

Other Pests

370. Appleby, J.E.; Neiswander, R.B. 1965. ***Oligotrophus apicis* sp. N., a midge injurious to junipers; with key to species of *Oligotrophus* found in the United States.** Ohio Journal of Science. 65: 166-175.

371. Baxter, D.V. 1939. **Some resupinate polypores from the region of the Great Lakes. XI.** Michigan Academy of Science. 25: 145-170.

Gives descriptions of 10 polypores, including *Poria ferox n.* sp. from dead wood of *Juniperus monosperma* and *J. virginiana* in Arkansas and New Mexico.

372. Beal, J.A.; McClintick, K.B. 1943. **The pales weevil in Southern Pines.** Journal of Economic Entomology. 36: 792-794.

The life history and habits of the pales weevil (*Hylobius pales* Herbst) in the southern States differ somewhat from those recorded for New England. In the vicinity of Durham, North Carolina, there is one complete generation and a partial second overlapping generation annually. The weevil appears to breed only in the roots of stumps and dying trees, and the larvae feed singly. Apparently all species of pine are liable to attack, and severe damage has been caused to *Cupressus arizonica*. *Juniperus virginiana* is also attacked to some extent. Damage is proportional to the size of the trees and to the number of weevils present. Young pines from the seedling stage up to 4 or 5 feet in height suffer most severely, especially if they are in the vicinity of freshly cut stumps, dying pines, or of logging or building operations. The weevil is attracted to the vicinity of pines infested by bark beetles, feeds upon the surrounding reproduction and the limbs of infested trees, and later breeds in the roots. Losses have been noticeably heavier in areas under the group selection method of cutting than where clear cutting in strips is the method used.

373. Berisford, C.W. 1974. **Hymenopterous parasitoids of the eastern juniper bark beetle, *Phloeosinus dentatus* (*Coleoptera: Scolytidae*).** Canadian Entomologist. 106(8): 869-872. 8 refs.

Nine species of Hymenopterous parasites were caught on adhesive traps as they were attracted to logs of redcedar (*Juniperus virginiana*) infested by *Phloeosinus dentatus* (Say) in Georgia in 1971 and 1972. All were successfully reared from infested logs; and *Cheiropachus arizonensis* (Ashm.), *Eurytoma aequabilis* Bugbee, *Heydenia unica* Cook & Davis, and *Spathius impus* Matthews were reared directly from larvae of *P. dentatus*, *H. unica* and *Roptrocerus eccoptogastri* (Ratz.), *Coeloides pissodis* (Ashm.), *Rhopalicus pulchripennis* (Crwf.) and *E. conica* Prov. Four of the species reared from the logs commonly attack *Dendroctonus frontalis* Zimm. and *Ips*. spp., indicating that *P. dentatus* may be an important alternate host when the other host populations are low.

374. Berisford, C.W. 1975. **Patterns of attack by the eastern juniper bark beetle, *Phloeosinus dentatus* and some common associates.** Journal of the Georgia Entomological Society. 10(1): 37-42. 7 refs.

The attack patterns of males and females of *Phloeosinus dentatus* (Say) and common associated insects on *Juniperus virginiana* were determined by using sticky traps attached to the boles of felled trees. Associated insects included nine species of Hymenopterous parasites, three Clerid beetle predators, and two species of Cerambycidae. Two parasites, *Spathius impus* Matthews and *Heydenia unica* Cook & Davis, made up about 80 percent of the parasite complex. Arrivals of both sexes of *P. dentatus* reached a peak 5 days after the initial attack and were low after 50 days. The arrivals of parasites reached a peak 40-50 days after the initial attack.

375. Boldrev, M.I.; Wilde, W.H.A.; Smith, B.C. 1969. **Predaceous coccinellid oviposition responses to *Juniperus* wood.** Canadian Entomologist. 101(11): 1199-1206. 10 refs.

In laboratory experiments at Belleville and Guelph, Ontario, four coccinellid species (*Cycloneda mundi*, *Adalia bipunctata*, *Coccinella transversoguttata richardsoni*, and *Coleomegilia maculata* *lengi*) were strongly attracted to *Juniperus virginiana* for oviposition. The attractant substances appeared to be in the wood. In laboratory cages at temperatures of 24° to 29.5° C, oviposition took place on test boards at distances up to 70 cm from the host plant. The possibility is discussed of using juniper boards to aggregate ovipositing coccinellid females in areas where large aphid infestations are expected.

376. Boratynski, K. 1957. **On the two species of the genus *Carulaspis Macgillivray* (*Homoptera*: *Coccccoidea, Diaspidinae*) in Britain.** Entomologists' Monthly Magazine. 93(1121): 246-251. 18 refs.
Includes diagnoses, life histories, and drawings of *Carulaspis juniperi* and *C. minima*, the former found on *Chamaecyparis lawsoniana* and *C. nootkatensis*, *Cupressocyparis leylandii*, *Cupressus* spp., *Juniperus communis* var. *hibernica* (but not on indigenous *J. communis*), *J. sinensis* and *J. virginiana*, *Libocedrus decurrens*, *Sequoia gigantea*, and *Thuja occidentalis*. *C. minima* has been found only at Kew Gardens (on *J. virginiana*, *T. occidentalis*, and *C. lawsoniana*). The material examined yielded no hymenopterous parasites.

377. Boyce, J.S. 1962. **Greenhouse inoculations of coniferous seedlings with *Fomes annosus*.** Phytopathology. 52(1): 4.
When seed of *Pinus taeda*, *P. palustris*, *P. echinata*, *P. elliottii*, and *P. strobus* was sown over infected pine roots buried 2-3 inches in the soil, infection was confirmed within a year only on the roots of two dying *P. echinata* seedlings and of one apparently healthy *P. palustris*. When 1- or 2-year-old seedlings of *P. taeda*, *P. strobus*, and *Juniperus virginiana* were planted in pots containing infected root pieces, infection occurred in all species within a year—mostly in roots 1-2 mm thick. In some inoculum pieces, *F. annosus* was still alive after a year in the soil.

378. Brener, W.D.; Setliff, E.C.; Norgren, R.L. 1974. ***Sclerophoma pythiophila* associated with a tip dieback of juniper in Wisconsin.** Plant Disease Reporter. 58(7): 653-657. 21 refs.
Reports surveys made in nurseries in 1972 and 1973 to determine the prevalence of this disease. In 1973, 45 out of the 53 nurseries had infected stock. The fungus was found on various selections of *Juniperus chinensis*, *J. glauca*, *J. horizontalis*, *J. sabina*, and *J. virginiana*. This is the first report of the fungus on *Juniperus* in North America. It is believed to be a weak pathogen, and winter injury may predispose branches to infection. Microscopical examination of the pycnidia is necessary to distinguish this disease from juniper blight caused by *Phomopsis juniperovora*.

379. Caveness, F.E. 1957. **Root-lesion nematode recovered from eastern redcedar at Halsey, Nebraska.** Plant Disease Reporter. 41: 1058.
One- and two-year-old seedlings from the Bessey Nursery at Halsey, Nebraska, had numerous root lesions caused by *Pratylenchus penetrans*. Infected 2-year-old seedlings were 6-8 cm in height, while unaffected seedlings were 31-37 cm.

380. Clakins, L.A. 1948. **DDT in juniper mealybug control.** Journal of the Kansas Entomological Society.19(2): 60-62.
The juniper mealybug (*Pseudococcus juniperi*) can be eradicated from heavily infested trees of the redcedar (*Juniperus virginiana*) varieties by thoroughly spraying the trunk and foliage with a mixture consisting of 4 ounces of 50 percent DDT wettable powder plus 2 teaspoons of NNOR (a commercial product containing rotenone) to 1 gallon of water. For protective spraying, 2 ounces of the 50 percent DDT wettable powder can be used to the same amounts of NNOR and water.

381. Davis, T.C.; Kelley, W.D.; Coggans, J.F. 1972. ***Curvularia intermedius* (sic) associated with seedling tip blight of Arizona cypress and eastern redcedar.** Plant Disease Reporter. 56(2): 192. 2 refs.
Reports a recurrence at Auburn Forest Nursery during 1970 of attack on *Cupressus arizonica* by *C. intermedia* (previously recorded in 1966), together with a similar but less severe attack on *Juniperus virginiana.*

382. Davis, W.C.; Wright, E.; Hartley, C. 1942. **Diseases of forest-tree nursery stock.** Civ. Conserv. Corps For. Pub. 9. Washington, DC: U.S. Federal Security Agency: 58-61.

383. Dean, G.A. 1940. **Report of the State Entomologist. Some insects causing injury to shade trees in 1939.** Biennial Report of the Kansas Horticultural Society. 45: 169-172.
Three sprayings with 1 pint of nicotine sulphate, 2 quarts of winter or summer spray oil, and 100 gallons of water, applied about 31 May, 1 July, and 14 August, gave excellent control of *Cryptaspidiotus shasta* Coleman on *Juniperus virginiana* and did not injure the trees; where infestation was severe, a fourth spraying was made in mid-September. Satisfactory control of *Fascista* (*Gelechia*) *cercerisella* Chamb. on *Cercis canadensis* was obtained with sprays of 3 pounds of lead arsenate and 2 quarts of summer oil in 100 gallons of water, applied in April and May. Good control of *Melasoma lineatopunctata* Forst. (*Lina scripta* F.) on willows and poplars was obtained with a spray of 4 pounds of lead arsenate and 2 quarts of summer oil per 100 gallons of water. Notes are included on the biology of these insects.

384. Dean, G.A. 1942. **Control of three red cedar scales.** Kansas Horticultural Society. 6: 80-82.

Describes life histories and controls for three scale insects: redcedar scale, *Cryptaspidiotus shasta*; European fruit lecanium, *Lecanium corni*; and redcedar mealy bug, *Pseudococcus juniperi*.

385. Doggett, C.A.; Hawley, V.; Norris, W. 1980. **Cricket damage to redcedar seedlings.** Tree Planters Notes. 31(3): 18. 1 ref.

Mortality of 1+0 *Juniperus virginiana* seedlings in a nursery in North Carolina in 1979 was confirmed as due to girdling by crickets (*Gryllus assimilis*) by experimental testing in cages containing crickets and seedlings. Damage was easily controlled by insecticide application.

386. Dominik, J. 1969. **Further results of studies on the possibility of damage to the wood of some tree species by *Hylotrupes bajulus*.** Sylwan. 13(8): 39-42. 6 refs. Polish.

Experiments showed that wood of *Thuja occidentalis*, *Chamaecyparis lawsoniana*, *C. obtusa*, *C. pisifera*, *Pinus strobus*, *P. cembra*, and *Juniperus communis* was not resistant to attack by *H. bajulus*, and suffered damage similar to that of *P. sylvestris*. However, wood of *Cryptomeria japonica* and *Juniperus virginiana* caused high mortality of *H. bajulus* larvae.

387. Dwyer, W.W., Jr. 1951. **Fomes annosus on eastern redcedar in two Piedmont forests.** Journal of Forestry. 49(4): 259-262. 6 refs.

Examination of over 10,300 cedars (*Juniperus virginiana*) in the Duke and Calhoun Forests showed *Fomes annosus* to be a common and serious pathogen on this species in these areas. The average diameter for all trees affected was 4 inches. Trees below 1 inch in diameter largely escaped lethal attack. The cedar was attacked primarily in pine forest types but also to varying degrees in hardwood forests. There may be a relation between this distribution and the fact that *F. annosus* occurred commonly on dead pine roots and stumps; also between *F. annosus* attack and the greater erosion in pine than in hardwood forests. More diseased trees were found on eroded and gullied pine slopes than in any other location. Certain soils derived from basic rocks seemed to have a lower incidence of *F. annosus* than soils from acid rocks. The fungus fruited on 15 percent of the cedars found to be attacked at Union. Root-to-root transmission and conidial sporulation on litter are other possible means of spread. Only sapwood of cedar is invaded by the fungus; heartwood contains a principle, presumably associated with cedarwood oil, that is toxic to the fungus. Redcedar approaching post and pole size in the Piedmont region, as exemplified by the two areas studied, can be expected to sustain losses exceeding 10 percent of the trees.

388. Ellis, J.B.; Everhart, B.M. 1887. **Additions to *Cercospora*, *Gloeosporium*, and *Cylindrosporium*.** Journal of Mycology. 3: 13-22.

389. Graves, A.A.; Witcher, W. 1971. **Monochaetia canker of Arizona cypress and redcedar in South Carolina.** Plant Disease Reporter. 55(9): 810-813. 20 refs.

Conidial morphology indicates that the canker disease of *Cupressus arizonica* and *C. glabra* is caused by *Monochaetia unicornis*. In inoculation experiments, conidial suspensions of *M. unicornis* caused infections in *C. arizonica*, *C. glabra*, and *Juniperus virginiana* when applied to artificial wounds, but infected the cypresses only when applied to unwounded plants. *M. unicornis* was found on *C. arizonica* and *C. glabra* throughout much of South Carolina, but not on *J. virginiana*.

390. Greene, H.C. 1942. **Notes on Wisconsin parasitic fungi. II.** Transactions of the Wisconsin Academy of Science, Arts and Letters. 34: 83-98.

Among the fungi recorded are *Microsphaera alni* var. *extensa* and *Phyllactinia corylea* on *Quercus rubra*, *Gloeosporium septorioides* on *Quercus ellipsoidalis*, *Uncinula salicis* on *Salix rostrata*, *Septoria salicina* on *Salix fragilis*, *Dothidella betulina* on *Betula pumila* var. *glandulifera*, *Phomopsis juniperovera*, and *Pestalotia funerea* on *Juniperus virginiana* and *Septoria populi* on *Populus nigra*.

391. Gremmen, J. 1963. **Conifer inhabiting fungi. II. *Chloroscypha seaveri* and *Fabrella tsugae* in the Netherlands.** Weinheim, Germany: Nova Hedwigia. 6(1/2): 21-27. 9 refs.

Covers *C. seaveri* on *Thuja plicata*, *C. sabinae* on *Juniperus virginiana*, *C. cryptomeriae* on *Cryptomeria japonica*, and *F. tsugae* on *Tsuga canadensis*. Other discomycetes from the same hosts are reviewed.

392. Gunkel, W. 1963. **(I) *Cupressobium juniperinum*, a pest of *Thuja occidentalis*. Its morphology and biology. (II) Natural enemies and population fluctuations of *C. juniperinum*.** Zeitschrift fuer Angewandte Zoogie. 50(1; 3): 1-48; 329-341. 41 refs. German.

Reports results of a study of *C. juniperinum* on *T. occidentalis* in northwest Germany, where it caused discoloration and dieback of branchlets. It was successfully transferred to *T. plicata*, *Juniperus virginiana*, and *Chamaecyparis lawsoniana*, but not to *J. communis*. Predators, parasites, and a fungus disease are discussed. Population peaks occurred in May and in October-November.

393. Haseman, L.; McLane, S.R. 1940. **The history and biology of the Juniper midge (*Contarinia juniperina* Felt).** Annales of the Entomological Society of America. 33: 432-433, 612-614.

Dead tip growth on *Juniperus virginiana* caused by *Contarinia juniperina* Felt was first observed in Missouri in the late autumn of 1936 and became more severe in 1937 and 1938. The midge has one generation a year and overwinters in the larval stage in the top 3 inches of litter and soil under the trees. Pupation occurs in spring and the emergence of adults begins at the end of April. Mating, oviposition, and death usually occur within a few days of emergence. Eggs are laid under the base of the needles of new growth near the tip of the twigs and hatch in about a week. The larvae bore under the base of the needles and make a cavity in the soft twig; they do not become fully fed until October or November, when they drop to the ground, though a few mature live larvae occur in the twigs throughout the winter and even in spring. The injury appears in early summer as a watery blister, but by late summer or early autumn many of the twigs are cut and the tips begin to dry and bleach. A severely infested tree turns brown during late autumn, especially on the south exposure, and most of the brown tips break off during the winter. After 2 or 3 years of severe injury, most of the fine growth is removed from the trees. *C. juniperina* appears to be confined to junipers. In Missouri it attacks *J. virginiana* and *J. scopulorum* the most severely and other species to a lesser extent, but has not been found on the upright or pfitzer varieties of *J. chinensis*. It is widely distributed in Missouri; has also been observed in Kansas, Nebraska, and Kentucky; and probably occurs in other states. It appears to be unaffected by normal winter cold or prolonged high summer temperatures, but infestation is reduced by prolonged cold rains when the adults are emerging and ovipositing. The only effective natural enemy is *Platygaster pini* Fonts, which parasitizes the larvae and destroyed large numbers in 1938 and 1939.

394. Hess, C.E.; Welch, D.S. 1954. ***Chalaropsis thielavioides* Peyronel found on evergreen grafting stock.** Plant Disease Reporter. 38(6): 415-416.

395. Hildebrand, D.M.; Dinkel, G.B. 1988. **Basamid and solar heating effective for control of plant-parasitic nematodes at Bessey Nursery, Nebraska.** Gen. Tech. Rep. RM-167. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 139-144. 11 refs.

Fumigation with Dowfume MC-33 (methyl bromide/chloropicrin), granular Basamid (dazomet) sealed by water spray or polyethylene sheeting, and solar heating with polyethylene sheeting were compared for control of *Fusarium* spp., plant-parasitic nematodes and weeds in an eastern redcedar (*Juniperus virginiana*) nursery. All treatments controlled nematodes. Solar heating and polyethylene-sealed dazomet were less effective than methyl bromide for control of *Fusarium* spp. Water-sealed dazomet did not control *Fusarium* spp. Only methyl bromide and solar heating controlled weeds. Seedling survival following autumn sowing was poor because of frost injury.

396. Hodges, C.S. 1961. **New hosts for *Cercospora thujina* Plakidas.** Plant Disease Reporter. 45(9): 745. 2 refs.

397. Hodges, C.S. 1962. **Comparison of four similar fungi from *Juniperus* and related conifers.** Mycologia. 54(1): 62-69. 15 refs.

A fungus causing serious needle blight of *Juniperus virginiana* in the eastern U.S.A., previously thought to be *Exosporium glomerulosum,* has been identified as *Cercospora sequoiae* var. *juniperi.* It also occurred on *Cupressus arizonica.* Taxonomy, host range, and distribution of this and of *C. sequoiae* (affecting *Thuja orientalis*, *Sequoia gigantea*, *S. sempervirens*, *Cupressus* spp., and *Chamaecyparis pisifera*), *Stigmina juniperina* (affecting *Juniperus* spp.), and *S.* (*Exosporium*) *glomerulosa* (affecting *J. communis*) are discussed.

398. Hodges, C.S.; Kuhlman, E.G. 1974. **Spread of *Fomes annosus* in roots of redcedar and loblolly pine.** Plant Disease Reporter. 58(3): 282-284. 14 refs.

In separate trials in 1970 and 1971, roots of *Juniperus virginiana* and *Pinus taeda* in a mixed stand in the Piedmont of North Carolina were exposed and inoculated with *F. annosus* (either by drilling or by contact), and the soil was then replaced and left for 6 months. There was substantial variation between the two trials in both the number of trees infected and the rate of spread of infection, and the results gave no satisfactory explanation of the previously observed difference in mortality between the two tree species.

399. Hodges, C.S.; May, L.C. 1972. **A root disease of pine, araucaria and eucalyptus in Brazil caused by a new species of *Cylindrocladium*.** Phytopathology. 62(8): 898-901. 9 refs.

Describes *C. clavatum*, found in four states in S. Brazil, where it attacks trees up to 15 years old. Pathogenicity studies in Brazil showed that seedlings of all seven species of *Pinus* commonly planted there were killed in 2 weeks. In the U.S.A., *Liriodendron tulipifera*, *Pinus taeda*, and *Araucaria angustifolia* seedlings were attacked and killed, whereas *Juniperus virginiana* was not visibly affected; *C. scoparium* was less pathogenic than *C. clavatum* on *L. tulipifera* and did not attack the other species. The symptoms and spread patterns are very similar to those of *Fomes annosus*.

400. Hostetter, D.L.; Ignoffo, C.M.; Kearby, W.H. 1975. **Persistence of formulations of *Bacillus thuringiensis* spores and crystals on eastern redcedar foliage in Missouri.** Journal of the Kansas Entomological Society. 48(2): 189-193. 5 refs.

The persistence of sprays of two preparations containing spores of *Bacillus thuringiensis* (Thuricide and Dipel) on eastern redcedar (*Juniperus virginiana*), an ornamental tree grown in residential areas of midwestern parts of the United States, was determined in field studies in Missouri. Determination of the number of viable spores on foliage samples collected immediately before and after treatment and 1, 3, 7, 14, and 28 days after treatment and determination of the insecticidal activity of the deposits (by bioassay with larvae of *Trichoplusia ni* (Hb.) showed that the addition of both carbon and molasses to the Thuricide spray significantly protected spore viability and insecticidal activity. The insecticidal activity of Dipel and a mixture of Thuricide and carbon was still detectable 14 days after treatment.

401. Howell, F.C.; Stambaugh, W.J. 1972. **Rates of pathogenic and saprophytic development of *Fomes annosus* in roots of dominant and suppressed eastern redcedar.** Plant Disease Reporter. 56(11): 987-990.

F. annosus inoculations were made by placing inoculum between the two parts of severed roots of dominant and suppressed *Juniperus virginiana* in a pure stand and in one mixed with loblolly pine (*Pinus taeda*). On both sites, proximal movement of the fungus, from the point of severance (and inoculation), was greater in roots of dominant trees (6.6 cm/month) than in roots of suppressed ones (4.2 cm/month). In both classes, root penetration proximally (5.2 cm/month) exceeded distal spread (3 cm/month). The results, which show a direct relationship between tree vigor and *F. annosus* susceptibility, differ from other results suggesting that other factors must be considered.

402. Kelman, A.; Hodges, C.S.; Garriss, H.R. 1960. **Needle blight of redcedar, *Juniperus virginiana* L.** Plant Disease Reporter. 44(7): 527-531. 22 refs.

A needle blight of *J. virginiana* in North Carolina, South Carolina, and Virginia is characterized by the ashbrown color of affected needles, severe defoliation of lower branches, and an unusual development of juvenile needles. The fungus *Exosporium glomerulosum* is associated with the disease, which was successfully controlled in a Christmas-tree plantation by spraying with Ortho Phaltan 50 W (N-trichloromethylthiophthalimide) at concentrations of 2 lb/100 gal water at 10- to 14-day intervals and after heavy rain, from the end of May to mid-September.

403. Kim, K.C.; Park, J.D. 1984. **Studies on ecology and injury characteristics of Japanese Juniperus bark borer, *Semanotus bifasciatus* Motschulsky.** Korean Journal of Plant Protection. 23(2): 109-115. 18 refs. Korean.

The biology, food-plant range, and damage caused by *Semanotus bifasciatus*, which recently caused severe damage to Juniperaceae in Chonnam Province, Korea Republic, were investigated. The most severe damage occurred on *Juniperus chinensis* and *J. chinensis* var. *kaizuka*, which was studied for the first time; *Thuja occidentalis*, *Biota orientalis* var. *nepalensis* (*T. orientalis* var. *nepalensis*), *J. virginiana*, *Chamaecyparis obtusa* and *Thujopsis dolabrata* were also attacked in order of descending intensity. Infestation was 16 percent in Kwangju, 6 percent in Hwasoon, and 4 percent in Damyang. Most (62 percent) of the larvae after penetrating the trunk bored downwards, 22 percent bored upwards, and 16 percent bored horizontally; the damage was greatest in trees or shrubs with stems 30-40 mm in diameter at breast height. The species was univoltine, with an adult population peak from late March to late April and a daily emergence peak at 1,300-1,500 hours according to temperature. The egg stage lasted 15.8-19.7 days, the larval stage lasted 112-126 days, the pupal stage lasted 15-21 days, and the adult life span was 19 days for females and 16 days for males.

404. Kudon, L.H.; Berisford, C.W. 1980. **Influence of brood hosts on host preferences of bark beetle parasites.** Nature. 283(5744): 288-290. 18 refs.

In the U.S.A., the forest pest *Dendroctonus frontalis* Zimm. is attacked by several species of Hymenopterous parasites, the most common of which also parasitize other bark beetles, including *Ips grandicollis* (Eichh.), *I. avulsus* (Eichh.), *I. calligraphus* (Germ.), *I. pini* (Say), and *Phloeosinus dentatus* (Say). The increasing importance of pest management has focused attention on the role of natural enemies. However, the dynamics of populations of parasites of scolytids is not generally known beyond estimates of mortality caused by the parasites. The hymenopteran-parasite guild of *D. frontalis* may kill up to 30 percent of a given brood. Since *D. frontalis* is cyclical in most areas, with epidemics being followed by very low population densities, other scolytid hosts probably act as reservoirs for certain species of these parasites. Conversely, during *D. frontalis* epidemics, other beetles, such as *I. grandicollis* and *P. dentatus*, may compete as alternative hosts. Information on parasite preferences for *D. frontalis* and other associated bark beetles is necessary to understand the interactions of this host-parasite complex. The authors report the results of a field study carried out in Georgia to determine whether several known parasites of *D. frontalis* exhibit any preferences between *D. frontalis, I. grandicollis,* and *P. dentatus*. Trap bolts for *D. frontalis* and *I. grandicollis* were cut from loblolly pine (*Pinus taeda*) and those for *Phloeosinus dentatus* were cut from eastern redcedar (*Juniperus virginiana*). The parasites found included *Heydenia unica* Cook & Davis, *Roptrocerus xylophagorum* (Ratz.), *Coeloides pissodis* (Ashm.), *Dendrosoter sulcatus* Mues., *Dinotiscus dendroctoni* (Ashm.) (*Cecidostiba dendroctoni*), *Spathius pallidus* Ashm., and *S. impus* Matthews. The results showed that parasites that were not host-specific tended to attack the host on which they were reared but still retained the ability to use other hosts if the preferred host was not available. This behavior was advantageous to the parasites in that they could use all the potential hosts more efficiently by switching to relatively more abundant alternative hosts when populations of preferred hosts decreased. This may also have increased prey diversity. It was thought that the switching mechanism would be particularly helpful to species with relatively low host-finding efficiencies. The most common parasite in the study, *R. xylophagorum*, was unable to locate potential hosts present in low numbers in proportion to the number located when hosts were abundant, but its ability to attack a variety of hosts apparently allowed it to maintain substantial populations. The impact of the parasite guild of *Dendroctonus frontalis* may have been affected by the numbers of alternative hosts. Parasites may have switched from other hosts during expansions of *D. frontalis* populations if *D. frontalis* became much more abundant than the 'preferred' host. The host-selection mechanism therefore served to concentrate the parasites on the epidemic host after a period of time. As the epidemic populations declined, the parasites could accept other hosts as they became relatively abundant, thereby reducing the impact of parasites on declining host populations.

405. Lee, J.J.; Weber, D.E. 1979. **The effect of simulated acid rain on seedling emergence and growth of eleven woody species.** Forest Science. 25(3): 393-398. 21 refs.

Seeds of 11 woody species were exposed to 2.3 cm/wk of simulated sulfuric acid rain at pH values of 3.0, 3.5, or 4.0, or to a simulated control rain at approximately pH 5.6. All treatments also contained a neutral mixture of cations and anions. Seeds or seedlings were subject to ambient conditions, except for precipitation. Ambient rainfall was excluded by a partial covering, which allowed some dry deposition. Seeds were planted in winter 1977; seedlings were harvested the following summer. The dry weights of the top and roots of each seedling were recorded. Although eight species were affected by simulated acid rain, the direction and magnitude of effects varied with species and with treatment. Seedling emergence was stimulated by at least one acid treatment for four species and inhibited for one species. Top growth was stimulated for at least one acid treatment for four species, while root growth was inhibited for one species. Except for one species, whose emergence rate and top growth were both affected, effects were confined to one measured parameter.

406. McDunnough, J. 1942. **Notes on the early stages of two *Eupithecia* species (*Lepidoptera*).** Canadian Entomologist. 74: 202-203.

Brief notes are given on the life history of *Eupithecia filmata* Pears. taken from spruce, and on larval differences in what are considered by the author to be two closely related species of *Eupithecia: E. gibsonata* Tayl. (*chagnoni Swett*), which feeds on cedar (*Thuja occidentalis*); and *E. arceuthata* Fr. which feeds on juniper (*Juniperus virginiana*).

407. McFeeley, J.C.; Roberts, E.P. 1974. ***Aureolaria grandiflora* var. *serrata*, parasite of *Juniperus virginiana*.** Plant Disease Reporter. 58(9): 773. 3 refs.

During the summer of 1973, *A. grandiflora* var. *serrata* was observed growing in parasitic relationship with *Quercus stellata* (post oak), *Q. marilandica* (blackjack oak), and *Juniperus virginiana* (eastern redcedar) in Lamar County, Texas; this is the first record of the parasite on eastern redcedar.

408. Mead, F.W., ed. 1989. **Bureau of nematology.** Triology Tech. Rep. Gainesville, FL: Florida Department of Agriculture Conservation Service, Division of Plant Industries. 28(10): 5-6.

New host records according to Department of Plant Industry files included *Criconemoides citri* on *Juniperus virginiana*.

409. Miller, J.K. 1943. ***Fomes annosus* and redcedar.** Journal of Forestry. 41: 37-40.

Redcedar (*Juniperus virginiana*) in the southeastern United States may be attacked by *Fomes annosus*, which kills trees of all ages and causes a pocket rot of butt logs. This tree is particularly susceptible to attack by the fungus when overtopped by competing trees, but *F. annosus* will cause little damage if cedars are grown on suitable sites and exposed to full sunlight. Silvicultural practices that reduce or eliminate competition for light should greatly reduce losses from the disease.

410. Ostrofsky, A.; Ostrofsky, W.D. 1984. ***Kabatina juniperi* associated with branch tip dieback of eastern redcedar in Maine.** Plant Disease Reporter. 68(4): 351.

The pathogen is newly reported from Maine, on naturally occurring *Juniperus virginiana*.

411. Ostrofsky, A.; Peterson, G.W. 1977. **Occurrence of *Kabatina juniperi* on *Juniperus virginiana* in eastern Nebraska.** Plant Disease Reporter. 61(6): 512-513. 9 refs.

In spring 1976, *K. juniperi* was isolated from branches of *J. virginiana* with tip dieback. This is the first report of *Kabatina* spp. in the U.S.A.

412. Ostrofsky, A.; Peterson, G.W. 1979. **Infection of *Juniperus virginiana* by *Kabatina juniperi*.** Phytopathology. 69(9): 1040-1041.

Symptoms are described for branch tip dieback caused by *K. juniperi*, and some cultural characteristics of the organism (isolated from several locations in Nebraska) are given. Wounding of healthy foliage before inoculation was necessary for successful infection as the fungus entered through the wound.

413. Ostrofsky, A.; Peterson, G.W. 1981. **Etiologic and cultural studies of *Kabatina juniperi*.** Plant Disease Reporter. 65(11): 908-910. 8 refs.

The fungus caused a branch tip dieback of *Juniperus virginiana* and *J. scopulorum* in eastern Nebraska. Infected tips became discolored in early spring; acervuli were present in February, abundant and erumpent in April and May, and were present in decreasing numbers until October. Cultural studies are described. Spore germination was maximum at 24° C and pH 6; light had no effect. Wounding was necessary for infection to occur in glasshouse tests. Seedlings became infected when incubated at 100 percent relative humidity, 24° C for 24 hours or at 16°-28° C for 5 days. Scanning electron microscopy showed that the fungus entered foliage through wounds.

414. Peterson, G.W. 1964. **Heat treatment of nematode-infested eastern redcedar roots.** Plant Disease Reporter. 48(11): 862. 1 ref.

Briefly describes successful tests made to determine whether hot-water treatment could be used to kill root-lesion nematodes (*Pratylenchus penetrans*) in *Juniperus virginiana*, as had been done with other species. Survival counts were made 4 months later on sample transplants, and immersion in hot water at 52° C for 2 minutes was found to have been the safest and most effective combination. Hot water was more injurious to roots of healthy plants than to roots of nematode-infected plants.

415. Peterson, G.W. 1987. **Resistance to *Kabatina juniperi* within *Juniperus virginiana* and *Juniperus scopulorum* progenies.** Phytopathology. 77(12): 1726-1728.

416. Platt, W.D.; Cowling, E.B.; Hodges, C.S., Jr. 1965. **Resistance of coniferous root wood and stem wood to decay by *Fomes annosus*.** Phytopathology. 55(2): 130-131.

In test with 16 tissue inoculata isolated from 8 tree species, the isolates caused no more decay in their associated species than in others. Resistance was greatest in *Juniperus virginiana*; intermediate in *Pinus resinosa*, *P. virginiana*, and *P. palustris*; and lowest in *P. echinata*, *P. elliottii* var. *elliottii*, *P. taeda*, and *P. strobus*. Stem wood was more resistant than root wood. In tests with tissue and monobasidiospore isolates on the stem sapwood of two species, the former caused more decay in *P. strobus*. *Liquidambar styraciflua* was highly resistant to both.

417. Ponnappa, K.M. 1975. ***Parasympodiella* gen. nov.** Transactions of the British Mycology Society. 64(2): 344-345. 3 refs.

Describes the genus and *P. laxa* comb. nov. (formerly *Sympodiella laxa*), which has been recovered from leaves of *Eucalyptus paniculata* in Brazil, and shoots of *Juniperus virginiana* in North Carolina.

418. Prince, A.E. 1946. **The biology of *Gymnosporangium nidus-avis* Thaxter.** Farlowia. 2(4): 475-525.

Includes taxonomy (nidus-avis = juvenescens); geographical distribution; life history of the spermogonial, aecial, and telial phases; the pomaceous hosts and their relative susceptibility to *G. nidus-avis*; the average degree of susceptibility of the three telial hosts (*Juniperus virginiana*, *J. scopulorum*, and *J. horizontalis*); a list of immune species; and economic importance and control.

419. Rowan, S.J. 1960. **Susceptibility of twenty-three tree species to black root rot.** Phytopathology. 50(9): 653.

In tests with seedlings pot-grown in soil heavily infected with *Sclerotium bataticola* and *Fusarium* spp. at soil temperatures of 85°-90° F, 6 coniferous species died of rot and/or soil temperature, and 11 Pinus species were rated susceptible. Of the rest, *P. glabra* and *Juniperus virginiana* were highly resistant, and *Cupressus arizonica*, *Taxodium distichum*, *Chamaecyparis thyoides* and *Liquidambar styraciflua* were totally resistant.

420. Schuder, D.L. 1963. **A juniper tip midge, *Oligotrophus* sp.** Entomological Society of America. 18: 60.

Describes the biology, bionomics (four broods in one summer), etc., of this pest, which causes serious damage to *Juniperus virginiana* var. *cannaerti* in Indiana, but is also reported from other regions and other species. In a trial of 11 insecticidal foliage sprays and 3 granular systemics worked into the soil at 1 oz active principle/tree at 5 dates from April to August, one application of the systemic Cygon (dimethoate) gave almost complete control.

421. Shokova, R.J. 1983. **Susceptibility of introduced woody plants to injury by sulphur dioxide.** Byulleten Glavnogo Botanicheskii Sada. 129: 55-57. 7 refs. Russian.

Shoots of 10 *Betula* spp. and 8 *Juniperus* spp. were exposed to 22 or 44 mg/m^3 SO_2 for 45 to 60 minutes, and leaf tissue injury was estimated 24, 48, and 72 hours after exposure. The severity of injury (chlorosis and necrosis) was affected mainly by plant origin (sp.), leaf age, and exposure duration. *B. lenta*, *B. subcordata*, *J. virginiana,* and *J. sabina* were the most resistant spp., and *B. fontinalis*, *B. papyrifera*, *J. sibirica,* and *J. communis* were among the least resistant.

422. Smith, B.C.; Starratt, A.N.; Bodnaryk, R.P. 1973. **Oviposition responses of *Coleomegilla maculata lengi* (*Coleoptera: Coccinellidae*) to the wood and extracts of *Juniperus virginiana* and to various chemicals.** Entomological Society of America. 66(2): 452-456. 14 refs.

Methods are described to determine the effects of different substances on the oviposition behavior of *Ceratomegilla* (*Coleomegilla maculata lengi* Timb.). The preparation, assay, and chemistry of various materials from the wood of *Juniperus virginiana* are reported. Two fractions (A and B) acted as oviposition stimulants, whereas surfaces treated with another fraction (C) were avoided. Fractions A and B were polyphenols of high-molecular weight and showed general similarities to phlobaphenes from other sources. Fraction A caused apterae of *Acyrthosiphon pisum* (Harris) to form aggregates on treated filter paper. o-Coumaric, salicylic and protocatechuic acids, fluorescein, tannin and widdrol (2,3,4,4a,5,6,7,8-octahydro-1,1,4a alpha, 7 beta - tetramethyl-1H-benzocyclohepten-7-ol) at concentrations of 2.0-10.0 mg/50 cm^2 influenced *C. m. lengi* to lay eggs on or near treated surfaces. Contact with fluorescein (2.0 mg/50 cm^2) increased the proportion of ovipositing females.

423. Smith, C.O. 1939. **Susceptibility of species of Cupressaceae to crown gall as determined by artificial inoculation.** Journal of Agricultural Research. 59: 919-925.

Cultures of *Bacterium tumefaciens* isolated from *Prunus persica* produced galls on *Cupressus*, *Juniperus*, and *Thuja*. Cultures from *Salix* sp. produced galls on the same genera and on *Thujopsis*. Those from *Libocedrus decurrens* gave negative results on all species except *L. decurrens*. Sixteen species of *Cupressus* proved susceptible to inoculation; on *C. glabra* and *C. montana* occasional knob-like growths, but no typical galls, were formed. One species, *C. guadalupensis* was apparently resistant. Galls were produced on *Juniperus virginiana*, *J. phoenicea*, and on one plant of *J. procera*, but only small knob-like growths were produced on *J. hibernica* and *J. cedrus*. *Libocedrus decurrens* and the three species of *Thuja* tested proved susceptible. The original plant of *Thujopsis dolabrata* was negative in response, but rooted cuttings from it developed typical rough galls. *Chamaecyparis lawsoniana* developed non-typical overgrowths. Control punctures on the various hosts healed over in a normal manner. The results are not conclusive because of the differences in the environmental conditions of the plants tested and the small number of inoculations on some of the species.

424. Smith, I.M. 1978. **Two new species of *Trisetacus* (*Prostigmata: Eriophyoidea*) from berries of juniper in North America.** Canadian Entomologist. 110(11): 1157-1160. 10 refs.

Trisetacus neoquadrisetus sp. n. is described from adult females found infesting berries of Rocky Mountain juniper (*Juniperus scopulorum*) in southern British Columbia in May 1976. It is suggested that specimens of *T. quadrisetus* (Thos.) that have been reported from the same food-plant in British Columbia in the past were in fact the new species. *T. batonrougei* sp. n. is described from adult females infesting berries of eastern redcedar (*J. virginiana*) in Ontario in September 1976.

425. Stevenson, J.A. 1940. **A *Meliola* on a new host genus.** Plant Disease Reporter. 24: 325-326.

A fungus agreeing in morphology with *Meliola pinicola* Dearness, previously described from *Pinus echinata* in North Carolina, has been found on *Juniperus virginiana* in the same state. This is the first record of *Juniperus* as a host for the genus *Meliola*. The fungus formed colonies not over 1-2 mm in diameter, scattered mostly at or near the base of the needle.

426. Tisserat, N.A.; Nus, A.; Barnes, L.W. 1991. **A canker disease of the Cupressaceae in Kansas and Texas caused by *Seiridium unicorne*.** Plant Disease Reporter. 75(2): 138-140. 13 refs.

S. unicorne caused cankers on oriental arborvitae (*Thuja orientalis*) and eastern redcedar (*Juniperus virginiana*) in Kansas and Texas and on Italian cypress (*Cupressus sempervirens*), Arizona cypress (*C. arizonica*), and Leyland cypress (*Cupressocyparis leylandii*) in Texas. The fungus was also associated with small, annual cankers on bald-cypress (*Taxodium distichum*) in Kansas landscape plantings. Cankers on Rocky Mountain (*J. scopulorum*) and Chinese (*J. chinensis*) junipers and on northern white-cedar (*Thuja occidentalis*) developed 1 month after inoculation in greenhouse or field studies. No evidence of host specificity in fungal isolates was found.

427. Tisserat, N.A.; Rossman, A.Y.; Nus, A. 1988. **A canker disease of Rocky Mountain juniper caused by *Botryosphaeria stevensii*.** Plant Disease Reporter. 72(8): 699-701. 17 refs.

B. stevensii caused cankering of Rocky Mountain juniper (*Juniperus scopulorum*) in windbreak and ornamental plantings in Kansas, U.S.A. Multiple, coalescing cankers resulted in branch dieback and sometimes tree mortality. The fungus was also pathogenic to and caused canker formation on eastern redcedar (*J. virginiana*) and Chinese juniper (*J. chinensis*) in greenhouse and field inoculation studies. Apple and juniper isolates were host-specific.

428. USDA Forest Service. 1959. ***Exosporium glomerulosum* disease of *Juniperus virginiana*.** Res. Rep. SE-25. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 25-26.

Severe infections in North and South Carolina and Virginia have seriously damaged plantations, causing 10-15 percent mortality and rendering many plants unfit for sale as Christmas trees. Infection usually begins in the lower branches, progressing upwards and outwards; often only the needles on the tips of branches remain alive. There are indications that the blight can be controlled with bi-weekly applications of Phaltan (no details) at 2 lb/100 gal water.

429. Wheeler, A.G., Jr. 1984. ***Clastoptera arborina*: seasonal history and habits on ornamental juniper in Pennsylvania (*Homoptera:Cercopidae*).** Entomological Society of Washington. 86(4): 835-839. 9 refs.

The seasonal history and habits of *Clastoptera arborina* (which was often misidentified in the eastern U.S.A. as *C. juniperina*) were observed in south-eastern Pennsylvania on an ornamental hedge of *Juniperus chinensis* cv. *Hetzii* in 1981-1982. The overwintered eggs hatched in mid-May, and adults began to appear in mid-July. Notes are given on food-plants and distribution records of *C. arborina* from New York, North Carolina, and Tennessee. The cercopid was found to develop larger populations on exotic ornamental junipers than on the indigenous species *J. virginiana*, but infestation did not appear to affect plant vigor despite the large numbers of spittle masses observed.

430. Wilford, B.H. 1940. **The seed-corn maggot, a pest of red cedar seedlings.** Journal of Forestry. 38: 658-659.

The maggots (*Hylemya cilicrura*) attack young redcedar (*Juniperus virginiana*) seedlings through the roots or the soft bark of the stem, eating the soft tissue beneath the bark. The first indication of attack is an unhealthy appearance of the seedlings followed by wilting and yellowing of the stems at and above ground line, and finally the shredded bark and injured roots indicate the damage done. If only lateral roots are attacked and conditions are favorable, adventitious roots may develop and the plant may recover. It is suggested that infestations may be prevented by using inorganic rather than organic fertilizers, applying them in the fall or after the seedlings are 1.5 to 2 inches above ground, and by delaying planting so that seedlings do not develop during the wet period. Satisfactory control may be obtained by spraying carbon disulphide emulsion (1 quart of 50 percent strength to 50 gallons of water) at the rate of 1 pint per square foot of soil surface.

431. Winter, T.G. 1989. **Cypress and juniper aphids.** Arboric. Res. Note 80. London, UK: Department of Environment. 3 p. 3 refs.

In 1988, *Cinara cupressi* (mainly on X *Cupressocyparis leylandii*, but also on *Chamaecyparis lawsoniana* and *Thuja occidentalis*) and *Cinara fresai* (on *Juniperus virginiana* and *J. chinensis*, but not *J. communis*) occurred widely in southern England causing damage to ornamentals. Symptoms, the pests, and control measures are described.

432. Witcher, W.; Baxter, L.W.; Marbut, S.A. 1973. **Benomyl promising chemical for leaf and stem diseases of redcedar and Arizona cypress.** Plant Disease Reporter. 57(4): 315-317.

Reports trials with seven different fungicides on 2-year-old Christmas trees of *Juniperus virginiana* and *Cupressus arizonica* that had been artificially inoculated (with or without wounding) with *Monochaetia unicornis*, *Phomopsis juniperovora*, or *Cercospora sequoiae* var. *juniperi* in South Carolina during 1970-1972. Spraying with benomyl (significantly better than the other fungicides) eight times during the 3-year study period gave good control of all three fungi on both tree species. Laboratory studies with pure cultures confirmed the results of the field trials.

433. Yamazaki, S. 1987. **Serious damage to mahogany by the shoot borer *Hypsipyla grandella* Zeller (*Lepidoptera, Pyralidae*).** Tropical Forestry. 8: 26-34. 5 refs. Japanese.

The characteristics and life cycle of the pest *H. grandella* are described. In an investigation in the Humboldt Experimental Forest (Peru), recent damage by this pest in September-October 1985 was greater in *Juniperus virginiana* than in *Swietenia* sp. while it was variable in *Cedrela brasiliensis*. The highest numbers of all developmental stages of the pest were found in March, but numbers were also high in November and April-May. The distribution of the pest showed a rapid spread between March and May. Methods of control using insecticides, biological control agents such as *Trichogramma* sp., *Bracon* sp. and *Beauveria* sp., and cultural control are discussed.

WEATHER-RELATED FACTORS

434. Albertson, F.W. 1940. **Studies of native redcedars in west central Kansas.** Transactions of the Kansas Academy of Sciences. 43: 85-95.

Severe drought, which began in 1933, caused heavy mortality to the native redcedar (*Juniperus virginiana*), which is nowhere common in the Great Plains Region, and, in the area studied, was found to be restricted to north-facing slopes of exposed limestone or protected river banks.

435. Albertson, F.W.; Weaver, J.E. 1945. **Injury and death or recovery of trees in prairie climate.** Ecological Monographs. 15(4): 393-433.

This study describes the effects of the greatest drought since meteorological records were kept, on forests and trees growing in a prairie climate. The area considered extends from Iowa to Colorado and from Oklahoma to Canada. Data are drawn from a wide range of sources; they include pre-drought surveys of trees and conditions for their growth in grassland, which give a necessary background for an understanding of their injury and death or recovery in different sites. The chief cause of injury was lack of sufficient available water, due to low precipitation and accentuated by one or more of several causes, such as competition for water by grasses, decreased rate of infiltration, and rapid run-off, drying up of streams and springs, and a rapid fall of the water table in ravines and lowland terraces. Other factors were low humidity, high evaporation, desiccating winds, and the inability of trees to accommodate their root systems to the rapidly changing environment. Unrestricted grazing was a common cause of excessive mortality in plantations and windbreaks. Experimental data on the harmful effects of competition with grass on both roots and shoots of trees are presented. Root distribution of the same tree species in different types of soil, including alluvial soil with a high water table, has been noted and the general relation between extent and distribution of roots in different sites and drought resistance is pointed out. Injury and death of woody plants from the effects of drought were often the results of continuous adverse conditions over a long period, but death of trees and shrubs on flood plains and terraces sometimes occurred in a relatively short time if the water table was lowered rapidly. Effects of early drought were wilting, discoloration, withering, or shedding of foliage. An early outward sign of repeated yearly drought among deciduous trees was great reduction in size and number of leaves and defoliation of the outer portions of the crown. Great injury was also often caused by partial or total and sometimes repeated defoliation by grasshoppers, webworms, and leaf-eating larvae of other insects; such attacks usually occurred during years of great drought. Exposure of branches with reduced foliage to high insolation, great heat, and low humidity was a common cause of injury. Desiccation resulted in the death of the smaller branches, and permitted the entrance of wood borers, other insect larvae, and fungi. Desiccation and wood borers caused the death of the branches to proceed rapidly downwards; often the entire tree succumbed. Effect of drought upon the radial growth of uninjured or least injured trees in western Kansas was ascertained. Trees that retained some life at the close of the drought usually remained alive unless infestation by wood borers was so complete or the trees so nearly dead that they were unable to resume growth. Recovery was shown principally by renewed growth locally within the crown. In dry sites, even after 3 or 4 years of good precipitation, leafy branches were sometimes few and foliage was sparse; but where drought had been less severe, the foliage of the renewed portions of the crown was unusually dense. Where moisture was plentiful, the dead branches in the tops of the crowns were often soon obscured by new ones. Sprouts developed from the bases of some trees and grew rapidly. Dead trees were partly replaced by seedlings, but only where the trees grew naturally. In this manner, redcedars (*Juniperus virginiana*) continued to replace their losses through the drought. Seedlings were not found in plantations, windbreaks, or hedgerows in mixed prairie. The report is illustrated by over 60 photographs.

436. Goebel, C.J.; Deitschman, G.H. 1967. **Ice storm damage to planted conifers in Iowa.** Journal of Forestry. 65(7): 496-497.

Study of climatological records suggests that damaging ice storms can be expected in Iowa at 7- to 10-year intervals. After the severe ice storm of February 16, 1961, a survey was made of (1) *Pinus strobus*, (2) *P. sylvestris*, (3) *Thuja occidentalis*, (4) *Pinus nigra*, (5) *Picea abies*, and (6) *Juniperus virginiana*, and their relative susceptibility. The survey indicated that: young trees less than 20 feet high did not sustain injury; (1) and (2) suffered greatest damage; (3) and (4) suffered less severely; and (5) and (6) were not affected at all.

437. Hinckley, T.M.; Dougherty, P.M.; Lassoie, J.P.; Roberts, J.E.; Teskey, R.O. 1979. **A severe drought: impact on tree growth, phenology, net photosynthetic rate and water relations.** American Midland Naturalist. 102(2): 307-316. 29 refs.

An unusually severe drought occurred in central Missouri during the summer of 1976. The drought resulted in an average soil water potential of -26.1 bars in the upper 45 cm of the soil profile in spite of the addition of 4.9 cm of irrigation water. Its effects on phenology, growth, physiological processes, and water relations of white oak (*Quercus alba*) and eight other species found in this oak-hickory forest were examined. The drought had a dramatic impact on base (presunrise) xylem pressure potential of white oak in both irrigated (-19.6 to -34.3 bars) and nonirrigated specimens (-27.8 to -45.2 bars). Growth was reduced, die-back increased, net photosynthetic rate was depressed to near the compensation point, and phenological patterns in the following year (1977) were altered. An estimation of the number of days on which stomata were closed for most of the photoperiod was compared to the number of days when mature leaves were present. The following ranking of species based on this index of stomatal control was possible (from most to least time spent with stomata closed): sunflower > flowering dogwood = black walnut > sugar maple > northern red oak > white oak = eastern redcedar = black oak. Various drought avoidance mechanisms are also presented and discussed in regard to these eight species. The long periods of low soil water potentials and base xylem pressure potentials experienced during the drought of 1976 did not prevent the recovery of the growth processes that autumn or the subsequent spring. All study species seemed well-adapted to survival and to continued functioning during this severe drought.

438. Holubcik, M. 1960. **Damage to trees by wind and snow on 8 and 9 January, 1959 in the Kysihybel Arboretum near Banska Stiavnica.** Vedecke Prace Vyskhumneho Ustavu Lesneho Hospodarstva vo Zvolene, Bansk. Stiav. 1: 97-106. Slovak.

The combination of wet snow, unfrozen ground, and a northerly wind (force 6) caused mostly selective damage, i.e., to individual trees with small crowns, or to suppressed trees, but also considerable damage to stands of *Thuja occidentalis*, *Juniperus virginiana,* and, in part, to *Pinus flexilis*. Younger stands of *Chainaecyparis lawsoniana*, *P. nigra*, *P. rigida,* and *P. nigra* var. *calabrica* also suffered badly. Other species, e.g., *Pinus peuce*, *Abies* spp., and *Picea* spp., proved resistant.

439. Inoue, Y.; Kakihara, M. 1958. **Studies on the snow-damaged forest in Kasuya University Forest.** Rep. 9. Kyushu University of Forestry: 1-27. Japanese.

Analyzes the damage done by an exceptional snowstorm (30 cm fall vs. the previous recorded maximum of only 8 cm) in February 1956. Damage on the south and east slopes was greater than elsewhere. Damage among Japanese cedar (*Cryptomeria japonica*) was greater on gentle than on steep slopes, and in 16-year stands it was greater on the lower slopes than on the upper. *C. japonica* and pencil cedar (*Juniperus virginiana*) were more heavily damaged than other species, with a higher incidence in the younger stands, but the thickest and tallest trees suffered most top-breakage. The height above ground of the point of breakage rose with age of tree. Damage increased with stand density, showing the need for suitable thinning. Volume and number of trees damaged are tabulated by species.

440. Maggrett, H.I. 1940. **The ability of certain common trees to withstand drought in southeastern South Dakota.** Proceedings of the South Dakota Academy of Science. 20: 84-90.

The percentage survival values of some common trees, as shown by a field survey extending from 1934 to 1939, were redcedar 97, Chinese elm 97, hackberry 96, ponderosa pine 92, honey locust 88, bur oak 85, American elm 79, cottonwood 78, green ash 63, white willow 63, boxelder 56, and black walnut 55. The average survival value for all was 76 percent.

441. Pallardy, S.G.; Parker, W.C.; Whitehouse, D.L.; Hinckley, T.M.; Teskey, R.O. 1983. **Physiological responses to drought and drought adaptation in woody species.** In: Randall, D., ed. Proceedings, 2d annual plant biochemistry physiology symposium; 1983 April 6-8; Columbia, MO. Current Topics on Plant Biochemistry Physiology. 2: 185-199. 27 refs.

Discusses published work with sections on plant distribution and site water regime, and recent work on responses to drought and drought adaptation in oak/hickory forest species (including *Juniperus virginiana* and *Juglans nigra*).

442. Pool, R.J. 1939. **Some reactions of the vegetation in the towns and cities of Nebraska to the great drought.** Bulletin of the Torrey Botanical Club. 66: 457-456.

Observations during the severe drought periods prevailing between 1933 and 1938 in the northern prairie and plains region of the United States have given some indication of the drought resistance of a number of native and introduced tree species. *Celtis occidentalis* has consistently shown the greatest drought resistance among native hardwoods; other species, in decreasing order of resistance, are *Gleditsia triacanthos*, *Fraxinus pennsylvanica* var. *lanceolata*, *Acer saccharinum*, *Platanus occidentalis*, *Ulmus americana*, and *U. fulva*. Of the planted hardwoods, *Quercus macrocarpa* was rather highly resistant, and *Ulmus parvifolia* did well, though most trees of the latter are too young for a reliable estimate of their susceptibility to be made. Among the conifers, *Juniperus virginiana* suffered little, and good survival has also been shown by *Pinus nigra* and *P. sylvestris*. Most of the other tree species occurring in the region, both hardwoods and softwoods, have suffered very severely.

443. Radu, S. 1960. **Injurious effects of snow on *Juniperus virginiana* and other species.** Revista Padurilor. 75(3): 173-176. 6 refs. Rumanian.

Describes injuries caused to exotic conifers, and especially to *J. virginiana* in the arboretum at Simeria, by a heavy snowfall after prolonged frost in February 1958 (3 times the normal fall for the month fell in 3 days). A large number of junipers (2,679) were uprooted, twisted or broken off. *Thuja occidentalis* and *Chamaecyparis lawsoniana* suffered less severely.

444. Stoeckeler, J.H. 1965. **Spring frost damage in young forest plantings near La Crosse, Wisconsin.** Journal of Forestry. 63(1): 12-14. 21 refs.

Ratings from observations of frost injury (occurring in May 1963) to 13 species in 2- and 3-year-old plantations are: very sensitive-black walnut, white ash, and red oak; moderately sensitive-Norway spruce, white spruce, European larch; slightly sensitive-Austrian pine; and not sensitive-jack, ponderosa, red, Scots and white pines, and eastern redcedar.

445. Traci, C. 1975. **The effects of the 1973 drought on the conifer plantations on eroded sites in the Cheia-Macin area in the forest-steppe of N. Dobruja.** Revista Padurilor. 90(1): 25-30. Romanian.

Tabulates, by conifer species and site types, the extent of crown killing in mixed conifer/hardwood plantations 8 to 12 years old on sites already described in Rumania. *Pinus nigra* and (especially) *P. sylvestris* were severely damaged, mortality being concentrated on the skeletal soils on south facing slopes and at total stand densities more than or equal to 8,000 trees/ha. *Juniperus virginiana*, *P. jeffreyi*, and *P. ponderosa* were undamaged. Most hardwoods suffered little damage apart from premature leaf shedding, but *Robinia pseudoacacia* was severely damaged. It is concluded that *P. nigra* and *P. sylvestris* should form not more than 25-30 percent of the stand, and that *P. sylvestris* should not be used on the driest sites, which should be planted at a density of 3,000-5,000/ha.

CONTROL OF EASTERN REDCEDAR

446. Alexander, H. 1993. **Controlling juniper: fire and goats, a combination.** Rangelands. 15(6): 257-259.

447. Bernardo, D.J.; Engle, D.M.; McCollum, E.T. 1988. **An economic assessment of risk and returns from prescribed burning on tallgrass prairie.** Journal of Range Management. 41(2): 178-183.

448. Bernardo, D.J.; Engle, D.M.; McCollum, F.T. 1992. **An economic assessment of risk and returns from prescribed burning to control eastern redcedar.** In: Bidwell, T.G.; Titus, D.; Cassels, D., eds. Range Research Highlights, 1983-1991. Circ. E. 905. Stillwater, OK: Oklahoma State University, Cooperative Extension Service: 36-38.

449. Bidwell, T.G.; Moseley, M.E. 1989. **Eastern redcedar: Oklahoma's centennial brush problem.** Circ. E. 892. Stillwater, OK: Oklahoma State University, Cooperative Extension Service. 4 p.

450. Bidwell, T.G.; Stritzke, J.F.; Engle, D.M. 1989. **Eastern redcedar update, 1989.** Stillwater, OK: Oklahoma State University, Cooperative Extension Service. 4 p.

451. Bidwell, T.G.; Lochmiller, R.L.; Engle, D.M.; Stritzke, J.F.; Anderson, S. 1991. **Eastern redcedar update—1991.** Stillwater, OK: Oklahoma State University, Cooperative Extension Service. 4 p.

452. Briggs, J.M.; Gibson, D.J. 1992. **Effect of fire on tree spatial patterns in a tallgrass prairie landscape.** Bulletin of the Torrey Botanical Club. 119(3): 300-307.

Spatial patterns of trees invading a tallgrass prairie in northeast Kansas, U.S.A., were examined using a Geographical Information System. Without burning and with adequate moisture levels, the number of trees increased over a 5-year period by over 60 percent, while in an area burned annually the number of trees decreased. Under a variety of burning regimes *Juniperus virginiana* and *Celtis occidentalis* were significantly more uniform in their distribution pattern than *Populus deltoides* and *Gleditsia triacanthos*. In addition, three tree species (*G. triacanthos*, *J. virginiana*, and *U. americana*) had a significant increase in the degree of aggregation with increasing tree height, while *C. occidentalis* showed no relationship between aggregation and tree height. There were significant associations between adult and juvenile trees at various scales, with bird-dispersed *J. virginiana* having a higher critical distance (39 m) than wind-dispersed *G. triacanthos* and *U. americana*. The spatial pattern of tree species appears to be affected by the means of dispersion; trees with wind-dispersed seeds had clumped distributions, whereas most trees with bird-dispersed seeds were regular to random in their dispersion patterns. The spatial pattern of trees invading tallgrass prairie is a function of the burning regime dispersal vectors, habitat availability, and reproductive mode.

453. Buehring, N.W.; Santlemann, P.W.; Elwell, H. 1970. **Responses of eastern redcedar to various control procedures.** Southern Weed Science Society. 23: 244.

Early spring burning gave excellent control of *Juniperus virginiana* less than 18 inches high, but the use of a rotary brushcutter against stems of 0.5-1.25 in basal diameter resulted in 22 percent regrowth. Undiluted picloram-K injected in winter, spring, and summer at 1 and 3 ml per inch of d.b.h. gave good top kill, but ester and amine formulations of 2,4,5-T and 2,4-D at 1 and 3 ml per inch of d.b.h. were ineffective. Among granular materials tested in spring and summer, picloram 10 percent a.i. at 3-6 teaspoonfuls and chlorfenac at 9 teaspoonfuls per inch of d.b.h. gave good control, but dicamba at 1, 3, and 6 teaspoonfuls, fenuron at 1, 2, and 3 teaspoonfuls and monuron-TCA at 3, 6, and 9 teaspoonfuls were inadequate. Foliar + stem sprays giving more than 80 percent kill of trees 2-4 feet high and 7-8 feet high included paraquat at 1 and 2 lb/acre + 0.5 percent wetter and 4 lb/acre (alone), dicamba at 3 and 6 lb/acre, dicamba at 2 lb/acre + 2,4,5-T ester at 4 lb/acre, 2,4-D + dichlorprop at 4 lb/acre each or 8 lb/acre each, and AMS at 50 and 75 lb/100 gal spray. A foliar application of 2,4,5-T amine + picloram, each at 2 lb/acre in 10 gallon spray, gave more than 70 percent top-kill.

454. Buehring, N.W.; Santelmann, P.W.; Elwell, H.M. 1971. **Responses of eastern redcedar to control procedures (*Juniperus virginiana*).** Journal of Range Management. 24(5): 378-382.

455. Crathorne, G.L.; Scott, W.T.; Ritty, P.M. 1982. **Eastern redcedar control in Kansas: control of *Juniperus virginiana* on rangeland.** Down to Earth. 38(1): 1-6.

456. Dalrymple, R.L. 1969. **Cedar control in southern Oklahoma.** Southern Weed Science Society. 22: 272-273.

457. Egler, F.E. 1950. **Herbicide effects in Connecticut vegetation, 1949.** Botanical Gazette. 112(1): 76-85. 3 refs.

The fourth report on this project describes inter alia experiments with various preparations of 2,4-D and 2,4,5-T esters (separately or together) in aqueous solution, used as foliage sprays, applied to wounds made in stems, and painted or sprayed in winter on stems with bark intact. The advantages of bark treatment were so marked that foliage spraying of woody plants was discontinued in midsummer. Broadleaved herbs were most easily controlled by spring spraying. The various esters represented in the preparations appeared equal in effect, and a concentration of 0.25 percent appeared entirely adequate. Some herbs required several sprayings. All ferns were comparatively resistant. Blackberries were controlled by cutting in winter and spraying new shoots as they appeared; they were particularly sensitive to 2,4,5-T. The base of woody plants may be sprayed in winter and possibly in summer. Concentrations of 20-25 percent were highly effective, and concentrations as low as 5-10 percent might possibly work. Since in some plants there was little downward movement of the killing effect, treatments should be made below the lowermost branches or at least to their bases. Bark sprays, though highly effective, were slow acting, and plants so treated may come into leaf and grow for 5 months after the treatment. Species previously unaffected, e.g., *Picea abies*, *Pinus strobus*, *Kalmia latifolia*, *Juniperus communis* var. *depressa* and *J. virginiana*, now appear to be controllable by a single application.

458. Elwell, H.M. 1948. **Preliminary report of chemicals for brush control.** Oklahoma Crops and Soils. 41-44. 4 refs.

Tests were made of aqueous spray solutions containing 2,000 p.p.m. of 2,4-D. The highest percent of plants affected occurred on brush 4-7 feet high. The 2,4-D spray did not seem to be effective on the larger trees. One application of spray produced 80-95 percent defoliation of *Rhus glabra*, *Prunus angustifolia*, *Robinia pseudoacacia*, *Gleditsia triacanthos*, *Diospyros virginiana*, and *Sassafras varifolium*; 50-75 percent defoliation of *Quercus marilandica*, *Q. stellata, Q. muehlenbergii*, and *Salix nigra*; it had no effect on *Ulmus* spp., *Prosopis* spp., *Celtis* spp., *Hicoria buckleyi*, *Maclura pomifera*, and *Juniperus virginiana*. In general, the 2,4-D appears to cause a gradual dying of the trees and brush. The leaves turn brown, and often the twigs curl and twist in 2-3 weeks. The plants most readily affected soon developed an abnormal knotty growth of the cambium layer along the main stems, which often caused cracking. Spray was not toxic to native grasses but killed broadleaved plants such as cotton and legumes. It is light and drifts readily. Trees, brush, and other plants sprayed with ammate (1 pound per gallon of water) began to turn 24-48 hours. All the species mentioned above were affected. Terminal twigs were often killed by one application, but a second or third application was sometimes necessary to completely kill regrowth. Ammate spray appears to be heavy, and drifting of the mist can be controlled. For this reason, it can be used advantageously for controlling underbrush, weeds, etc., in orchards, gardens, etc. Experiments were also made in poison-girdling near ground level with various preparations of 2,4-D, ammate, and sodium arsenite. In general, poor results were obtained with the 2,4-D preparations. Ammate was effective on small trees. Sodium arsenite was the only chemical that killed large trees. None of the chemicals were effective when applied in holes punched in trees. The best time for girdling and poisoning seems to be during a summer dormant period, or about 2-3 weeks before leaves fall.

459. Elwell, H.M.; Santelmann, P.W.; Stritzke, J.F.; Greer, H. 1974. **Brush control research in Oklahoma.** Bull. B-712. Stillwater, OK: Oklahoma State University, Agriculture Experiment Station. 46 p. 28 refs.

Reviews research dating from early experiments up to the present, including details of the control of *Juniperus ashei*, *J. virginiana*, *Carya* spp., *Crataegus* spp., *Diospyros virginiana*, *Quercus marilandica*, *Q. stellata*, *Ulmus alata*, and *U. americana*.

460. Engle, D.M.; Kulbeth, J.D. 1992. **Fuel and weather related to kill of eastern redcedar from fire.** In: Bidwell, T.G.; Titus, D.; Cassels, D., eds. Range Research Highlights, 1983-1991. Circ. E. 905. Stillwater, OK: Oklahoma State University, Cooperative Extension Service: 14-15.

461. Engle, D.M.; Stritzke, J.F. 1992. **Enhancing control of eastern redcedar through individual plant ignition following prescribed burning.** Journal of Range Management. 45(5): 493-495. 12 refs.

Fire-scorched crowns of living eastern redcedar (*Juniperus virginiana*) were ignited using a propane torch in three studies on range sites in Payne County, Oklahoma. In the first study, 98 fire-scorched trees were ignited 20-64 days after a controlled burn. Igniting scorched trees in several positions killed 90 percent of the crown and two-thirds of the trees regardless of their size. Logistic regression models indicated that reburning was more effective on trees already badly damaged by the controlled burn. In the second study, one person equipped with a self-contained backpack propane burner used single-point ignition to treat an average of one tree every 17 seconds (range 11-20 seconds) on 0.25-ha plots. Effectiveness of the single-point ignition declined with increasing tree size. In the third study of operational effectiveness, the average time required to burn a tree was 19 seconds in eight 32-ha pastures at a cost of $0.03/treated tree.

462. Engle, D.M.; Stritzke, J.F. 1992. **Igniting crowns of partially scorched juniper.** In: Bidwell, T.G.; Titus, D.; Cassels, D., eds. Range Research Highlights, 1983-1991. Circ. E. 905. Stillwater, OK: Oklahoma State University, Cooperative Extension Service: 15-16.

463. Engle, D.M.; Stritzke, J.F.; Claypool, P.L. 1988. **Effect of paraquat plus prescribed burning on eastern redcedar (*Juniperus virginiana*).** Weed Technology. 2(2): 172-174. 11 refs.

Paraquat was evaluated as a pre-treatment for *J. virginiana* before spring burning in tallgrass prairie. Wetting sprays of paraquat at 0.3 or 0.6 g/liter were applied to crowns of small (0.8-1.5 m), medium (1.5-2.5 m), and large (2.5-5.0 m) *J. virginiana* trees in August 1983 and 1984 before prescribed burns in the spring of 1984 and 1985. Paraquat alone at 0.6 g/liter killed about 90 percent of the crown of small trees but as little as 30 percent of the crown of large trees. Paraquat pre-treatments increased post-fire damage to small- and medium-size trees and partially compensated for light fine fuel loading.

464. Engle, D.M.; Bernardo, D.J.; Hunter, T.D.; Stritzke, J.F.; Bidwell, T.G. 1992. **A decision support system for eastern redcedar control.** In: Bidwell, T.G.; Titus, D.; Cassels, D., eds. Range Research Highlights, 1983-1991. Circ. E. 905. Stillwater, OK: Oklahoma State University, Cooperative Extension Service: 16.

465. Fletchall, O.H. 1956. **Brush control with CMU in bands and grids.** Proceedings, 13th Annual North Central Weed Control Conference: 70. (Weed Abstracts. 6(6): 1357.)

An area of brush regrowth (originally cleared about 1935) was treated in July 1955 with monuron 15 lb/acre applied as a dry powder in three ways: (1) in 2-inch strips, 4, 8, 12, and 16 feet apart; (2) in a grid pattern with 2-inch strips at right angles to each other 4, 8, 12, and 16 feet apart each way; and (3) in a narrow circular band around each tree, about 1 foot from the base. The mean percent defoliation from all treatments 14 months later was: *Quercus stellata* 91; *Quercus velutina* 90; *Q. alba* 76; *Carya* spp. 73; *Juniperus virginiana* 49; *Juglans* spp. 25. Natural defoliation due to drought ranged from 10 to 20 percent for *Quercus* and *Carya* spp. and was little less than that indicated for the treated *J. virginiana* and *Juglans* spp. Method (3) gave the most rapid and the greatest (95 percent) defoliation; (2) gave 89 percent and (1) gave 84 percent. Trees that were within 2 feet of a monuron strip averaged 88 percent defoliation compared with 78-79 percent for those further away. Less grass was killed with (1) than with (3).

466. Herron, J.W. 1958. **A new concept of brush control using a pelleted material.** Proceedings, 15th Annual North Central Weed Control Conference: 27-28. (Weed Abstracts. 8(8): 1503.)

Preliminary results indicate that fenuron pellets at 12-18 lb/acre will kill or severely injure *Fraxinus americana*, *Carya* spp., *Quercus* spp., *Ulmus* spp., *Morus alba*, *Maclura pomifera*, *Juniperus virginiana*, *Acer* sp., *Rhus radicans*, *Celtis occidentalis*, *Cercis canadensis*, *Robinia pseudoacacia,* and *Sassafras* sp. *Rhamnus caroliniana* was resistant.

467. Keating, B. 1991. **A different kind of rodeo.** Stillwater, OK: Oklahoma State University, Agriculture Experiment Station. 2(2): 10-11.

468. Kucera, C.L.; Ehrenreich, J.H.; Brown, C. 1963. **Some effects of fire on tree species in Missouri prairie.** Iowa Journal of Science. 38(3): 179-185. 7 refs.

The effects of prairie fire on young trees of four broadleaved species and *Juniperus virginiana* were observed under different burning conditions. Drier fuel, combined with greater vapor deficits, resulted in higher percents of individuals killed back. In the hardwoods, less crown damage resulted in less sprout production. Fire may retard development of young trees in tall-grass prairie, and further studies are needed on the relationships of fire in the forest/prairie transition.

469. McNeil, W.K.; Stritzke, J.F.; Basler, E. 1984. **Absorption, translocation and degradation of tebuthiuron and hexazinone in woody species.** Weed Science. 32(6): 739-743. 22 refs.

Seedlings of *Ulmus alata*, *Quercus macrocarpa*, *Juglans nigra*, *Juniperus virginiana,* and *Pinus taeda* were treated in nutrient solution with ring-labeled 14C-tebuthiuron or 14C-hexazinone. Species showed differing rates of root and foliar uptake of both herbicides. Results suggest that reduced translocation may account for tebuthiuron resistance in *J. nigra*, and herbicide degradation may account for hexazinone resistance in *P. taeda*.

470. Melichar, M.W.; Geyer, W.A.; Strine, J.H.; Ritty, P.M. 1985. **Oil substitutes in basal sprays of Garlon 4 herbicide.** Down to Earth. 41(2): 21-24. 7 refs.

In field trials at Manhattan, Kansas, in 1980-1981, control of *Juniperus virginiana*, *Fraxinus pennsylvanica*, *Celtis occidentalis,* and *Juglans nigra* by basal sprays of Garlon (triclopyr) diluted with various polyglycol derivatives was studied. The standard treatment of 2 percent Garlon in oil gave 80 percent defoliation of *J. nigra* and 100 percent defoliation of the other trees, and no resprouting occurred as the Garlon killed the entire root systems. The herbicide/polyglycol mixtures did not provide consistent tree control.

471. Neely, D.; Crowley, W.R., Jr. 1974. **Toxicity of soil-applied herbicides to shade trees.** Horticultural Science. 9(2): 147-149. 8 refs.

Seventeen commercial products containing 11 herbicides used to control weeds in lawns were tested for three consecutive seasons at rates recommended by the manufacturers and at three times those rates in established plots of several ornamental trees. Bandane, benefin, bensulide, 2,4-D, DCPA, DSMA, siduron, silvex, 2,4,5-T, and trifluralin were not phytotoxic, but dicamba consistently caused damage, especially at the higher application rate. The sensitivity of tree species to dicamba varied with soil type and rainfall. White and blue spruce (*Picea glauca* and *P. pungens*) were readily killed; tulip trees (*Liriodendron tulipifera*), honey locust (*Gleditsia triacanthos*), pin oak (*Quercus palustris*), and lime (*Tilia cordata*) trees suffered twig damage; walnut (*Juglans nigra*), ash (*Fraxinus* spp.), maple (*Acer* spp.), and redbud (*Cercis canadensis*) trees suffered leaf distortion; and redcedar (*Juniperus virginiana*) trees were unaffected.

472. Owensby, C.E. 1975. **Controlling eastern redcedar (*Juniperus virginiana*).** Tech. Rep. 457. Manhattan, KS: Kansas State University, Cooperative Extension Service. 4 p.

473. Penfound, W.T. 1968. **Influence of a wildfire in the Wichita Mountains Wildlife Refuge, Oklahoma.** Ecology. 49(5): 1003-1006. 14 refs.

After a severe fire in 1963, 92 percent of the crowns were killed in *Quercus stellata/Juniperus virginiana* forest (a); few oaks and no *J. virginiana* coppiced. In neighboring *Q. marilandica/ Q. stellata* forest (b), only 66 percent of the crowns were killed and 70 percent of the trees coppiced. The results are attributed either to the greater fire resistance of *Q. marilandica* or to the greater heat of the fire in (a) caused by the extreme inflammability of *J. virginiana.* A reversion of (a), but not of (b), to grassland or scrub is predicted.

474. Peters, R.A. 1957. **Observations on the effectiveness of polychlorobenzoic acid for pasture brush control.** Proceedings, 11th Northwest Weed Control Conference: 236-237. (Weed Abstracts. 6(7): 1019.)

Overall foliar applications of polychlorobenzoic acid, 8 and 16 lb/100 gal water killed *Juniperus communis*, *J. virginiana*, and *Pinus strobus*. *Equisetum* sp. was effectively controlled by 4 lb/100 gal, while bracken showed considerable dieback and no regrowth.

475. Phillips, F.D. 1987. **Burning improves Oklahoma rangeland.** Soil and Water Conservation. 8(7): 5.

476. Poulsen, W.G. 1964. **Weed control in Utah conifer tree plantings.** Utah Farm & Home Science. 25(1): 22-23.

Simazine 80 W was tried on soils varying from loam to clay-loam, planted with *Picea pungens*, *Juniperus virginiana*, *Pinus ponderosa*, and *Pseudotsuga taxifolia*. Four areas were sprayed in November and one in May, using various dosages in 6 gal water/1,000 ft^2. The trees were in their second growing season on three areas and in their fifth season on the remaining ones. *P. ponderosa* became chlorotic when 1.25-1.75 oz/1,000 ft were used in November, but suffered no ill effects from the 2-oz rate in May. For annual weeds, 0.5 oz was adequate. Little additional effect was gained from rates greater than 1.25 oz. *Physalis subglabrata* was not controlled, even at the 1.75-oz rate. In general, 1 oz/1,000 ft^2 is recommended for light soils low in organic matter, and 1.25 oz/1,000 ft^2 are recommended for heavy clay and loam soils high in organic matter, applied at almost any season, though autumn is preferable where winter annuals are to be controlled.

477. Poulsen, W.G. 1965. **Simazine weed control.** Tree Planters Notes. 73: 1-2.

Describes experiments in six areas in Utah, applying simazine at various rates to conifer transplant beds, which achieved 77-100 percent control of weeds, and reduced costs of weed control by 50-75 percent. *Pinus ponderosa* appeared to be more sensitive to the chemical than *Picea pungens*, *Juniperus virginiana,* and *Pseudotsuga taxifolia*, and simazine should be applied to it in the spring and at lower rates.

478. Smith, S.D. 1987. **Ecology and control of eastern redcedar (*Juniperus virginiana* L.).** Dissertation Abstracts International, B. Science and Engineering. 47(11): 4376-B. 207 p.

Juniperus virginiana is widespread east of the Rocky Mountains and, in the last few decades, has spread across many areas of the midwest that were formerly pure grassland. Because the tree reduces forage production, studies were made of the control of *J. virginiana* with herbicides and of the ecological relations between the tree and its associated understory herbaceous vegetation. Hexazinone, picloram, and tebuthiuron gave at least 80 percent kill of *J. virginiana*. Germination of native grass was inhibited by extracts of both foliage and duff of *J. virginiana*, but neither extract had great effects on height or weight growth. Overall forage production was 83 percent less under the tree canopy than in adjacent open areas. Soil water content and understory light intensities were less under the canopy than in open areas on all dates when differences were measured. Establishment of *J. virginiana* was less when grass was clipped to 5 cm rather than 25 cm. Vegetation regrew on depauperate areas underneath tree canopies within 2 years of tree removal.

479. Starker, T.J. 1932. **Fire resistance of the trees of the Northeast United States.** Forest Worker. 3(3): 8-9.

Redcedar was ranked 20th, with only northern white-cedar and balsam fir being considered more susceptible.

480. Steinert, W.G.; Stritzke, J.F. 1975. **Karbutilate and tebuthiuron for control of brush on pasture land.** Southern Weed Science Society. 28: 246.

In studies during 1972 and 1973, soil applications of tebuthiuron at 12 and 16 lb/acre controlled eastern redcedar (*Juniperus virginiana*) less than 3 feet high but had little effect when the trees were taller than 5 feet. Blackjack oak (*Quercus marilandica*) and American elm (*Ulmus americana*) were well controlled by tebuthiuron, but persimmon (*Diospyros* sp.) was only moderately susceptible. In a study in which karbutilate and tebuthiuron were basally injected into *Q. marilandica*, winged elm (*Ulmus alata*), white ash (*Fraxinus americana*), and hawthorn (*Crataegus* sp.), karbutilate showed poor activity against the first three species during the first year and only fair activity against *Crataegus* sp. Good first-year activity was observed with tebuthiuron on all species. In a large-plot, soil placement study carried out with the two herbicides, the first-year activity of tebuthiuron was increased by concentrating the herbicide in spots every 6 or 9 feet compared with a broadcast treatment. Karbutilate showed little activity during the first season.

481. Sternitzke, D.; Stritzke, J.F. 1983. **Effectiveness of various herbicides for the control of eastern redcedar.** Southern Weed Science Society. 36: 247.

0.12-0.48 kg dicamba, 0.18-0.72 kg glyphosate or fosamine, and 0.06-0.24 kg paraquat, picloram or triclopyr/100 liter spray were applied to *Juniperus virginiana* to run-off. Additional treatments were the lowest rate of each chemical + 5 percent SA-77 or 1 percent diesel oil. Chemicals were applied in July or September 1981 or April, July, or September 1982, and assessments were made 4-6 weeks after treatment; leaf moisture readings were also made in spring 1982 for the 1981 treatments. In general, the order of efficiency for foliage desiccation was dicamba = paraquat = picloram > glyphosate > fosamine = triclopyr. Greatest leaf DM reduction was given by 0.24 kg paraquat/100 liter applied in July with 17.6 percent moisture the following spring compared with 42.4 percent moisture on the controls.

482. Stritzke, J.F. 1978. **Comparative phytotoxicity of tebuthiuron and Velpar [3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione] on woody plants.** Weed Science Society: 44-45.

In field studies, *Gleditsia triacanthos* and *Gymnocladus dioicus* appeared to be susceptible to tebuthiuron and somewhat tolerant of Velpar (hexazinone), whereas *Quercus rubra* was more susceptible to Velpar. *Pinus echinata* was tolerant of Velpar and susceptible to tebuthiuron, while the reverse was true of *Juniperus virginiana* and *Diospyros virginiana*. A number of species showed similar responses to the herbicides. The activity of both compounds was reduced in soils relatively high in clay and OM.

483. Stritzke, J.F.; Rollins, D. 1984. **Eastern redcedar and its control.** Weeds Today. 15(3): 7-8.

The distribution morphology and ecology of *Juniperus virginiana* in the eastern U.S.A. and Canada is described, and methods of control by herbicides, burning and mechanical means are reviewed.

484. Stritzke, J.F.; Engle, D.M.; McCollum, F.E. 1991. **Vegetation management in the Cross Timbers: response of woody species to herbicides and burning.** Weed Technology. 5(2): 400-405. 20 refs.

Brush control and woody plant community structure in the Cross Timbers of Oklahoma resulting from treatments with herbicides and fire were compared. Tebuthiuron and triclopyr were applied alone and in combination with burning at 2.2 kg/ha in March and June 1983, respectively. The pastures were burned with strip headfires in late spring of 1985, 1986, and 1987. Both herbicides were effective on the dominant overstory brush species, *Quercus marilandica* and *Q. stellata*, and this resulted in good reduction of canopy cover of brush initially. However, effects of triclopyr were short-lived because of ineffectiveness on many of the other broadleaved species, including *Ulmus americana*, *Bumelia lanuginosa*, *Celtis occidentalis*, *Cornus drummondii,* and *Symphoricarpos orbiculatus*. Crown reduction and tree kill of these broadleaved species was usually better with tebuthiuron than with triclopyr. Neither herbicide was effective on *Juniperus virginiana*. Better brush control, associated with tebuthiuron, resulted in better fine fuel release and by 1988, burning was having a significant effect on woody plants in the tebuthiuron-treated plots.

485. Sucoff, E.I. 1968. **N,N'-dinitroethylenediamine retards growth of Red cedar and American arborvitae.** Horticultural Science. 3(1): 42-43.

Single applications at 4,000 and 100 p.p.m. reduced the height growth of *Thuja occidentalis* by 88 and 36 percent, respectively and dry-weight increment by 54 and 9 percent, respectively. Corresponding figures for *Juniperus virginiana* were 64 and 9 percent and 49 and 15 percent. The number and length of internodes of *J. virginiana* were reduced. The effect at 4,000 p.p.m. persisted longer than 90 days.

486. Voeller, J.E.; Holt, H.A. 1973. **Continued evaluation of the Hypo-Hatchet for woody species control.** Southern Weed Science Society. 26: 354-360.

In a continuation of trials with the Hypo-Hatchet, aqueous solutions of picloram plus or minus 2,4-D were effective against *Acer rubrum*, *Carya* sp., and *Quercus* sp. and also controlled *Juniperus virginiana*. The amine formulation of 2,4-D was also very effective against *Quercus* sp. and *Carya* sp. but lacked activity against *A. rubrum*. The Hypo-Hatchet appeared to be capable of treating more stems/hour than could basal injections.

487. Wade, K.A.; Menges, E.S. 1986. **Effects of fire on invasion and community structure of a southern Indiana cedar barrens.** Indiana Academy of Science. 96: 273-286. 40 refs.

A floristic and community summary of Leavenworth Barrens Nature Preserve (LBNP), a northern example of a limestone cedar (*Juniperus virginiana*) barrens, showed high floristic diversity, including rare species with high affinities to more southerly limestone glades. Ordination and classification of 1-year herb-layer abundance showed that the composition of the herbaceous community is strongly related to the degree of shading by woody species. Plants most typical of glades, barrens, and prairies occur in the most open habitat. Forested portions add to the overall diversity of LBNP, but woody encroachment into open glade-like areas excludes species most typical of cedar glades. Initial findings indicated that controlled burning may be useful for maintaining barrens by discouraging or excluding some woody species. At least 10 herbaceous glade and prairie species were more abundant on burned than on unburned areas.

488. Wilson, J.S.; Schmidt, T.L. 1990. **Controlling eastern redcedar on rangelands and pastures.** Rangelands. 12(3): 156-158. 5 refs.

Reviews the control of eastern redcedar (*Juniperus virginiana*) in range lands and pastures. Methods discussed are removal by hand, machine control, chemical control, and burning.

489. Wittwer, R.F.; Engle, D.M. 1985. **Proceedings, eastern redcedar in Oklahoma conference.** Stillwater, OK: Oklahoma State University, Cooperative Extension Service. 98 p.

PRODUCTS

490. Arend, J.L. 1947. **An early eastern red cedar plantation in Arkansas**. Journal of Forestry. 45: 358-360.
An eastern redcedar plantation was established with wildling stock in 1902. After 44 years, average survival was 85 percent. The 1,027 trees were estimated to contain 5,866 fence posts with a value of approximately $800. Under intensive management, potential returns could have been much larger.

491. Back, E.A.; Rabak, F. 1922. **Red cedar chests as protectors against moth damage**. Bull. 1051. Washington, DC: U.S. Department of Agriculture. 14 p.

492. Booth, F.L. 1929. **Manufacturing and shipping cedar chests**. Wood-Worker. 48: 32-33.

493. Brown, L.E. 1912. **Tennessee red cedar**. Southern Lumberman. 69(900): 109-111.

494. Brown, L.E. 1926. **Tennessee red cedar**. Southern Lumberman. 125(1629): 201-202.

495. Cromie, G.A. 1944. **Fields of red cedar**. Connecticut Woodland. 9: 23-25.
Red cedar can be one of the most profitable tree crops on farm edges. A variety of products and the number of salable trees per acre that can be grown are discussed.

496. Evelyn, J. 1664. **Sylva, or a discourse of forest trees and the propagation of timber**. London: Martyn and Allestay.
"The cedar...grows in all extremes: in the moist Barbados; the hot Bermudas, the cold New England; even where the snow lies (as I am assur'd) almost half the year: Why then it should not thrive in Old England, I conceive is from our want of industry: It grows in the bogs of America...".

497. Hall, W.L.; Maxwell, H. 1911. **Uses of commercial woods of the United States. I. Cedars, cypresses, and sequoias**. Bull. 95. Washington, DC: U.S. Department of Agriculture, Forest Service: 19-29.
Describes properties, uses, and supply of redcedar.

498. Jane, F.W. 1954. **The structure of world timbers. XXII. Four species of the cedar**. Timber Technology. 62: 67-69.

499. Maughan, W. 1936. **A cubic volume table for eastern redcedar**. Journal of Forestry. 34: 777-778.
Features a local volume table in cubic feet for the middle Atlantic Piedmont.

500. Maughan, W. 1937. **A board foot table for eastern redcedar**. Journal of Forestry. 35: 734-735.
Features a board foot volume table for the middle Atlantic Piedmont.

501. Morton, T. 1637. **New English Canaan**. In: Force, P., ed. Tracts relating to the colonies in North America. 2: 45-54.
"Cedar, of this sorte there is an abundance: and this wood was such as Solomon used for the building of that glorious temple at Hierusalem.... This wood cuts red, and is good for bedsteads, tables, and chests....".

502. Pochan, M. 1977. **Redcedar (*Juniperus virginiana*) - useful tree.** Connecticut Woodland. 42(1): 7-9.

503. Shoulder, E. 1954. **Costs of skidding eastern redcedar**. For. Notes 90. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station.
Skidding eastern redcedar in tree lengths and bucking the stems at loading points appears cheaper than bucking at the stump and skidding products. Savings increased with the diameter and merchantable length of the trees handled.

504. USDA Forest Service. 1943. **Useful trees of the United States.** Washington, DC: U.S. Department of Agriculture, Forest Service.
Includes seven leaflets of a series, each giving brief notes on the distribution, tree characters, wood properties and uses, etc., for one of the economically useful trees of the United States. These leaflets deal respectively with eastern redcedar (*Juniperus virginiana*), redwood (*Sequoia sempervirens*), white ash (*Fraxinus americana*), American elm (*Ulmus americana*), black walnut (*Juglans nigra*), yellow birch (*Betula lutea*), and American beech (*Fagus grandifolia*).

505. Zimmerman, A.H.; Cummings, W.H. 1952. **Redcedar cumulative volume tally**. Journal of Forestry. 50: 867.
This is a form based on volume tables for eastern redcedar in the Tennessee Valley.

Cedar Extracts

506. Adams, R.P. 1987. **Investigation of *Juniperus* species of the United States for new sources of cedarwood oil.** Economic Botany. 41(1): 48-54. 31 refs.
The yields and composition of commercially important components of the oils were determined

for 11 taxa of *Juniperus* with widespread distribution in the U.S.A. and significant biomass production. Taxa studied were *J. ashei*, *J. californica*, *J. erythrocarpa*, *J. deppeana*, *J. monosperma*, *J. occidentalis* var. *occidentalis* and var. *australis*, *J. osteosperma*, *J. pinchotii*, *J. scopulorum,* and *J. virginiana*. Cedarwood oil yields in *J. erythrocarpa* and *J. scopulorum* were similar to those of the species currently used commercially (*J. ashei* and *J. virginiana*); neither species is likely to be competitive on a large scale, but both might support small, local distillation facilities.

507. Adams, R.P. 1987. **Yields and seasonal variation of phytochemicals from Juniperus species of the United States.** Biomass. 12(2): 129-139. 16 refs.

An analysis was made of hexane- and methanol-soluble phytochemicals from leaves, bark/sapwood, and heartwood. Foliage provided the best yields with 5.4-16.7 percent DM of hexane-extractables and 23.8-35.2 percent DM of methanol-extractables. The 10 species examined were: *J. ashei*, *J. californica*, *J. deppeana*, *J. erythrocarpa*, *J. monosperma*, *J. occidentalis*, *J. osteosperma*, *J. pinchotii*, *J. scopulorum,* and *J. virginiana*.

508. Bailey, L.F. 1948. **Leaf oils from Tennessee Valley conifers.** Journal of Forestry. 46(12): 882-889. 20 refs.

Freshly collected foliage of *Juniperus virginiana*, *Pinus echinata*, *P. virginiana,* and *P. taeda* was steam-distilled to determine the yield and characteristics of the oils produced. The methods employed are described. Maximum yields for the four species, obtained by distilling fresh foliage harvested during winter months from dominant trees of merchantable size, were 0.46, 0.32, 0.28, and 0.35 percent respectively. Yields from suppressed trees and young plantation growth were poor, and foliage harvested in June gave consistently low yields. Physical characteristics of the oils are reported. Since the yields obtained were rather lower than those of species used for commercial production of leaf oils in the northeastern U.S.A., the development of improved harvesting and distilling procedures may be necessary before waste tops from logging operations can be used commercially for this purpose in the Tennessee Valley.

509. Bender, F. 1963. **Cedar leaf oils.** Publ. 1008. Canada: Department of Forestry. 16 p. 7 refs.

Gives data on yields and some production figures and prices. Some physical and mechanical properties of the oil are tabulated, and a brief description is given of the industry in Canada and the U.S.A., together with details of the main commercial outlets in Canada.

510. British Standards Institute. 1975. **Specifications for essential oils.** BS 2999/53 to 57. London, UK: British Standards Institute. 12 p.

This specification covers definition, description, requirements, sampling and size of sample of oil of eucalyptus, oil of Indonesian clove leaf, oil of *Litsea cubeba*, dementholized oil of *Mentha arvensis*, and oil of Virginian cedarwood (*Juniperus virginiana* L.), in specifications 53 to 57, respectively.

511. Chavchanidze, V.Y.; Kharebava, L.G. 1989. **Studies on the essential oils of juniper.** Subtropicheskie Kul'tury. 4: 131-143. 78 refs. Russian.

Analytical data are tabulated and discussed for essential oils extracted from needles of the following species grown in the Central Botanic Garden at Tbilisi: *Juniperus pachyphloea*, *J. polycarpos*, *J. chinensis*, *J. sabina*, *J. virginiana,* and *J. foetidissima*. The oils showed marked quantitative and qualitative differences, with the number of components detected ranging from 179 (*J. sabina*) to 246 (*J. foetidissima*).

512. Chopra, I.C.; Handa, K.L.; Kar, A.B. 1959. **Himalayan cedarwood oil as a substitute for imported cedarwood oil in microscopical work.** Journal of Scientific and Industrial Research (India). 18C(7): 133-134. 2 refs.

Oil from *Cedrus deodara* compared favorably with that of *Juniperus virginiana* for microscopic work.

513. Environmental Protection Agency. 1993. **RED facts: wood oils and gums (cedarwood oil).** Fact Sheet. Washington, DC: Environmental Protection Agency, Office of Pesticide Programs. 4 p.

Cedarwood oil is a natural component of wood from the tree, *Juniperus virginiana* L. It is an active ingredient in five pesticide products that are used as repellents and feeding depressants to control moths and fleas and retard the growth of mildew. Three of these products are solid cedarwood blocks used to repel moths from clothing and retard mildew growth on fabrics. The other two products, which contain extracted cedarwood oil, are a pet tag or collar and a liquid sprayed on animal bedding. Cedar also is a major component of many non-pesticidal consumer products currently marketed in the United States.

514. Greaves, C. 1939. **Cedar leaf oils**. Canadian Forestry Products Laboratory. 18 p.

515. Guenther, E. 1942. **Essential oils and their production in the Western Hemisphere.** New York, NY: Fritzsche Brothers, Inc. 30 p.

In this popular account of the plants of the Western Hemisphere from which essential oils are obtained on a commercial basis, reference is made to the following forest trees: rosewood (*Aniba rosaeodora* var. *amazonica*) and Copaiba (*Copaiba* spp.) from the Amazon basin; *Bulnesia sarmienti* from the Gran Chaco of Paraguay; *Myroxylon pereirae* (balsam Peru) from El Salvador; *Bursera aloexylon* from Mexico; and *Betula lyenta*, *Sassafras albidum*, *Juniperus virginiana*, and *Pinus* spp. from the United States.

516. Guenther, E. 1943. **Oil of cedar wood.** Soap and Sanitary Chemicals. 19: 94-97, 109.

The red heartwood of *Juniperus virginiana* L. contains a useful oil, the main constituent of which is cedrol, a tertiary tricyclic alcohol (C15H26O). Prior to 1917, the main source of cedar wood oil was the old virgin timber used by pencil slat manufacturers. Later, owing to scarcity of this material, the oil had to be distilled more and more from sawdust of younger trees, and at the present time it is obtained almost exclusively from shavings and refuse in the processing of cedar boards and shingles. The yield of normal oil from fresh chips and dust averages 2 to 2.5 percent. As the proportion of heartwood to sapwood increases with the age of the tree, redcedars should not be felled before reaching the age of 25 years. Heartwood from either second-growth or virgin cedar contains approximately the same amount of oil. Because of its relative abundance and low cost, cedar wood oil is itself seldom adulterated, but it is frequently used to adulterate more expensive essential oils. Means for its detection are indicated. Data are given on the composition and properties of the oil of *Juniperus virginiana*, and a note is added on recent developments in the distillation of so-called cedar wood oil from *Thuja occidentalis*. The physiochemical properties of this oil are quite distinct from those of redcedar oil.

517. Hayward, F.W.; Seymour, R.B. 1948. **Determination of major constitutents of cedar oil vapor in cedar chests.** Analytical Chemistry. 20(6): 572-574. 7 refs.

A procedure is given for rapid colorimetric determination of cedrene and cedrol in cedar (*Juniperus virginiana*) chests. The method is based on a red-violet color formation resulting from the reaction of cedrene with vanillin in the presence of HCl. The cedrol is then dehydrated to cedrene with phosphoric acid and determined as above.

518. Huddle, H.B. 1936. **Oil of Tennessee red cedar.** Industrial and Engineering Chemistry. 28(1): 18-21.

Production of redcedar oil is dependent on the supply of virgin redcedar, which is being depleted rapidly. Briefly describes the history of oil production, a typical still, and the physical properties and analyses of samples of oil distilled in 1932, 1933, and 1935.

519. Huddle, H.B. 1938. **A preliminary report on the vacuum fractionation of the oil of *Juniperus virginiana*.** Journal of Tennessee Academy of Science. 13: 259-267.

520. Rabak, F. 1929. **Cedrol: its source and derivation.** American Perfume and Essential Oil Review. 23: 727-728.

521. Runeberg, J. 1960. **The chemistry of the natural order Cupressales. XVIII. Constituents of *Juniperus virginiana* L.** Acta Chemica Scandinavica. 14: 1288-1294.

Cedar wood oil contains cuparene, cedrol, widdrol, a-cedrene, and thujopsene.

522. Sievers, A.F. 1947. **The production of minor essential oils in the United States.** Economic Botany. 1(2): 148-160.

Includes accounts of the distillation of the oils of cedarwood (*Juniperus virginiana*), sassafras (*Sassafras albidum*), cedar leaf (*Thuja occidentalis*), sweet birch (*Betula lenta*), witch-hazel (*Hamamelis virginiana*).

523. Visser, J.; TerHeide, R.; VanDerLinde, L.M.; VanLier, F.P. 1988. **On the chemical composition of cedarwood oil (*Juniperus virginiana*).** Developmental Food Science. 18(10): 627-639. 44 refs.

Virginia redcedar wood oil produced by steam distillation of sawdust or finely chopped reddish heartwood of *Juniperus virginiana* is an indispensable raw material for the fragrance industry. The major constituents were sesquiterpene hydrocarbons and cedrol. The hydrocarbon fraction and cedrol were found to have an important role in producing the typical odor of the cedarwood oil. The remaining portion of the oil was analyzed using chemical, chromatographic, and spectroscopic methods. Several previously unreported oxygen-containing sesquiterpenes were identified. The synthesis of some of them is described.

524. VonRudloff, E. 1975. **Chemosystematic studies of volatile oils of *Juniperus horizontalis, J. scopulorum* and *J. virginiana*.** Phytochemistry. 14(5-6): 1319-1329. 38 refs.

525. Walker, G.T. 1968. **Cedarwood oil.** Perfume and Essential Oil Research. 59(5): 347-350. 12 refs.

Discusses the chemistry and uses of the oil and its sources, from *Juniperus virginiana*, *J. procera*, and *J. mexicana*. Wood of *J. mexicana* is said to be unsuitable for furniture, and the cedarwood oil from it is inferior to that of the other species, but it is a useful source of cedrol.

526. Whitaker, K.W.; Setzer, W.N.; Lawton, R.O. 1991. **Terpenoid constituents of the essential oil of redcedar (*Juniperus virginiana*).** American Chemical Society. 201: 33.

Christmas Tree Production

527. Alvord, B.F. 1957. **Marketing Christmas trees in Alabama**. Bull. 309. Tuscaloosa, AL: Alabama Agricultural Experiment Station. 26 p.

528. Brewer, C.W. 1975. **Results of marketing Louisiana-grown Christmas trees (*Pinus, Juniperus virginiana, Cupressus arizonica*).** For. Notes 112. Baton Rouge, LA: Louisiana State University. 3 p.

529. Brewer, C.W.; Hu, S.C. 1974. **Performance characteristics and consumer acceptance of Louisiana-grown Christmas trees.** For. Notes 109. Baton Rouge, LA: Louisiana State University. 2 p. 2 refs.

Briefly records the suitability for Christmas trees of *Pinus virginiana, P. echinata, P. taeda, P. glabra, Juniperus virginiana,* and *Cupressus arizonica*, as shown by consumer response. *P. virginiana* was clearly the preferred species.

530. Davis, T.S. 1983. **Shearing, shaping, and pruning Christmas trees (mainly *Pinus virginiana, Pinus strobus, Juniperus virginiana*, production in the South).** In: 32d Annual forestry symposium. Baton Rouge, LA: Louisiana State University, Division of Continuing Education: 52-60.

531. Garin, G.I. 1963. **Christmas tree production in Eastern redcedar and Arizona cypress plantations.** Circ. 145. Auburn, AL: Auburn University, Alabama Agricultural Experiment Station. 13 p. 7 refs.

In a plantation in central Alabama, both species required some pruning and considerable clipping to shape. Customers preferred *Cupressus arizonica* to *Juniperus virginiana* as better in color and less prickly. It was harvestable earlier (first trees at age 4 and 75 percent by age 11 vs. 8 and 15 for juniper) and more easily grown from stumps, but survival was slightly poorer.

532. Graeber, R.W. 1944. **Christmas cedars beat cotton crop**. Southern Plantmen. 105(2): 19.

At age 6 years, a 2-acre red cedar plantation yielded 630 Christmas trees for a value of $785. The plantation still had more than 500 trees per acre for future harvest.

533. Hinesley, L.E. 1990. **Latex colorant slows drying of redcedar Christmas trees.** Horticultural Science. 25(6): 673-674. 2 refs.

Eastern redcedar (*Juniperus virginiana*) Christmas trees, harvested in North Carolina in December 1987 or 1988, were coated with combinations of latex-based green colorant (Pinegreen) and needle sticker (Needleholder) and observed for 2 weeks at 20° C. Pinegreen reduced drying rates and helped to maintain a better water status following rehydration. Trees coated with Pinegreen (1:20), Pinegreen (1:20) plus Needleholder (1:20) or Pinegreen (1:20) followed by Needlehold (1:4) maintained a relatively steady water potential near -0.5 MPa. Water consumption was highest for control trees and those sprayed with combinations of Pinegreen (1:20) and Needlehold. The reduction in drying rate and the improved water status after rehydration were attributed to Pinegreen rather than Needlehold. The primary use of Pinegreen and Needlehold was cosmetic, making the trees look and feel better to customers.

534. Hinesley, L.E.; Snelling, L.K.; Goodman, S. 1993. **"Crop-Life" does not slow postharvest drying of fraser fir and eastern redcedar Christmas trees.** Horticultural Science. 28(10): 1054.

535. Hu, S.C.; Brewer, C.W. 1978. **Shearing is a necessary cultural practice for Virginia pine Christmas tree production.** Southern Journal of Applied Forestry. 2(4): 135-136.

Four species of pine (*Pinus virginiana, P. glabra, P. echinata,* and *P. taeda*), Arizona cypress (*Cupressus arizonica*), and eastern redcedar (*Juniperus virginiana*), were planted in Louisiana in 1967 and sheared (clipped) once a year from the third to fifth growing seasons between April and August. Christmas trees of salable grade were produced only from *P. virginiana* (maximum 44 percent) and *P. glabra* (maximum 24 percent), the best shearing time being April-May. Further shearing tests in plantations of *P. virginiana* showed that greatest numbers of limbs were produced and buds set after two shearings/year in the third and fourth growing seasons, and when these shearings were made in the periods April 1-May 1 and June 15-July 15. In a final test, 89 percent of trees subjected to this regime were found to be US Grade 2 or better.

536. Hu, S.C.; Main, A.C. 1986. **Growing and marketing Christmas trees in Louisiana.** Tech. Rep. 1876. Baton Rouge, LA: Louisiana State University, Louisiana Cooperative Extension Service. 24 p.

537. Kessler, G.D. 1985. **Growing and marketing Christmas trees in South Carolina.** Circ. 566 (Revised). Clemson, SC: Clemson University, Cooperative Extension Service. 13 p.

538. Moore, J.C. 1945. **Christmas tree production.** Circ. 92. Auburn, AL: Auburn University, Alabama Agricultural Experiment Station. 15 p.
Arizona cypress (*Cupressus arizonica*), redcedar (*Juniperus virginiana*), scrub pine (*Pinus virginiana*), and white pine (*Pinus strobus*) give promise of making good Christmas trees when grown in Alabama and the Southeast as erosion-control covers on sloping lands where cultivated crops are inadvisable. These and 11 other species of conifers were tested in contour rows at 4-feet spacing (2,700 to the acre) in combination with (i) native vegetation, (ii) partridge peas, (iii) *Lespedeza sericea,* and (iv) crimson clover and fescue grass. All combinations control erosion but better tree growth is given by (iv), which is a winter/early-spring crop dying in summer and forming a heavy mulch. Top-renewal studies show that several Christmas trees can be cut from one stump by allowing it to coppice and training or pruning the shoots.

539. Sowder, A.M. 1966. **Christmas trees, the tradition and the trade**. Inf. Bull. 94. Washington, DC: U.S. Department of Agriculture. 31 p.
Eastern redcedar ranked fifth in popularity among all U.S. species. In 1964 it comprised 7 percent of the Christmas tree harvest, with more than 2 million trees cut.

Pencils

540. Greaves, C.; Harkom, J.F. 1949. **Treatment of pencil slats. Parts 1 and 2.** Rep. 0-122 (Revised). Canada: Forest Products Laboratory. 45 p.
Revises a 1931 report to include further experimental results and manufacturers' opinions on the slats (western redcedar, eastern cedar, and yellow cypress) so treated. The preparation, staining, waxing, and testing procedures are detailed.

541. Hallauer, F.J. 1914. **Tests and supplies of pencil wood**. American Lumberman. 2049: 42.

542. Nichols, C.R. 1946. **The manufacture of wood-cased pencils.** Mechanical Engineering. 6(11): 956-960.
This is a fairly detailed description of the whole process of manufacture of wood-cased lead pencils, including the preparation of the wood slats, which are kiln-dried, dyed in pressure vats, and then impregnated with wax. *Juniperus virginiana* was formerly used almost exclusively for this purpose, but now that supplies of this species are almost exhausted, its place is being taken by *Libocedrus decurrens.*

543. Rehman, M.A.; Gupta, P.G. 1961. **Timber for pencil slats, its conversion, seasoning and treatment.** Journal of Timber Dryers' Presidents Association (India). 7(1): 20-26. 4 refs.
Briefly traces the history of the pencil industry in Germany, Britain, and the U.S.A., mentioning the properties required for making slats and the main timbers used (particularly *Juniperus virginiana*, *J. barbadensis*, *J. procera,* and *Libocedrus decurrens*) and describing the American method of conversion, seasoning, and treatment. Relating this experience to the development of the pencil industry in India, suggestions are made for the establishment of the pencil-slat industry there, stressing especially the suitability of such Indian species as *Cedrus deodara* and *Cupressus torulosa.*

544. White, L.L. 1907. **Production of red cedar for pencil wood**. Circ. 102. Washington, DC: U.S. Department of Agriculture, Forest Service. 19 p.
Describes the wood and its uses, with species range, silvical characteristics, and reproduction. Also describes logging methods and proposals for management.

Lumber Products

545. Alemdag, I.S. 1983. **Mass equations and merchantability factors for Ontario softwoods.** Inf. Rep. PI-X-23. Canada: Petawawa National Forestry Institute. 24 p. 3 refs.
Equations are given for oven-dry biomass of stem wood, stem bark, live branches, twigs plus needles, dead branches, and total above-ground biomass of *Pinus banksiana*, *P. strobus*, *P. resinosa*, *Picea mariana*, *P. glauca*, *Abies balsamea*, *Larix laricina*, *Thuja occidentalis*, *Juniperus virginiana,* and *Tsuga canadensis*, based on diameter outside bark (d.o.b.) and total height. Equations for predicting the percent of merchantable and unmerchantable components are also given, based on merchantable top diameter and d.o.b., or merchantable height and total height.

546. Anonymous. 1942. **Plywood (hardwood and eastern redcedar). Commercial standard CS 35-42.** (2d ed.). Washington, DC: U.S. National Burea of Standards. 24 p.
This standard provides minimum specifications for four grades of hardwood plywood made with three different types of bondage having a high, moderate, and low resistance to moisture. It covers tests, standard thicknesses, widths and lengths, tolerances, workmanship, packing, inspection, and nomenclature and definitions.

547. Anonymous. 1955. **Three North American 'cedar' timbers.** Holz-Zentralblatt. 81:132-133. 8 refs. German.
Describes *Chamaecyparis lawsoniana*, *Juniperus virginiana,* and *Libocedrus decurrens*, including

nomenclature, timber properties, uses, and grading rules.

548. Beckwith, J.R., III. 1976. **An illustration of wood color measurement.** Res. Pap. 74. Georgia: Georgia Forestry Research Council. 6 p. 17 refs.

Specimens from 21 tree species groups were examined spectrophotometrically. Average colors were plotted on a chromaticity diagram and described in terms of dominant wavelength, purity, and luminosity. A means of describing the variability of color was also developed. U.S. manufacturers of color measuring equipment are listed.

549. Betts, H.S. 1942. **American woods.** Washington, DC: U.S. Department of Agriculture, Forest Service. 1942-44.

550. Betts, H.S. 1953. **American woods.** Washington, DC: U.S. Department of Agriculture, Forest Service: 4. 7 refs. (Revised 1954).

Describes silvicultural characters, wood properties, and uses of *Juniperus virginiana.*

551. Browne, F.L.; Rietz, R.C. 1949. **Exudation of pitch and oils in wood.** Res. Rep. 1735. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p.

Pitch exudation is most successfully prevented by heat treatment at a high temperature for long enough to volatilize the turpentine, leaving the pitch with so little turpentine that it will remain hard at any temperature. Recommended kiln schedules to attain this are given for different species. Whether solvent seasoning, which removes a large proportion of pitch from sapwood during drying, will replace kiln drying for pine and similar woods will depend largely on the value of the extractives and other economic factors. Discoloration of paint over heartwood is largely caused by high moisture content of the wood during or soon after painting, and rarely occurs on boards kept below 10 or 12 percent moisture content while the paint is drying; some paints are more easily discolored than others. Spirit varnishes can be used as sealers to prevent discoloration. The general remedy for the prevention of exudation of the volatile oils of cedars is a suitable heat treatment; modifications are necessary for eastern redcedar and Soanishg cedar in order to retain enough oil to produce the aromatic smell. Recommendations are made to lumber producers for preventing pitch and oil exudations by seasoning and to lumber users for treating these if they occur.

552. Ferguson, E.R.; Lawson, E.R. 1974. **Eastern redcedar: an American wood**. WO-260. Washington, DC: U.S. Department of Agriculture, Forest Service. 6 p.

553. Grosenbaugh, L.R.; Arend, J.L. 1949. **International rule modified for small eastern redcedar (*Juniperus virginiana*) logs.** Journal of Forestry. 47(9): 736, 738-739.

554. Hanks, L.F. 1979. **Cubic-foot tree volumes and product recoveries for eastern redcedar in the Ozarks.** Res. Note NE-283. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

Volume prediction equations are derived from data of diameter outside bark (d.o.b.) and height from stump to 3 inches d.o.b. from 91 *Juniperus virginiana* trees of 5-12 inches d.o.b., and tables of gross tree volume (volume u.b. from stump to 3 inches d.o.b.), cant volume, and sawmill residue volume are given.

555. McGinnes, E.A., Jr. 1975. **Influence of incandescent and fluorescent light on the color of unfinished heartwood of black walnut and eastern redcedar.** Wood Science. 7(4): 270-279. 10 refs.

Stresses the inadequacy of present knowledge of color changes in wood, and describes the design and construction of equipment to evaluate the effects of interior lighting on the color properties of wood. Incandescent and fluorescent lights significantly changed the spectral properties of small samples of wood of *Juniperus virginiana* and *Juglans nigra*. The changes in reflectance of all the samples, which were more pronounced after 15 weeks than after 5 weeks, were greatest and negative in the blue and red portions of the spectrum, giving a 'yellowing' effect. Redcedar was affected more than walnut. Previous extraction with methanol reduced the color changes.

556. McGinnes, E.A., Jr.; Dingeldein, T.W. 1971. **Effect of light, extraction, and storage on color and tackiness of clear-finished eastern redcedar.** Forest Products Journal. 21(1): 53-60. 7 refs.

Small specimens of *Juniperus virginiana* wood (used for the manufacture of small decorative objects because of its bright red heartwood enclosing bands of lighter sapwood) suffered considerable color changes when exposed for 120 hours to visible and, even more so, to ultraviolet light, but not when exposed to infrared light. Extraction with methanol and, to a lesser extent, the use of a polyvinyl-alcohol sealer, reduced color changes. Only the methanol treatment prevented softening of the nitrocellulose lacquer used. Electron-microscope photos are presented of the extractive incrustations of heartwood cells.

557. McGinnes, E.A., Jr.; Melcarek, P.K. 1976. **Equipment for studying the color characteristics of wood at the cellular level.** Wood Science. 9(1): 46-50. 8 refs.

Describes, with photographs, equipment for monitoring both reflectance and transmittance properties of the visible spectrum of wood at the cellular level. There are three separate units: a light source and wavelength monitoring system; a light microscope with fluorite optics and facilities for measuring the programming area and shape of the microscopic field; and a data sensing the read-out system suitable for digital display or computer tape preparation. Preliminary investigations of transmittance properties of sapwood and heartwood of *Juniperus virginiana* are presented with suggestions for future studies.

558. Schwartz, H. 1949. **Structural boards from cedar bark.** Paper Trade Journal. 128(24): 27-28.

Low-density insulating boards and hardboards were made from eastern cedar (*Juniperus virginiana*) and western redcedar (*Thuja plicata*) barks and tested for strength, specific gravity, and moisture resistance. Low density boards of eastern cedar were within the specified range for tensile strength and specific gravity; those from western redcedar alone did not show adequate tensile strength but did so when 10 percent sulphite pulp screenings were added. The water resistance of most of the boards was good and could be controlled within limits by sizing. Hardboards from cedar barks did not meet current strength requirements for wood-fiber hardboards.

559. Stajduhar, F. 1982. **Foreign timbers in European woodworking industry.** Drvna Industrija. 33: 3-6. Serbo-Croatian.

Brief notes are given, in separate issues of the journal, on the characteristics and properties of No. 3/4 African pencil cedar (*Juniperus procera*); No. 5/6 American redcedar (*Juniperus virginiana*).

560. Veer, J.J.G.; King, F.W. 1963. **Moisture blistering of paints on house siding.** Rep. 1024. Canada: Canadian Department of Forestry. 25 p. 21 refs.

Laboratory studies showed that free water is necessary for blistering to occur, and that water vapor alone does not cause blistering. Wood species was found to be one of the factors affecting susceptibility to blistering, which decreased in the order *Thuja plicata*, *Pseudotsuga taxifolia*, *Chamaecyparis nootkatensis*, *Pinus strobus*, *Juniperus virginiana*, *Pinus resinosa*, and *Picea* spp.

561. Zimmerman, A.H.; Potts, S.M. 1952. **Cedar (*Juniperus virginiana*) volume tables for the Tennessee Valley.** Tech. Note. Nashville, TN: Tennessee Valley Authority. 8 p.

Repellents and Inhibitors

562. Adams, R.P. 1989. **Bioresources of termiticides from junipers. Phase 1.** Waco, TX: Bio-Renewables Institute, Inc.; Washington, DC: National Science Foundation: Small Business Innovation Research Programs. 3 p.

The purpose of the research was to determine the termiticidal activities in various extractive fractions from juniper wood and leaves. No-choice, treated paper trials showed termiticidal activities in: hexane extracts from the heartwood of both species and in the methanol extract from the *J. virginiana* wood; hexane extracts from the leaves of both species and in the methanol extract from *J. virginiana* leaves. Next, the extracts were impregnated into yellow pine blocks at known concentrations. No-choice trials revealed that the highest termiticidal activities were in hexane leaf extract and volatile leaf oil of *J. virginiana* and the methanol extract from the wood of *J. virginiana*. Choice trials (treated and untreated blocks available for feeding) resulted in a few termites being killed but also showed that almost all the juniper extracts have anti-feedant properties, as the termites generally avoided the treated blocks. Because the hexane leaf extracts contain considerable waxes, treating wood with these extracts renders wood water-proof, which presents another defense against termites and rotting.

563. Adams, R.P.; McDaniel, C.A.; Carter, F.L. 1988. **Termiticidal activities in the heartwood, bark/sapwood and leaves of *Juniperus* spp., from the USA.** Biochemical Systematics and Ecology. 16(5): 453-456.

Twelve taxa of *Juniperus* from the United States were investigated for termiticidal activities of the heartwood, bark/sapwood, and leaves. All taxa exhibited termiticidal activities for the fresh heartwood sawdusts. All except *Juniperus scopulorum* showed high termiticidal activities for the bark/sapwood sawdusts. The activity in the sawdusts could be removed by washing with hexane followed by methanol for about half of the taxa. Both hexane and methanol (sequential) extracts of the heartwoods showed termiticidal activities. Hexane and methanol (sequential) extracts of intact leaves displayed termiticidal activities for most of the taxa. (The following species are also discussed: *J. ashei*, *J. californica*, *J. deppeana*, *J. erythrocarpa*, *J. monosperma*, *J. occidentalis* var. *australis*, *J. osteosperma*, *J. pinchotii*, and *J. virginiana*.)

564. Appel, A.G.; Mack, T.P. 1989. **Repellency of milled aromatic eastern redcedar to domiciliary cockroaches (*Dictyoptera*: *Blattellidae* and *Blattidae*).** Journal of Economic Entomology. 82(1): 152-155. 21 refs.

Repellency and toxicity of milled aromatic eastern redcedar (*Juniperus virginiana*) flakeboard were evaluated against *Blattella germanica, Periplaneta americana,* and *P. fuliginosa.* Cedar flakeboard was repellent to *B. germanica* in Ebeling choice-box tests but was not repellent to either *P. americana* or *P. fuliginosa.* The degree of repellency for *B. germanica* increased linearly ($P < 0.05$) with surface area of cedar in the choice box, but in no case were more than 63 percent of the cockroaches repelled. Cedar boards did not cause cockroach mortality in continuous-exposure tests. Cedar flake may be useful as a repellent in the integrated pest management of indoor cockroaches.

565. Carter, F.L.; Smythe, R.V. 1974. **Feeding and survival responses of *Reticulitermes flavipes* (Kollar) to extractives of wood from 11 coniferous genera.** Holzforschung. 28(2): 41-45. 18 refs. German.

In a laboratory experiment in which *R. flavipes* was force-fed on heartwood blocks of 11 species, *Chamaecyparis lawsoniana, Juniperus* sp. (*J. virginiana*), *Thuja plicata, Taxodium distichum, Sequoia sempervirens,* and *Pinus ponderosa* were least favored by the termites. In a choice test, the same species proved unfavorable, except for *C. lawsoniana*, which was omitted because of its toxicity. Some variation in favorability was found in wood of *T. plicata* and *Tsuga heterophylla* from more than one source. In force-feeding tests on sawdusts, solvent-extracted sawdusts, and the corresponding wood extracts on filter paper, overall survival was best on test materials of *Pseudotsuga menziesii, Abies lasiocarpa,* and *Larix occidentalis.*

566. Ferenczy, L. 1956. **TI: occurrence of antibacterial compounds in seeds and fruits.** Acta Biologica. 6(3/4): 317-323. 25 refs.

Species inhibiting growth of Gram-positive micro-organisms included *Abies alba, Picea glauca, Picea abies* var. *chlorocarpa, Pinus nigra, P. strobus, Pseudotsuga taxifolia, Juniperus chinensis, J. virginiana,* and *Thuja occidentalis. Fraxinus excelsior* and *F. pennsylvanica* inhibited both Gram-positive and Gram-negative groups.

567. Hartwell, J.L.; Johnson, J.M.; Fitzgerald, D.B.; Belkin, M. 1953. **Podophyllotoxin from *Juniperus* species; savinin.** American Chemical Society. 75(1): 235-236.

Podophyllotoxin, a tumor-damaging component of podophyllin, was isolated from Savin (dried needles of an evergreen stated to be *J. sabina*), *J. virginiana, J. lucayana, J. scopulorum* , and *J. sabina* var. *tamariscifolia*, male plant. Savinin, a new substance inactive towards tumors, was also obtained from Savin.

568. Heston, W.E. 1975. **Testing for possible effects of cedar (*Juniperus virginiana*) wood shavings and diet on occurrence of mammary gland tumors and hepatomas in C3H-A and C3H-AvyfB mice (Bedding).** Journal of the National Cancer Institute. 54(4): 1011-1014.

569. Kupchan, S.M.; Hemingway, J.C.; Knox, J.R. 1965. **Tumor inhibitors VII. Podophyllotoxin, the active principle of *Juniperus virginiana*.** Journal of Pharmaceutical Sciences. 54(4): 659-660. 3 refs.

Alcoholic extracts of leaves and twigs showed significant inhibitory activity; similar activity was also shown by extracts of other species, e.g., *J. occidentalis, J. scopulorum,* and *J. procera.* Systematic fractionation of the extract of *J. virginiana* led to the isolation and characterization of podophyllotoxin as the active principle.

570. McDaniel, C.A.; Klocke, J.A.; Balandrin, M.F. 1989. **Major antitermitic wood extractive components of eastern redcedar, *Juniperus virginiana*.** Material und Organismen. 24(4): 301-313. 25 refs.

The major extractive components of *J. virginiana* were initially examined by capillary gas chromatography/mass spectrometry. They were separated by chemical partitioning, silica gel column chromatography, and reverse-phase high performance liquid chromatography. The structures of the major toxic components were verified by infrared and H-nuclear magnetic resonance spectroscopy. Bioassays were performed using *Reticulitermes flavipes, R. virginicus,* and *Coptotermes formosanus.* The antitermitic activity was primarily contained in the neutral extractive fraction, with the sesquiterpene alcohol widdrol exhibiting the highest toxicity. Cedrol also exhibited some toxic activity, but less than that of widdrol.

571. Sabine, J.R. 1975. **Exposure to an environment containing the aromatic redcedar, *Juniperus virginiana*: procarcinogenic, enzyme-inducing and insecticidal effects (Mice, *Elasmolomus sordidus, Plodia interpunctella, Tyrophagus putrescentiae*).** Toxicology. 5(2): 221-235.

572. Sighamony, S.; Anees, I.; Chandrakala, T.S.; Osmani, Z. 1984. **Natural products as repellents for *Tribolium castaneum* Herbst.** International Pest Control. 26(6): 156-157. 6 refs.

When oils of clove, cedarwood (*Juniperus virginiana*), and karanja (*Pongamia glabra*) and an acetone extract of black pepper (*Piper nigrum*) were tested in India by a choice method to determine their repellent effects on adults of *Tribolium castaneum*, the cedarwood, karanja, and pepper products were found to be more potent than the standard repellent dimethyl phthalate. Karanja oil and pepper extract were rated as the most repellent at the highest concentration tested (10.38 mg/cm^3) but were less repellent at the lowest concentration tested (2.59 mg/cm^3). Karanja oil appeared to retain its repellent effect strongly over the 8 weeks of the experimental period.

573. Sighamony, S.; Anees, I.; Chandrakala, T.; Osmani, Z. 1986. **Efficacy of certain indigenous plant products as grain protectants against *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.).** Journal of Stored Products Research. 22(1): 21-23. 6 refs.

Oils of clove, cedarwood (*Juniperus virginiana*), and karanja (*Pongamia glabra* [*P. pinnata*]), at doses of 25-100 p.p.m., and acetone extracts of pepper (*Piper nigrum*) provided protection to wheat against the curculionid *Sitophilus oryzae* and the bostrichid *Rhyzopertha dominica* for up to 60 and 30 days of exposure, respectively. Initially, and after 15 days, all the oils gave complete mortality of *S. oryzae*. The persistence of toxicity was ranked clove, pepper, karanja, and cedarwood. With *R. dominica*, both toxicity and persistence were lower and were ranked pepper, karanja, cedarwood, and clove. The viability and water absorption of treated seeds were normal.

574. Sweetman, H.L.; Benson, D.A.; Kelley, R.W., Jr. 1953. **Efficacy of aroma of cedar in control of fabric pests.** Journal of Economic Entomology. 46(1): 29-33. 7 refs.

The aroma of cedar oil (from the heartwood of *Juniperus virginiana*) in a commercial cedar plaster had no repellent or toxic effects on *Tineola bisselliella*, *Attagenus piceus*, or *Anthrenus vorax*. No definite conclusion could be reached concerning the possible protective value of the aroma of cedar in well-fitting chests.

Other Products

575. Fergusson, J.A. 1938. **Comparative durability of shingles and shingle nails.** Bull. 353. State College, PA: Pennsylvania Agricultural Experiment Station. 25 p.

Tests made under favorable atmospheric conditions indicate that shingles of untreated redcedar and redwood were durable for 25 years as were shingles of southern yellow pine that had been treated with creosote. Shingles of treated chestnut were durable while those of treated pitch pine were not durable. The preservative treatment materially lengthened the life of shingles of durable wood, resulting in less warping, splitting, and surface weathering, and shingle nails lasted longer when used with treated shingles.

576. Hemmerly, T.E. 1970. **Economic uses of eastern red cedar.** Economic Botany. 24(1): 39-41. 7 refs.

Juniperus virginiana is now of minor economic importance in the eastern U.S.A. because of its limited availability, and is confined to the following uses (in order of decreasing value): fence posts; furniture; cedar oil; ornamental planting; Christmas trees; souvenirs; and kindling, shavings, etc.

577. Kubes, G.J. 1984. **The effect of wood species on kraft recovery furnace operation - an investigation using differential thermal analysis.** Journal of Pulp and Paper Science. 10(3): 63-68. 8 refs.

Activation energies of spent liquors were calculated for the following Canadian species: black spruce, jack pine, balsam fir, coastal western hemlock and Douglas fir, interior redcedar (*Juniperus virginiana*), poplar, sugar maple, and white birch (*Betula papyrifera*) and three mixtures, viz., eastern softwoods, western softwoods, and hardwoods. Redcedar and jack pine had higher activation energies than other softwoods; this was attributed to the type and quantity of resin in the wood. Sugar maple and white birch had lower activation energies than poplar.

578. Laudani, H.; Clark, P.H. 1954. **The effects of red, white and South American cedar chests on the various stages of the webbing clothes moth and the black carpet beetle.** Journal of Economic Entomology. 47(6): 1107-1110.

Newly made chests of *Juniperus virginiana* (24), *Chamaecyparis thyoides* (16-20), *Cedrela odorata* (16), and *Pinus strobus* (control), were tested over 3 1/2 years for their toxicity at various ages to all stages of *Tineola bisselliella* and *Attagenus piceus*. All cedars had inhibiting effects on eggs (if laid in the chest), on larvae (particularly the younger) of both insects, and on adults of the moth, but these effects are only partial and are early lost.

579. Maga, J.A.; Chen, Z. 1985. **Pyrazine composition of wood smoke as influenced by wood source and smoke generation variables.** Flavour Fragrance Journal. 1(1): 37-42. 46 refs.

In the context of using wood smoke in food processing, results are reported from a study of *Quercus alba*, *Q. rubra*, *Juglans nigra*, *Castanea dentata*, *Malus pumila*, *Prunus speciosa*, *Alnus glutinosa*, *Sequoia sempervirens*, *Populus tremuloides*, *Betula alba*, *Acer saccharum*, *Juniperus virginiana*, *Carya laciniosa*, *Pseudotsuga menziesii*, and *Pinus contorta*.

580. Plaster, K.; Johnson, B.D.; Sifford, D.H. 1992. **Zeolite cracking of *Juniperus virginiana* (eastern redcedar) ether extracts into high-grade fuel products.** SAAS Bull. 5. Cookeville, TN: Biochemistry and Biotechnology, Southern Association of Agriculture Scientists: 43-47.

581. Walters, C.S.; McMillan, F.W. 1955. **Report on Project 301-C. Preservative treatment of fence posts with toxic oil solutions by cold-soaking, dipping and brushing.** For. Note. 52, 54. Champaign, IL: University of Illinois Agricultural Experiment Station: 4.

Gives tabulated data on service tests of green ash, river birch, cottonwood, sassafras, sycamore, tupelo, willow, eastern redcedar, shortleaf pine, and loblolly pine, treated with different concentrations of Cu naphthenate and PCP.

582. Walters, C.S.; Meek, W.L. 1951. **The cold-soak preservative treatment of eastern redcedar.** For. Note 27. Champaign, IL: University of Illinois Agricultural Experiment Station: 1.

Satisfactory penetration was obtained by cold soaking *Juniperus virginiana* fence posts in a diesel oil solution of pentachlorophenol.

WILDLIFE RELATIONSHIPS

583. Belthoff, J.R.; Ritchison, G. 1990. **Roosting behavior of postfledging eastern screech owls.** AUK. 107(3): 567-579.

We examined roosting behavior of adult and juvenile eastern screech-owls (*Otus asio*) during the postfledging period using radiotelemetry. We located 1,107 screech-owl roost sites in 39 species of trees, shrubs, and vines. Nearly half (48 percent) were in eastern redcedar (*Juniperus virginiana*), shagbark hickory (*Carya ovata*), black locust (*Robinia pseudoacacia*), and black walnut (*Juglans nigra*). Owls used open limb roosts (46 percent), tangle roosts (36 percent), and conifer roosts (17 percent). Tree cavities were used rarely (n = 3). Open limb roosts were more common early in the postfledging period, whereas use of tangles for roosting increased later in the season. The mean roost site was 10.2 ± 0.2 m high in a tree 14.2 ± 0.2 m tall with a d.b.h. (diameter at breast height) of 23.8 ± 0.4 cm. Based on a random sample of 800 potential roost trees, screech-owls used significantly shorter trees than those available. However, we found no significant difference in mean d.b.h. between used and available trees. On average, screech-owls roosted 252 ± 5.3 m from their nests and moved 64 ± 3.5 m between daily roost sites. Juvenile and adult owls differed little in selection of roost sites, although juveniles used a greater variety of trees. Paired adults did not differ in roost-site use. The mean distance between roost sites of young owls and their parents (both male and female) increased significantly after the fifth week postfledging. After this period, juvenile owls roosted unaccompanied by adults much more often, which suggests young gain some independence from adults. We noted significant differences among families for all roost-site variables, with most variation explained by differences in areas occupied by families. Entire families roosted together in the same tree 31 ± 7.5 percent of the time (range: 16.7-51.5 percent). Coefficients of association of roost sites between adults and their young were similar for both members of a pair. We suggest that adult eastern screech-owls do not divide their broods.

584. Bugbee, R.E.; Riegel, A. 1945. **Seasonal food choices of the fox squirrel in Western Kansas.** Transactions of the Kansas Academy of Science. 48(2): 199-203. 3 refs.

The following choice of food by *Sciurus niger rufiventer* was noted at Hays, Ellis County, Kansas: Late summer and autumn: nipple galls on *Celtis occidentalis*, *Juniperus virginiana* berries, pods of *Gleditsia triacanthos*, walnuts, bark of *Elaeagnus angustifolia*, and seeds of *Cucurbita foetidissima*. Summer: petiole galls on *Populus deltoides* or *P. sargentii*, seeds of *Celtis occidentalis*. Winter and spring: seeds and buds of *Ulmus americana*, exudations on the branches of walnut, and fruit of *E. angustifolia*. The only serious damage was to *E. angustifolia*. The branches stripped of bark died, though the trees as a whole recovered.

585. Clapp, J.R. 1977. **Wildlife habitat evaluation of the unchannelized Missouri River in South Dakota.** Brookings, SD: South Dakota State University, Department of Wildlife and Fish. 114 p. M.S. thesis. 80 refs.

Areas of eight habitats were identified, delineated, and measured along the unchannelized Missouri River in South Dakota. Agricultural and urban developments existed on 60 percent of the land within 1 km of the river. Six habitat types made up the non-developed land in the study area: cottonwood-dogwood (16 percent), cottonwood-willow (9 percent), elm-oak (7 percent), cattail marsh (3 percent), sand dune (3 percent), and sand bar (1 percent). All non-developed habitats except sand bar were sampled to obtain vegetative composition and to determine their value to wildlife. The value of each habitat to nine faunal groups of wildlife was subjectively rated from 0 (poor) to 10 (excellent). An interspersion value was added to arrive at total habitat value. Cattail marshes were typically monospecific stands of narrow-leaved cattail (*Typha angustifolia*) in slow-moving, shallow water. This habitat was rated highest in its value to wildlife (8.9), and was especially important for aquatic furbearers, waterfowl, other water and marsh birds, and herptiles. Cottonwood-dogwood habitat generally consisted of three layers of vegetation: eastern cottonwood (*Populus deltoides*), redosier dogwood (*Cornus stolonifera*), and poison ivy (*Toxicodendron rydbergii*). A rating of 7.9 was given this habitat, and conditions were good for all terrestrial faunal groups except herptiles. Cottonwood-willow stands were dominated by eastern cottonwood and various willows (*Salix* spp.) and occurred in a clumped distribution. Woody vegetation was interspersed with open areas covered with grasses, forbs, sedges (*Carex* spp.), or horsetail (*Equisetum* spp.), forming a system of edges. The total habitat value for cottonwood-willow communities was 7.5; big game and upland game birds found conditions excellent there. Elm-oak habitat was comprised of a wide variety of trees; the most important were slippery elm (*Ulmus rubra*), bur oak (*Quercus macrocarpa*), box elder (*Acer negundo*), and eastern redcedar (*Juniperus virginiana*). Grazing of the understory and ground cover reduced the value of this habitat to most types of wildlife (6.7). Sand dunes were deposited by floods occurring prior to the closure of Fort Randall Dam and Lewis and Clark Dam. Vegetation consisted of older cottonwoods probably existing prior to the floods and younger cottonwood/willow stands, interspersed with bare sand and patches of alfalfa. Conditions were fair for most species of wildlife (5.3), with terrestrial birds and herptiles receiving the most benefit. Future alterations of the unchannelized river in the study area should be planned with an objective of leaving areas of all six habitats on non-developed land to maintain the diversity of wildlife presently found there.

586. Crawford, H.S., Jr. 1961. **Eastern redcedar**. In: Deer browse plants of southern forests. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 34-35.

Describes eastern redcedar's site requirements, susceptibility to fire, growth habits of foliage, use by deer, use of berries by wildlife, durability of wood, and aggressiveness on poor range and croplands.

587. Dunkeson, R.L. 1955. **Deer range appraisal for the Missouri Ozarks**. Journal of Wildlife Management. 19: 358-364.

Eastern redcedar and shortleaf pine have been destructively browsed during winter, both rank low in palatability, and browsing was heaviest during mast shortages.

588. Gawlik, D.E.; Bildstein, K.L. 1990. **Reproductive success in nesting habitat of loggerhead shrikes in north-central South Carolina.** Wilson Bulletin. 102(1): 37-48. 25 refs.

A study during 1986-1987 showed that 63 percent of nests of loggerhead shrikes (*Lanius ludovicianus*) were in redcedar (*Juniperus virginiana*). Shrikes nesting in redcedar fledged one more young per nest than shrikes nesting in other tree species. The reported relatively high reproductive success of loggerhead shrikes does not explain the recent decline in shrike populations in the region.

589. Grand, J.B.; Mirarchi, R.E. 1988. **Habitat use by recently fledged mourning doves in east central Alabama.** Journal of Wildlife Management. 52(1): 153-157. 9 refs.

Conifer (*Juniperus virginiana* and *Pinus taeda*) stands with low basal area and stem densities, large amounts (more than 50 percent) of unoccupied space from ground cover to midstory, and dense clumps of vegetation in strata less than 3 m tall provided good habitat for recently fledged *Zenaida macroura*. The maintenance of such stands of conifers may be important to fledgling survival.

590. Hahn, H.C., Jr. 1945. **Cedar important to wildlife.** Texas Game and Fish. 3(12): 27-28.

Discusses the spread of eastern redcedar on grassland due to absence of fire and to excessive grazing. Although it is not important as a food for domestic livestock, eastern redcedar is very valuable in the prevention of erosion and as habitat and winter food for wildlife.

591. Halls, L.K. 1977. **Eastern redcedar/*Juniperus virginiana* L. (Woody plants as wildlife food, species).** Gen. Tech. Rep. SO-16. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 105-107.

592. Halls, L.K.; Crawford, H.S., Jr. 1960. **Deer-forest habitat relationships in North America.** Journal of Wildlife Management. 24: 387-395.

When deer populations are heavy, young redcedar may have a hedged appearance from overbrowsing.

593. Lochmiller, R.L.; Boggs, J.F.; McMurry, S.T.; Leslie, D.M., Jr.; Engle, D.M. 1991. **Response of cottontail rabbit populations to herbicide and fire applications on cross timbers rangeland.** Journal of Range Management. 44(2): 150-155.

Knowledge of how resident wildlife populations respond to brush management strategies is especially limited for rangelands in the cross timbers vegetation type of Oklahoma. We examined how cottontail rabbit (*Sylvilagus floridanus*) density and habitat use were influenced by applications of tebuthiuron or triclopyr, with and without annual burning, on cross timbers rangeland. Line transect flush-counts, mark-recapture live trapping, and fecal pellet counts were used to evaluate seasonal differences in population density among five brush control treatments. Cottontail rabbits (n = 225) were flushed along 362 km of line transects during five census periods. Density in winter was consistently lower than in summer for all treatments, except for the untreated control in winter 1987. Line transect density estimates ranged from 0 to 1.975 rabbits/ha and suggested that herbicide and annual burning treatments had a positive influence on cottontail rabbit populations compared to untreated controls. Mark-recapture density estimates did not differ among treatments. Fecal pellet counts were greater on herbicide-treated pastures than on an untreated control in both spring and fall. Prairie-eastern redcedar (*Juniperus virginiana* L.) and forest-prairie ecotone habitats were utilized greater than expected by cottontail rabbits. Mature hardwood overstory and mixed-brush habitats were avoided. Tebuthiuron and triclopyr effectively decreased hardwood overstory and increased preferred habitats for cottontail rabbits.

594. Phillips, F.J. 1910. **The dissemination of junipers by birds**. Forestry Quarterly. 8: 60-73.

Birds are responsible for most of the dissemination of the junipers. Lists birds that eat juniper berries.

595. Read, R.A. 1948. **Winter browsing of cedar by Ozark deer.** For. Notes. 55. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station.

During the winter of 1947-1948, white-tailed deer in heavy concentrations browsed almost three-fourths of all cedar trees under 5.5 feet in height, eating 85 percent of the terminal height growth these trees had made during the previous growing season.

596. Segelquist, C.A.; Green, W.E. 1968. **Deer food yields in four Ozark forest types.** Journal of Wildlife Management. 32(2): 330-337. 7 refs.

Sparsely timbered redcedar (*Juniperus virginiana*) glades and bottomland hardwoods produced the most herbage and evergreen browse. Browsing was heaviest where mast was scarce. The more densely stocked hardwood types grew less forage, but were the main source of winter food in good mast years. Average mast yields were 5-10 times greater than average winter browse yields.

597. Swengel, S.R.; Swengel, A.B. 1992. **Roosts of northern saw-whet owls in southern Wisconsin.** Condor. 94(3): 699-706.

We described 623 roosts of northern saw-whet owls (*Aegolius acadicus*) in southern Wisconsin from 1986 to 1990. Roosts were in seven species of trees, with 98 percent in white (*Picea glauca*) and Norway (*P. abies*) spruces, red (*Pinus resinosa*) and jack (*P. banksiana*) pines, and eastern redcedar (*Juniperus virginiana*). Mean roost height was 4.05 ± 2.21 m (range 0.15-11.20 m) in a 9.15 ± 3.40 m tall tree. Roosts averaged 46.6 ± 43.4 cm from the trunk on a 150.4 ± 69.6 cm long limb. Roost characteristics varied according to tree species, size, and shape. Mean roost height ranged from 1.5 ± 0.4 m in eastern redcedars to 6.9 ± 1.3 m in red pines. Roost height correlated positively with tree height and negatively with distance of roost from trunk. Distance of roost from trunk correlated positively with limb length. Directions of roosts relative to the trunk were random. Mean roost height and height of roost tree increased with time. Most roosts afforded good cover from above and most sides. Saw-whet owls chose roosts that provide concealment, not those of a particular height. Roosts conferred thermal benefits on owls. Behavior of roosting saw-whet owls suggests that the owls' motionlessness when approached by humans is a camouflaging strategy.

598. Thompson, F.R., III; Fritzell, E.K. 1988. **Ruffed grouse winter roost site preference and influence on energy demands.** Journal of Wildlife Management. 52(3): 454-460. 25 refs.

A study at the Ashland Wildlife Research Area, Missouri, showed that ruffed grouse (*Bonasa umbellus*) had a strong preference for roosting in *Juniperus virginiana* canopies. Roosts in and under *J. virginiana* provided less thermal benefit than snow roosts (rarely available), but more benefit than deciduous roosts. Management implications are discussed.

599. Thompson, F.R., III; Fritzell, E.K. 1989. **Habitat use, home range, and survival of territorial male ruffed grouse.** Journal of Wildlife Management. 53(1): 15-21. 27 refs.

Habitat preference, home range, daily movement, and survival of territorial male ruffed grouse (*Bonasa umbellus*) were investigated in the Ashland Wildlife Research Area in central Missouri during 1984-1987. The study area comprised a variety of habitats, including oak (*Quercus* sp.)/hickory (*Carya* sp.) pole and sawtimber stands (63 percent), mixed sapling to pole-size eastern redcedar (*Juniperus virginiana*)/hardwood stands (16 percent), pine (*Pinus* spp.) plantations (4 percent), open areas (9 percent) and 1- to 4-year-old clearcuts (2 percent of the area). Thirty-two male grouse were equipped with radio transmitters, and an average of 55 locations per grouse was obtained. Ruffed grouse did not show strong habitat preference in locating their home range, but within their home range grouse strongly preferred mixed cedar/hardwood areas during spring-summer and autumn-winter.

600. Thompson, F.R., III; Fritzell, E.K. 1989. **Habitat differences between perennial and transient**

drumming sites of ruffed grouse. Journal of Wildlife Management. 53(3): 820-823.

We determined habitat differences among perennial, transient, and random non-drumming sites of ruffed grouse (*Bonasa umbellus*) from vegetation measurements. Perennial drumming sites had more eastern redcedar (*Juniperus virginiana*) stems per hectare, greater eastern redcedar canopy closure, greater understory density, and less deciduous canopy closure than transient and non-drumming sites. Vegetation characteristics of transient sites were more similar to non-drumming than perennial sites. We suggest perennial drumming sites were in higher quality habitat, and the low dense cover provided by eastern redcedar is an important component of grouse habitat in areas without suitable hardwood regeneration in Missouri.

601. Tyler, J.D. 1992. **Nesting ecology of the loggerhead shrike in southwestern Oklahoma.** Wilson Bulletin. 104(1): 95-104.

Loggerhead shrike (*Lanius ludovicianus*) nests were studied in southwestern Oklahoma (U.S.A.) from 1985 through 1988. Pairing began in late February to early March, and completed nests were found from 13 March to 20 June. Nesting peaked in mid-April, with second nestings from late May to late June. Average length of the nesting season was 11 weeks. Almost one-third of all nests were built in Osage orange (*Maclura pomifera*) trees, but netleaf hackberry (*Celtis reticulata*), Chinese elm (*Ulmus pumila*), and eastern redcedar (*Juniperus virginiana*) were also used frequently. Mean nest height was 3 m, and average clutch size was 5.8. At least one egg hatched in 84 percent of clutches. A mean of 16.9 days was required for incubation, and the average fledging period was 16.8 days. Probability of survival using Mayfield's (1961, 1975) method was 46 percent.

602. Van Dersal, W.R. 1938. **Utilization of woody plants as food by wildlife**. Transactions of the 3d North American Conference. 1938: 768-775.

Seventy wildlife species were reported using eastern redcedar, the widest use of any woody plants in North America.

603. White, J.; Lloyd, M.; Karban, R. 1982. **Why don't periodical cicadas normally live in coniferous forests?** Environmental Entomology. 11(2): 475-482. 20 refs.

An unusual occurrence of *Magicicada* spp. in a white pine-hemlock (*Pinus strobus*-*Tsuga canadensis*) plantation in Ohio is documented. Historical information suggests that cicadas invaded this plantation when intermixed deciduous species were available for oviposition. Subsequent studies showed that hatching success is far better in deciduous plants than in pines. The reduction in pines is attributed to resin secretion, which seals the egg-nests shut and prevents the eggs from hatching. Of the three evergreen species examined, hatching success was poorest in white pine, reasonably good in juniper (*Juniperus virginiana*), and intermediate in hemlock. The dense emergence found in the pine-hemlock plantation indicates that the nymphs may be able to feed on the roots of hemlocks or pines or both. If so, then poor hatching success in resinous twigs may be the only barrier preventing *Magicicada* spp. from becoming economic pests in coniferous plantations and forests.

604. Whitford, P.C.; Whitford, P.B. 1988. **A note on nurse trees and browsing.** Ann Arbor, MI: Michigan Botanical Club. 27(4): 107-110.

ECOLOGICAL RELATIONSHIPS

605. Allard, H.A.; Leonard, E.C. 1943. **The vegetation and floristics of Bull Run Mountain, Virginia.** Castanea. 8: 1-64. Ukrainian.

An ecological and floristic survey was made of the Bull Run Mountain and Pond Mountain highlands of Virginia, located about 40 miles from Washington, DC. This paper gives a brief account of the vegetation of the region and lists all the vascular plants collected or known to occur within the area. The original forest of the Bull Run highlands was oak/chestnut in composition, the dominant species being *Quercus montana* (the major dominant) and *Castanea dentata*, together with *Quercus rubra*, *Nyssa sylvatica*, *Liriodendron tulipifera,* and *Carya*. Following the elimination of chestnut, the composition of the forest is rapidly changing into an oak/hickory association. On the thin, sandy, porous soils of some of the drier ridges, *Quercus montana* forms almost pure stands with hickory reproduction becoming established in some situations. These dominant chestnut oak stands represent an edaphic climax; the original climax type on the deeper and moister soils was largely a mixed mesophytic forest of white oak, chestnut oak, red oak, black oak, black gum, hickory, tulip poplar, white ash, and some beech. Abandoned lands and pastures as a rule revert quickly to forest, mainly of pines, cedars, black locust, persimmon, and tulip poplar. The most aggressive conifers are scrub pine (*P. virginiana*) and redcedar (*Juniperus virginiana* var. *crebra*). Other conifers found in the area are *Pinus strobus*, *P. pungens*, *P. rigida,* and *P. echinata*.

606. Anonymous. 1949. **Influence of vegetative cover.** Southern Lumberman. 179(2249): 177.

Soil porosity tests at the Caltoun Experimental Forest near Union, South Carolina, showed that permeability rates under hardwoods are 25 times more rapid, and under softwoods 8 times more rapid than on bare clay. The soil under young redcedars (*Juniperus virginiana*) has 3 times the volume of open pores and 20 times the permeability of adjacent soils in the open.

607. Arend, J.L. 1950. **Influence of fire and soil on distribution of eastern redcedar in the Ozarks.** Journal of Forestry. 48(2): 129-130. 2 refs.

The distribution of *Juniperus virginiana* is so closely correlated with shallow limestone soils and rough topography that these sites are often considered the characteristic habitat of the tree. Systematic observations in the Arkansas Ozarks indicate, however, that redcedar does not prefer these shallow soils, but that competition and fire wipe it out on the better sites. Contrary to general belief, soil acidity appears to have little effect on the distribution of this species. The reduced acidity of the soil under dense and long-established stands of eastern redcedar probably results from the relatively high Ca content of its foliage.

608. Arend, J.L.; Collins, R.F. 1949. **A site classification for eastern redcedar in the Ozarks.** Soil Science Society of America. 13: 510-511.

A survey of site conditions for 91 different natural stands of *Juniperus virginiana* showed depth of soil to be the most important factor on upland sites. Soil acidity within the pH range 4.7-7.8 has little effect on growth and distribution in the Ozarks. Four site classes are recommended for the region.

609. Axmann, B.D.; Knapp, A.K. 1993. **Water relations of *Juniperus virginiana* and *Andropogon gerardii* in an unburned tallgrass prairie watershed.** Southwestern Naturalist. 38(4): 325-330.

We assessed several factors influencing the success of *Juniperus virginiana* in unburned tallgrass prairie by mapping the distribution of individuals in a 21-ha watershed on the Konza Prairie Research Natural Area in northeastern Kansas. We also compared the water relations of this tree with those of the dominant grass *Andropogon gerardii*. No general relationships were detected between the distribution of *J. virginiana* and plant water status, plant size, soil type, slope, aspect, or elevation. Leaf xylem pressure potential (psi) in upland trees was significantly lower (0.44 MPa) than in lowland trees, but only during the driest portion of the growing season. In contrast, topographic position influenced psi more strongly in *A. gerardii* with psi in upland plants as much as 1.0 MPa lower than in lowland plants. During wetter periods, photosynthetic rates in *A. gerardii* were higher than in *J. virginiana* in uplands, but the reverse occurred during the driest period of the growing season. The ability of *J. virginiana* to maintain higher psi and higher photosynthetic rates relative to *A. gerardii* during periods of water limitation may contribute to its success in tallgrass prairie protected from fire.

610. Bard, G.E. 1952. **Secondary succession on the Piedmont of New Jersey.** Ecological Monographs. 22(3): 195-215. 45 refs.

A study of succession on abandoned fields showed that they are invaded by *Juniperus virginiana* in the first few years and that this is the dominant tree species for more than 60 years. Most of the species of the oak/hickory forest then enter the succession and are in the understory by the 60th year.

611. Bartgis, R.L. 1993. **The limestone glades and barrens of West Virginia.** Castanea. 58(2): 69-89.

Cedar glade, limestone barren, and glade woodland communities are reported from limestone terraines in the ridge and valley of northeastern West Virginia. The cedar glade communities are dominated by *Bouteloua curtipendula*, *Solidago arguta* var. *harrisii*, *Paronychia virginica,* and *Monarda fistulosa* var. *brevis*; limestone barren communities are dominated by *Bouteloua*, *Hystrix patula,* and *Schizachyrium scoparius*; and glade woodlands are dominated by *Juniperus virginiana*, *Quercus muehlenbergii,* and *Cercis canadensis*. Drought stress appears to play a role in determining the vegetation of these areas. The flora of these three communities consists of 202 known species, including 24 considered to be rare in West Virginia and 8 Appalachian shale barren endemics. *Monarda fistulosa* var. *brevis* appears to be endemic to cedar glades, limestone barrens, glade woodlands, and dry limestone cliffs of West Virginia and Virginia. Six other species are almost completely restricted in West Virginia to these communities; *Ophioglossum engelmannii* and *Senecio plattensis* are reported from West Virginia for the first time. The unique flora of these communities in West Virginia suggests that they apparently originated independently of cedar glade communities of the Interior Low Plateaus.

612. Baskin, J.M.; Baskin, C.C. 1985. **A floristic study of a cedar glade in Blue Licks Battlefield State Park, Kentucky.** Castanea. 50(1): 19-25.

613. Beilmann, A.P.; Brenner, L.G. 1951. **The changing forest flora of the Ozarks.** Annals of the Missouri Botanical Garden. 38(3): 283-291. 8 refs.

Reports results of a study of the soils, land use, and development of tree associates during a 10-year period. A rapid invasion of the *Quercus marilandica*/*Q. stellata* and *Q. alba* /*Acer saccharum* associations by the valuable timber species *Q. borealis*, *Q. alba,* and hickory (*Carya* sp.) is taking place.

614. Beilmann, A.P.; Brenner, L.G. 1951. **The recent intrusion of forests in the Ozarks.** Annals of the Missouri Botanical Garden. 38(3): 261-282. 48 refs.

An attempt is made to reconstruct from historical records the course of recent vegetation changes in the Ozarks. Within historical time much of this region, which is now forest land, was open, park-like country or grassland. Insufficient time has elapsed since the change towards forest cover began, to permit any plant association to reach a climax; 85 percent of the commercial forest land is classified as immature. *Juniperus virginiana* is a very aggressive invader of the grasslands and old fields. The beginning of its invasion coincides with the reduced burning of grassland that accompanied an increase in the population. There are also indications that the climate of the Ozarks has become milder and wetter.

615. Bidwell, T.G. 1993. **Eastern redcedar ecology and management.** OSU Ext. Facts. 2868. Stillwater, OK: Oklahoma State University, Cooperative Extension Service. 4 p.

616. Bragg, T.B.; Hulbert, L.C. 1976. **Woody plant invasion of unburned Kansas bluestem prairie.** Journal of Range Management. 29(1): 19-24. 27 refs.

A remnant of tall-grass prairie in the Flint Hills, eastern Kansas, was studied by reference to section-line survey records (since 1856) and aerial photos (since 1937). The history of woody plant cover was determined on a total of 12 sites that were (a) unburned for 20-50 years, (b) regularly burned, or (c) regularly sprayed with herbicides (since 1943). Results are presented and discussed in relation to soils and topography. The area covered by woody plants increased by 34 percent in (a) and only 1 percent in (b) over the same period (1937-1969), confirming the importance of fire in maintaining the natural prairie; little net change occurred in (c) where woody cover was already substantial before spraying. In (a), woody plants invaded rapidly on lowland, lower slope and rocky soils, and very slowly on upland soils (which were shallow, heavy-textured, and droughty). Major invading species were *Juniperus virginiana*, *Quercus muehlenbergii*, *Ulmus americana*, and the shrubs *Rhus glabra*, *Cornus drummondii*, and *Symphoricarpos orbiculatus*.

617. Brenner, L.G. 1942. **The environmental variables of the Missouri Botanical Garden Wildflower Reservation at Gray Summit.** Annals of the Missouri Botanical Garden. 29: 103-135.

This paper presents a preliminary survey of the geology, physiography, soils, climatology, and vegetation of a characteristic area in the Wildlife Reservation of the Missouri Botanical Garden. The arborescent flora is a complex one composed of 40 species, representing 28 genera. The large number of species and the relativeiy wide distribution of many of them in the area may be attributed largely to human occupation rather than to natural causes. The area as a whole has been generally and quite intensively grazed, and approximately half of it has been deforested. Grazing and firing of the forest floor in earlier times led to the invasion of some parts by various heliophilous plants, notably *Juniperus virginiana*, *Ulmus fulva*, and *Cercis canadensis*. Apart from these plants, the vegetation of the area may be arranged in three principal groups: (1) the *Quercus/Carya* association, (2) the *Quercus alba/Acer saccharum* association, and (3) the *Quercus muehlenbergii/Acer saccharum* association. The open glade associates contain practically no arborescent flora, but the closed glade associate is forested with *Juniperus virginiana* and other tree species, including *Quercus muehlenbergii* and *Bumelia lanuginosa*.

618. Broadfoot, W.M. 1951. **Redcedar litter improves surface soil.** For. Notes SO-71. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 3 p.

Measurements under 15- to 20-year-old *Juniperus virginiana* on eroded soils in Mississippi showed a new A horizon development of 1 to 7 inches compared with 1.3 inches under adjacent herbaceous cover. The surface soils under *J. virginiana* had more large pores and transmitted water several times faster. They had 5.3 percent organic matter—nearly twice as much as soils under herbaceous cover—and more than twice as much available Ca; pH was 6.75 compared with 5.71 under herbaceous cover. Amount of litter/acre was 3 tons more under *J. virginiana*, and each unit of litter contained five times as much Ca and twice as much excess base for neutralizing soil acidity.

619. Broadfoot, W.M. 1951. **Soil rehabilitation under eastern redcedar and loblolly pine.** Journal of Forestry. 49(11): 780-781. 5 refs.

Tabulates and discusses differences in properties of litter in the top 2 inches of soil under *Pinus taeda*, *Juniperus virginiana,* and herbaceous cover. *P. taeda* produces considerable quantities of litter in a short time, but soil beneath *J. virginiana* develops more desirable characteristics.

620. Bryant, W.S. 1989. **Redcedar (*Juniperus virginiana* L.) communities in the Kentucky River gorge area of the Bluegrass Region of Kentucky.** Gen. Tech. Rep. NC-132. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 254-261. 76 refs.

Stand structure and composition were studied in redcedar (*Juniperus virginiana*) communities on the soil borders of the exposed clifftops of gorges of the Kentucky River and its tributaries in central Kentucky. Redcedar accounted for approximately 76 percent of the density and 79 percent of the basal area;

because of its clear dominance, species diversity was low and "evergreenness" high. The small tree/shrub associates formed a distinct and characteristic component of the communities. The harsh clifftop environments serve to reduce competition from more site-demanding species. The absence of fire has also served to select for redcedar. The coefficients of determination and the species replacement patterns indicate that these clifftop communities are rather stable and persistent.

621. Buell, M.F.; Buell, H.F. 1971. **Invasion of trees in secondary succession on the New Jersey Piedmont.** Bulletin of the Torrey Botanical Club. 98(2): 67-74. 15 refs.

Quadrates were established on old fields (on soils derived from Triassic red shales), and succession was studied from 1958 to 1969. Tree seedlings (*Juniperus virginiana* and hardwoods) began to appear during the second year, and continued to appear thereafter. Mortality of previously established individuals was common during the early stages of succession. At first, when much bare soil was exposed, frost-heaving was an important hindrance to the early establishment of tree seedlings.

622. Coile, T.S. 1950. **Effect of soil on the development of hardwood understories in pine stands of the Piedmont Plateau.** Soil Science Society of America. 14: 250-252. 3 refs.

In connection with an earlier study, hardwood understory species over 4 1/2 feet high were enumerated by diameter classes, and the effect of age and density of the pine overstory and of various soil factors on the density, or space occupied by the main understory species, was determined by regression analysis. The soil variables tested were: depth of the A horizon in inches, inhibitional-water value of the B horizon, site quality of the land, and the texture of the surface soil (i.e., coarse, medium, and fine). The relationships between the variables and the space occupied (milliacres per 200 milliacres) are presented in formula and graphs for *Cornus florida*, *Liquidambar styraciflua*, and *Juniperus virginiana*. These correlations, which relate to 70 percent of the total understory of the average pine stand, are considered useful in estimating the competitive hardwood potential of any land in the Piedmont region.

623. Collins, S. 1962. **Three decades of change in an unmanaged Connecticut woodland.** Bull. 653. Storrs, CT: Connecticut Agricultural Experiment Station. 32 p. 21 refs.

Describes changes in the composition and structure of the Cox Plot, an unmanaged oak woodland developed on land abandoned or cut over 75 years ago (see Bull. Conn. Ag. Exp. Sta. No. 330, 1931, for summary and description). Pioneer species such as redcedar, aspen, and black cherry have disappeared in favor of *Quercus* spp., which increasingly dominate the stand.

624. Colvin, W.S.; Eisenmenger, W.S. 1943. **Relationships of natural vegetation to the water-holding capacity of the soils of New England.** Soil Science Society of America. 55: 433-446.

From a study made in New England on the relation between the natural vegetation and the water-holding capacity of the soil, it appears that certain trees, shrubs, and herbs grow in greatest abundance on soils of particular water-holding ranges, while the distribution of other species seems to be unaffected by this soil factor. Pitch pine, black oak, and scrub oak are among the species that are generally most abundant on soils with a comparatively low water-holding capacity. Black birch, flowering dogwood, hickory, white oak, and scarlet oak occur mainly on soils with a medium water-holding capacity. Ash, beech, ironwood, sugar maple, red oak, and spruce prefer soils with a comparatively high water-holding capacity. A considerable number of species, including gray birch, hemlock, red maple, redcedar, and white pine are found growing on soils varying widely in their moisture-retaining properties.

625. Conner, J.J.; Shacklette, H.T.; Erdman, J.A. 1971. **Extraordinary trace-element accumulation in roadside cedars near Centerville, Missouri.** Profess. Pap. 750-B. Washington, DC: U.S. Geological Survey: 151-156.

Unusually high concentrations of Pb, Cu, Zn, and Cd found in roadside *Juniperus virginiana* trees were probably attributable to transport of lead-bearing ores along the roads rather than to mineralization of underlying rock.

626. Cook, D.I.; VanHaverbeke, D.F. 1977. **Suburban noise control with plant materials and solid barriers.** Gen. Tech. Rep. NE-25. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 234-241.

Includies use of: *Pinus nigra*, *P. ponderosa*, *P. sylvestris*, *Thuja orientalis*, *Juniperus scopulorum*, *J. virginiana*, and *Picea* sp.

627. Cotta, A. 1950. **Natural regeneration of exotic species in Piemonte, Italy.** Schweizeriche Zeitschrift fuer Forstwesen. 101(2/3): 104-111. Italian.

A number of exotic species were planted, about 150 years ago, in the park surrounding a castle in Monferrato. These included larch, Scots pine, spruce, *Abies pinsapo*, Corsican pine, three species of cedar, two of *Chamaecyparis*, *Thuja*,

Tsuga, *Juniperus virginiana*, *Ginkgo*, *Acer negundo*, horse chestnut, *Ailanthus*, *Melia azedarach*, and *Robinia*. With the exception of the larch (which stagnated) and the Scots pine (chlorotic), all these species have grown well, but only the horse chestnut and *Robinia* appear to be reproducing themselves in any appreciable degree.

628. Cross, E.A. 1981. **Reclamation of surface-mine spoil.** Auburn, AL: Alabama University, School of Mines and Energy Development. 53 p.

Research being performed on land reclamation at the Corona and Kellerman mines in Alabama is reported. Information is presented under the following headings: effects of topsoiling and mulching treatment on plant growth and soil erosion; preliminary findings on the germination and growth of southern red oak seedlings on calcareous shale surface mine spoil; some effects of vegetation type and fertilization on growth, survival, and tip moth damage in loblolly pine planted on alkaline shale surface mine spoil; some effects of competition and fertilizer on the growth and survival of selected Christmas tree stock and Virginia pine on alkaline shale spoil; growth and survival of eastern redcedar on alkaline shale spoil; and greenhouse studies. The appendixes are entitled: study of the effects of acidification of calcareous shale on the growth of weeping love grass; the effects of competition and spoil mixtures on the growth of perennial ryegrass and weeping lovegrass; and the effects of delayed fertilization on the growth of weeping lovegrass.

629. Dooley, K.L.; Collins, S.L. 1984. **Ordination and classification of western oak forests in Oklahoma.** American Journal of Botany. 71(9): 1221-1227. 32 refs.

Data on the composition of the tree size class (less than 10 cm d.b.h.) and numbers of seedlings (less than 2.5 cm) were collected in 46 stands in Wichita Mountains Wildlife Refuge. Saplings were extremely rare and data were not analyzed. The data were analyzed to determine patterns of forest vegetation, species diversity, and soil type. The most important species in both the tree and seedling strata were *Quercus stellata*, *Q. marilandica,* and *Juniperus virginiana*. Cluster analysis revealed three community types: low diversity forests dominated by *Q. marilandica/Q. stellata* or by *Q. stellata* and mesophytic forests. A polar ordination produced a gradient of vegetation corresponding to a moisture gradient. Many high diversity, mesophytic forests were on loamy drainageway soils or north facing slopes. Tree species diversity was inversely related to the importance of *Q. stellata*. Stand ordinations differed for trees and seedlings, suggesting that these strata respond differently along the moisture gradient.

630. Duncan, S.A.; Ellis, W.H. 1969. **An analysis of the forest communities of Montgomery County, Tennessee.** Journal of the Tennessee Academy of Sciences. 44(1): 25-32. 24 refs.

Distinguishes and describes six distinct forest communities: white oak/northern red oak/ hickory; post oak/black oak; beech/maple; redcedar/hardwood; bottomlands; and stream banks.

631. Einspahr, W. 1955. **Coal spoil-bank materials as a medium for plant growth.** Iowa Academy of Science. 62: 133-144. 8 refs.

Reports results of a chemical and physical analysis of spoil from Iowa coal strip-mining. Field trials (no details) suggested that *Pinus virginiana*, *P. rigida*, *Juniperus virginiana*, *Fraxinus pennsylvanica*, *Populus deltoides*, *Ulmus americana*, *Platanus occidentalis,* and *Robinia pseudoacacia* are promising for some of the acid or toxic shales unsuitable for other crops.

632. Engle, D.M.; Stritzke, J.F. 1992. **Herbage production around eastern redcedar trees.** In: Bidwell, T.; Titus, D.; Cassels, D., eds. Range Research Highlights, 1983-1991. Circ. E. 905. Stillwater, OK: Oklahoma State University Cooperative Extension Service: 13.

633. Engle, D.M.; Stritzke, J.F.; Claypool, P.L. 1987. **Herbage standing crop around eastern redcedar trees.** Journal of Range Management. 40(3): 237-239. 17 refs.

Herbage standing crop was measured in 1984 and 1985 at distances radiating away from individual trees of eastern redcedar (*Juniperus virginiana*) in north-central Oklahoma tallgrass prairies. Trees of two height classes (2 and 6 m) were studied. Soil water content at 0 and 3 m from the dripline and tree leaf water content were studied during 1982-1984. There was very little herbage beneath the tree canopy; herbage production was slightly reduced at the dripline, but there was little reduction beyond the dripline. Tree height did not affect the herbage crop. Soil water content at the tree dripline was sometimes less than that 3 m outside the dripline, but the differences were small. Leaf water content generally followed the seasonal trend of soil water content. It was concluded that herbage reduction would be very little in the early stages of tree encroachment when the canopy is small. Since tree leaf water content is relatively low in late spring, this is an appropriate season for prescribed burns to control *J. virginiana*.

634. Erickson, R.O.; Brenner, L.G.; Wraight, J. 1942. **Dolomitic glades of east-central Missouri.** Annals of the Missouri Botanical Garden. 29: 89-101.

An account of the physical characteristics and vegetation of the outcrops of thin-bedded dolomite or dolomitic limestone that occur in the Ozark region of Missouri. The most characteristic flora is herbaceous, but small trees are often found surrounding gullies or ledges of rock. The most common tree

species are *Juniperus virginiana*, *Quercus muehlenbergii*, *Q. stellata*, *Celtis pumila*, *C. pumila* var. *georgiana*, *Acer saccharum* var. *schneckii*, *Rhamnus caroliniana*, *Vitis lincecumii* var. *glauca*, *Cornus florida*, and *Bumelia lanuginosa*.

635. Ferguson, E.R.; Lawson, E.R.; Maple, W.R.; Mesavage, C. 1968. **Managing eastern redcedar.** Res. Pap. SO-37. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 14 p. 48 refs.

Reviews the literature, and recent studies in Arkansas, on the characteristics, distribution, site requirements, natural regeneration, planting and sowing, protection, control of competition, growth and yield, and marketing of *Juniperus virginiana*.

636. Fletcher, P.W.; Ochrymowych, J. 1955. **Mineral nutrition and growth of eastern redcedar in Missouri.** Res. Bull. 577. Columbia, MO: University of Missouri Agriculture Experiment Station. 16 p.

Mineral composition of twigs and foliage was compared with mineral composition of soil on which the plants grew. (1) Rich, calcareous soils produced maximum growth but least ash per unit of oven dry matter; (2) The percentages of total seedling weight in root, stem, and foliage remain almost constant regardless of plant size or soil; (3) Soluble phosphorus and exchangeable calcium in silt loam soils were directly related to seedling growth; (4) Phosphorus concentration in the foliage of seedlings and mature trees was related directly to phosphorus concentration in the silt loam soils studied; (5) The foliage contained greater concentrations of potassium, magnesium, and phosphorus than did the twigs, about the same silica and total ash, and less calcium; (6) As the growing season advanced, concentration of phosphorus in the foliage increased.

637. Freeman, C.P. 1933. **Ecology of the cedar glade vegetation near Nashville, Tennessee.** Tennessee Academy of Science. 8: 143-228.

Investigated a subclimax eastern redcedar forest on a shallow soil overlying horizontal limestone. Presents information on soil temperature, weekly course of soil water, hydrogen-ion concentrations, and surface evaporation.

638. Gams, H. 1943. **The forests of southern Russia and their history.** Forstarchiv. 19: 69-85. German

The development of vegetational types in southern Russia has been conditioned to a large extent by five factors: (1) the repeated overflowing of the Black Sea and the Caspian Sea, which, even during the last ice age, covered a large part of the neighboring lowlands to the north; (2) glaciation and other disturbances during the ice age; (3) the continental climate with its low precipitation and great variations in temperature throughout the greater part of the area, and the high-mountain climate of the Caucasus; (4) the salt deposits left by the retreating sea, and (5) damage by grazing, often accompanied by forest clearance and burning of the steppe. After dividing the area into six main zones, the author discusses the composition of the natural forests and reviews the vegetational development of the area from pre-historic times. Much damage has been caused to the forests by grazing, overexploitation and forest and steppe fires. Afforestation of deforested areas and of the timberless steppe has been in progress for many years. In addition to indigenous hardwoods (oak, maple, elm, ash, and birch) fruit trees, pines, and many exotics have been planted. The latter include *Pinus nigra*, *Juniperus virginiana*, *Robinia*, *Gleditsia*, *Acer negundo*, *Morus alba*, *Elaeagnus angustifolia*, and many shrubs such as *Caragana arborescens*, *Amorpha fruticosa*, and *Lycium barbarum*.

639. Gehring, J.L.; Bragg, T.B. 1992. **Changes in prairie vegetation under eastern redcedar (*Juniperus virginiana* L.) in an eastern Nebraska bluestem prairie.** American Midland Naturalist. 128(2): 209-217. 32 refs.

On a native prairie located on bluffs adjacent to the Platte River Valley in eastern Nebraska, plant species composition under and adjacent to isolated 10- to 22-year-old *J. virginiana* trees was examined. *Andropogon scoparius* (*Schizachyrium scoparium*) dominated plots without trees (44 percent cover), and *Poa pratensis*, a non-native species dominated under trees (19 percent); this difference represents a 20-year change in herbaceous composition following establishment and growth of tree crowns over native prairie. In addition to *A. scoparius* (-34 percent), 11 other species declined under persistent tree cover including *A. gerardii* and *Aster ericoides* (-10 and -5 percent, respectively); *P. pratensis* and *Carex* spp. cover increased 13 and 10 percent, respectively. Direction from the main tree stem affected the response of *Bouteloua hirsuta*, *Linum rigidum* var. *compactum*, *B. curtipendula*, and *Ambrosia psilostachya* to tree crown development; the percentage cover of these species was generally lower to the north and east than to the west and south.

640. Graf, D.I. 1970. **Distribution pattern of eastern redcedar, *Juniperus virginiana* L., in Iowa.** Dissertation Abstracts International, B. Science and Engineering. 31(2): 544.

The present distribution is compared with that in presettlement times, and reasons for present distribution are discussed.

641. Graf, D.I.; Landers, R.Q.; Poulter, R.W. 1965. **Distribution patterns of eastern redcedar, *Juniperus virginiana* L., in Henry County, Iowa.** Iowa Academy of Science. 72: 98-105. 2 refs.

Older planted trees are the seed source for natural regeneration, which takes place easily in the predominantly rolling grasslands, and which can constitute a serious pasture management problem.

642. Guyette, R.P.; Cutter, B.E. 1991. **Tree-ring analysis of fire history of a post oak savanna in the Missouri (USA) Ozarks.** Natural Areas Journal. 11(2): 93-99.

Fire scars from 43 trees were dated by dendrochronological methods to reconstruct the extent and frequency of fire in an area of post oak savannas in southern Missouri. Post oak (*Quercus stellata* Wang.), shortleaf pine (*Pinus echinata* Mill.), and eastern redcedar (*Juniperus virginiana* L.) trees from the Caney Mountain Wildlife Refuge were used to construct two fire-scar chronologies. Fire frequency and extent were found to be greater between 1700 and 1810 on post oak savannas. The mean fire-free interval during the pre-1810 period was 4.3 years for an area of post oak savanna of approximately 2.5 km^{-2}. Evidence for several fires at least 6 km^{-2} in extent was found from trees scarred in the years 1785, 1796, and 1806. A decrease in fire frequency on post oak savannas begin in 1820, the time when native Americans began moving westward out of this area. In oak-pine woods, fire frequency was found to increase after 1850 with the settlement of the area in the 1860s by European-Americans.

643. Guyette, R.P.; McGinnes, E.A., Jr. 1987. **Potential in using elemental concentrations in radial increments of old growth eastern redcedar to examine the chemical history of the environment.** In: Jacoby, G.; Hornbeck, J., comps. International symposium of ecological aspects of tree ring analysis. Washington, DC: U.S. Department of Energy, Office of Energy Research: 671-680.

644. Guyette, R.P.; Cutter, B.E.; Henderson, G.S. 1989. **Long-term relationships between molybdenum and sulphur concentrations in redcedar tree rings.** Journal of Environmental Quality. 18(3): 385-389. 22 refs.

Molybdenum and sulfur concentrations were determined in growth rings of 13 eastern redcedar (*Juniperus virginiana*) trees from the Ozark region of Missouri. Neutron activation analysis was used to determine Mo concentrations; S concentrations were determined turbidimetrically as barium sulfate. Chronologies were constructed which dated from AD 1280 to 1960 for Mo and from 1580 to 1960 for S. A 45 percent increase in Mo concentrations occurred between 1720 and 1860 when compared with the previous 440 years. A decline in heartwood Mo concentrations, beginning in 1860, was thought to be due to increases in soil SO_4 from atmospheric deposition of S compounds. There was a 65 percent reduction in Mo concentrations concomitant with a 44 percent increase in S concentration in redcedar heartwood formed after 1860. S and Mo concentrations were negatively correlated in serial heartwood increments. Competition between sulfate and molybdate ions in soil solutions is thought to have led to decreased molybdenum concentrations in recent heartwood growth increments.

645. Guyette, R.P.; Cutter, B.E.; Henderson, G.S. 1991. **Long-term correlations between mining activity and levels of lead and cadmium in tree-rings of eastern redcedar.** Journal of Environmental Quality. 20(1): 146-150. 20 refs.

Growth increments of eastern redcedar (*Juniperus virginiana*) from sites in the lead mining district of southeast Missouri were subjected to multi-element analysis to determine whether lead and cadmium concentrations in growth increments could be used as indicators of historical changes in these elements in the environment. Three chronologies, two of lead and one of cadmium, were constructed from heartwood growth increments of 27 trees on mining-district and control sites. No significant increases in lead and cadmium were found in growth increments of trees on control sites. Lead in the heartwood of trees on acid soils of the mining district increased from 3.1 Êmol/kg in growth increments formed before 1900 to 7.8 Êmol/kg in increments formed after 1900. Cadmium was detected in 3 and 46 percent of the wood formed before and after 1900, respectively. Lead and cadmium were found only in wood grown on acid soils (pH less than 4.6). Redcedars on soils overlying dolomite with a mean horizon pH greater than 5 had no detectable lead or cadmium. Lead and cadmium concentrations in growth increments were highly correlated with lead production in the district. Soil pH was inversely correlated with lead in sapwood in both mining and control sites.

646. Guyette, R.P.; McGinnes, E.A., Jr.; Probasco, G.E.; Evans, K.E. 1980. **A climate history of Boone County, Missouri, from tree-ring analysis of eastern redcedar.** Wood Fiber. 12(1): 17-28. 17 refs.

A ring-width index was constructed from an analysis of 12 eastern redcedar (*Juniperus virginiana*) trees. Correlations with summer temperature, spring rainfall, and Palmer drought index (June) were demonstrated. The index was comparable with other chronologies for the midwest U.S.A. A 2-year cycle was apparent—a wide ring

was followed by a narrow ring. A 2-year cycle of drought occurred during certain periods. Some possible interpretations of past climate history, based on the ring-width index, are listed for selected time periods back to 1650.

647. Hall, M.T. 1955. **Comparison of juniper populations on an Ozark glade and old fields.** Annals of the Missouri Botanical Garden. 42(2): 171-194. 19 refs.

In the northeastern Ozarks, *Juniperus virginiana* is represented by the Ozark race (introgressants from *J. ashei*) on bluffs, glades, and most old fields. Occasionally the northern race is found locally with a little admixture of the Ozark race. Three populations of *J. virginiana* in the northeastern Ozarks were studied in detail in order to compare their variation patterns and habitats. The evidence suggests that the three populations, Glade, Cedar Hill, and Old Field, are distinct and differ more or less proportionately to the difference in their habitats. The Glade (Ozark race) is the most southwestern in affinity, more closely resembling a population and habitat of *J. ashei*. Cedar Hill (Ozark race) is intermediate between Glade and typical eastern and occurs on old fields that are in good condition, or, farther southwest from Gray Summit, Missouri, on more worn-out lands. The Old Field (northern race with a little mixing from the Ozark race) occurs on worn-out acidic and sandy lands in the vicinity of St. Louis and north-eastward. Distribution in the age classes in the junipers indicates that the bluffs, knobs, and glades have been colonized longest, followed by the old fields, supporting the Ozark race, and, last, the worn-out sandy, acidic fields supporting youthful colonies of the northern race. An explosive expansion of juniper colonization resulting from man's activities seems to have occurred within the last 100 years, growing progressively as land has been worn out and abandoned.

648. Hall, M.T.; Carr, C.J. 1964. **Differential selection in juniper populations from the Baum limestone and Trinity sand of southern Oklahoma.** Butler University Botany Studies. 14(2): 21-40. 48 refs.

The data suggest that, in southern Oklahoma, *Juniperus ashei* develops plentifully in areas where soil moisture is low enough to limit *J. virginiana*. Since the habitats of the two species overlap, hybridization occurs, but only those hybrids survive that are adapted to intermediate habitats. These are rich sources for confirmed hybridization and introgression.

649. Hall, W.L. 1900. **Notes in Oklahoma. I. The extermination of the red cedar.** Forester. 6: 163-164.

650. Harper, R.M. 1926. **The cedar glades of middle Tennessee.** Ecology. 7: 48-54.

651. Hoering, T. 1955. **Variations of nitrogen-15 abundance in naturally occurring substances.** Science. 122(3182): 1233-1234. 5 refs.

The substances studied include leaves of red oak, cedar (*Juniperus virginiana*), and American elm.

652. Holthuijzen, A.M.A.; Sharik, T.L. 1985. **Colonization of abandoned pastures by eastern redcedar (*Juniperus virginiana* L.).** Canadian Journal of Forest Research. 15(6): 1065-1068. 19 refs.

Rates and patterns of colonization of the predominantly avian dispersed *J. virginiana* were investigated in three abandoned pastures in southwest Virginia. The three populations, with median ages of 2, 5, and 14 years, showed sigmoid patterns of increase. Exponential increase occurred during the first 6-9 years and peaked in 8-10 years. Only the youngest population showed a significant spatial gradient in distribution, numbers decreasing exponentially with distance from the nearest cone-bearing trees along the edge of the pasture. A decreasing activity gradient of avian dispersers with distance from the seed source may have resulted in the spatial trend in tree density. No relationship existed between age and location of individuals within stands. The apparent spatial uniformity with increasing age is probably due to several factors, including the increasing availability of avian perching sites and seed sources.

653. Holthuijzen, A.M.A.; Sharik, T.L. 1985. **The avian seed dispersal system of eastern redcedar (*Juniperus virginiana*).** Canadian Journal of Botany. 63(9): 1508-1515. 34 refs.

654. Holthuijzen, A.M.A.; Sharik, T.L. 1985. **The redcedar (*Juniperus virginiana* L.) seed shadow along a fenceline.** American Midland Naturalist. 113(1): 200-202.

655. Holthuijzen, A.M.A.; Sharik, T.L.; Fraser, J.D. 1987. **Dispersal of eastern redcedar (*Juniperus virginiana*) into pastures: an overview.** Canadian Journal of Botany. 65(6): 1092-1095.

J. virginiana is predominantly an avian-dispersed species. Seed dispersal, predispersal and postdispersal seed predation, seed dormancy, and germination were followed during the 1981-1982 fruiting season on four trees in grazed pastures in southwest Virginia. Of the total cone crop, 35 percent was recovered within 12 m of the source tree. The remaining 61 percent of the crop was dispersed at least 12 m. From other studies, it is

concluded that less than 4 percent of the total cone crop may germinate within 12 m of the source tree, while 27 percent of those dispersed greater distances may germinate. Total germination was greater in seeds that had passed through avian digestive tracts than in seeds that had been manually depulped. Dormant seeds rapidly lost their viability. Seed shadows generated by avian dispersers decreased exponentially with increasing distance from the source tree. The large cone crop, diverse avian dispersers, adaptation to open, xeric sites, and availability of seed sources in fence rows contribute to the successful invasion of pastures by this species.

656. Hutcheson, H.L.; Rothe, S.C. 1977. **Eastern redcedar (*Juniperus virginiana*) reproduction and spread in Brookings County, South Dakota.** Proceedings of the South Dakota Academy of Sciences. 56: 125-134.

657. Jackson, T.A. 1971. **Biochemical weathering of calcium-bearing minerals by rhizosphere micro-organisms, and its influence on calcium accumulation in trees.** Plant and Soil. 35(3): 655-658. 12 refs.

Comparisons were made of the microflora of (a) the rhizosphere of *Juniperus virginiana*, (b) that of *Pinus strobus*, and (c) soil under grass. The species composition of (a) was more varied than that of (b), the trees being of the same age, in identical growing conditions; and although there were fluctuations from winter to spring, (a) had always more $CaSiO_3$-solubilizers than (b). The known high Ca content of *J. virginiana* and the relations (possibly symbiotic) between trees and rhizosphere micro-organisms are discussed.

658. Jeffries, D.L. 1985. **Analysis of the vegetation and soils of glades on calico rock sandstone in northern Arkansas.** Bulletin of the Torrey Botanical Club. 112(1): 70-73. 25 refs.

Describes a survey of 25 sites dominated by *Juniperus virginiana* made in July to early September 1982.

659. Klein, S. 1948. **Cedar species: their geographic distribution and use.** American Perfume Essential Oil Review, New York. 51(2-3): 137-140, 242-245. 39 refs.

Gives a brief account of the most common cedars of the U.S.A. (*Chamaecyparis*, *Libocedrus*, and *Juniperus*) and describes the production of oils from *J. virginiana* and *J. mexicana*, their chemical constituents, comparative properties, and uses. That from *J. virginiana* is a byproduct, obtained from waste wood from cabinet-making; that from *J. mexicana* is the principal product. The latter species is a comparatively new source, producing an oil that differs in odor from that of *virginiana* mainly in its greater strength.

660. Lawson, E.R.; Law, J.R. 1983. **Eastern redcedar (*Juniperus virginiana*), ecology, management, eastern United States, Ontario, Quebec.** Agric. Handb. 445 (Revised) Washington, DC: U.S. Department of Agriculture, Forest Service: 109-112.

661. Leopold, A.C. 1947. **The distribution of redcedar in eastern Massachusetts.** Rhodora. 49(583): 172-175.

The plant succession of old fields to oak/ hickory stands of the Central Hardwoods type originally covering most of Connecticut, Rhode Island, and the eastern margin of Massachusetts is said to have had an initial stage of redcedar and gray birch. Old fields in central Massachusetts commonly come up to white pine, which later gives way to the Transition Hardwoods characterized by red oak, white ash, sugar maple, red maple, and black birch. The approximate boundary in eastern Massachusetts between old fields that come up to redcedar (*Juniperus virginiana* var. *crebra*) and those that come up to white pine has been mapped, and a small section has been analyzed in considerable detail. A map shows that the frequency distribution of redcedar, as shown by isopleths, has remarkable similarities in pattern to isotherms of no fewer than four cold weather phenomena.

662. Little, E.L., Jr. 1971. **Atlas of United States trees: Vol. 1. Conifers and important hardwoods.** Misc. Publ. 1146. Washington, DC: U.S. Department of Agriculture, Forest Service. Map 31-w, 31-e.

663. Livingston, R.B. 1972. **Influence of birds, stones and soil on the establishment of pasture juniper, *Juniperus communis*, and redcedar, *J. virginiana*, in New England pastures.** Ecology. 53(6): 1141-1147. 10 refs.

Describes a study showing that on grazed pastures exposed stones offer advantages to nearly all plants adjacent to the stones, and are virtually essential for the establishment of *J. communis* var. *depressa*. The stones protect seedlings from grazing or trampling damage, and provide a micro-environment that may save the seedlings from desiccation while still satisfying the stratification requirements for juniper seed. Robins rest on exposed stones, and their droppings become concentrated on them. Birds are the effective disseminators of juniper seed, and though their digestive action has a marked inhibitory effect on germination, the depositing of seeds on stones introduces them to a micro-habitat that more than compensates for the reduced germination. Seed is washed from the droppings and carried downward into cracks caused by frost heaving around each stone. Here the seed remains moist during the long period necessary for double stratification. Seedlings growing in the cracks are under the influence of a stone micro-catchment that can provide extra water to aid survival during drought periods. *J. virginiana* var. *crebra* also benefits in the same way, but since its germination requirements are less exacting, its seed can germinate even on the surface. Thus, when grazing pressures are light or non-existent, *J. virginiana* var. *crebra* may become established without the benefit of stones.

664. Lorio, P.L., Jr.; Gatherum, G.E. 1965. **Relationship of tree survival and yield to coal-spoil characteristics.** Res. Bull. 535. Ames, IA: University of Iowa Agriculture Experiment Station: 394-403. 18 refs.

Plots of *Pinus resinosa*, *P. banksiana*, *P. rigida*, *P. virginiana*, *Juniperus virginiana*, *Fraxinus pennsylvanica,* and *Populus deltoides* were established in 1952 on six coal-spoil areas in Iowa. This study attempts to correlate survival and yield after 7-8 years with: (a) pH, (b) exchangeable Al, (c) exchangeable and soluble bases, (d) nitrifiable N, (e) cation exchange capacity, (f) soluble-salt concentration, (g) available P, (h) available K, and (i) position on slope. Some relationship was found between survival of all species and (a), (b), (d), (e), and (f), but correlations varied with species. Significant correlations were found between yield [undefined] and (b) and (f) for *P. deltoides*, between yield and (d), (f) and (i) for *J. virginiana*, and between yield and (c) and (e) for *P. rigida*. Interactions between variables obscured relationships in many cases.

665. Lowry, G.L. 1958. **Conifer growth and survival varies on acid soils.** Ohio Farm Home Research. 43(311): 20-21.

Shows, in diagrammatic form, total height and survival percent at 2 years on five different types of soil (pH varying from 2.1 to 7.3), for *Pinus strobus*, *P. rigida*, *P. banksiana*, *P. echinata*, *P. ponderosa*, *P. resinosa*, *Juniperus virginiana,* and *Chamaecyparis thyoides* in Ohio. *P. rigida* was the most consistently promising.

666. Lutz, H.J. 1928. **Trends and silvicultural significance of upland forest succession in southern New England**. For. Bull. 22. New Haven, CT: Yale University, School of Forestry. 68 p.

Redcedar-gray birch association is classed as xerophytic and is commonly designated old field type, since it usually originates on abandoned farmland. Silviculturally, the greatest value of this association lies in its beneficial influence on soil conditions.

667. McClurkin, D.C. 1970. **Site rehabilitation under planted redcedar and pine. (*Juniperus virginiana, Pinus*).** In: Papers of the 3d North American forest soils 1968 conference on forest soils related to North America: 339-345.

668. McClurkin, D.C. 1971. **Problems of chemical and physical properties of forest soils and litter.** Corvallis, OR: Oregon State University Press: 305-411. 5 refs.

Describes site rehabilitation under planted redcedar (*Juniperus virginiana*) and pine. Five-year results indicated that loblolly and shortleaf pines (particularly loblolly) produced more litter and were better for rehabilitating abandoned land in Mississippi with loess-type soils.

669. McCormack, M.L.; Korstian, C.F. 1963. **Conversion of post oak-blackjack oak type to pine in North Carolina Piedmont.** Journal of Forestry. 61(6): 445-446. 3 refs.

Conversion by (a) improvement felling, reserving the most promising pines (*Pinus taeda* and *P. echinata*) and *Juniperus virginiana*, and conversion by (b) planting with *P. taeda* after clear felling both proved to be satisfactory. After both treatments, a sufficient number of pines and *J. virginiana* were free to form the major components of the stands. In untreated areas, pines remained minor components, and most of the growth occurred on poor-quality oaks.

670. McDonnell, M.J. 1986. **Old field vegetation height and the dispersal pattern of bird-disseminated woody plants.** Bulletin of the Torrey Botanical Club. 113: 1, 6-11. 37 refs.

In a study in central New Jersey in 1981, species collected in seed traps included *Toxicodendron radicans*, *Rosa multiflora*, *Phytolacca americana*, *Juniperus virginiana* (the four most abundant species), *Nyssa sylvatica*, *Cornus florida*, other *Cornus* spp., *Viburnum dentatum*, *Rhus* spp., and *Prunus* spp.

671. Mann, D.T.; Hays, R.S. 1948. **Effect of grass on invasion of cedar**. Journal of Soil and Water Conservation. 3: 49.

A Texas range in fair condition had 456 cedar trees per acre, while there were only 196 cedars per acre on range in good condition.

672. Maple, W.R. 1957. **Redcedar growth in Arkansas' Ozarks**. For. Notes 112. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station.

Improvement cutting and hardwood control stimulated a stand of 161 cubic feet per acre to grow at a rate of 10 percent annually. Annual growth was computed to be worth $3.69 per acre.

673. Maple, W.R. 1965. **Forest species compared in Ozark Plantations.** Res. Note SO-28. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 2 p.

Eastern redcedars planted on a loamy sand in north Arkansas were 19 feet tall and 3.6 inches in diameter at age 15. The seedlings were low in vigor when planted, and survivals ranged from 17 to 44 percent.

674. Martin, S.C.; Crosby, J.S. 1955. **Burning and grazing on glade range in Missouri**. Tech. Pap. 147. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 13 p.

Carrying capacities of many glade range areas in Missouri are being reduced by the spread of eastern redcedar. Burning is not recommended for control due to the damage to desirable forage and cover plants. Cutting or chemical control is effective.

675. Miller, L.C. 1902. **The red cedar in Nebraska**. Forest and Irrigation. 8: 282-285.

Considering red cedar's wide distribution, annual height, diameter growth, and excellent reproduction, red cedar is destined to be widely used for future planting throughout Nebraska.

676. Minckler, L.S. 1953. **Poor oak sites may grow good pine.** Tech. Pap. CS-134. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 6 p.

Mixed stands of *Quercus* spp. and *Carya* sp. on poor sites were treated either by cutting openings 30, 60, and 120 feet in diameter or by clear felling, and then planting with *Pinus echinata* or *Juniperus virginiana*. The latter did poorly on all sites. Pine survival was good in all plantings, and height growth increased with size of opening, being easily best on the 17-acre clear-felled area.

677. Minckler, L.S. 1966. **Establishing mixtures of redcedar in poor oak-hickory forests.** Res. Note NC-20. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 2 p.

Experimental planting of *Juniperus virginiana* to enrich poor oak/hickory stands was successful. Openings should be cut with a diameter one or two times the height of surrounding trees. Hardwood brush in the openings should first be killed and regrowth kept down.

678. Mohr, C.T. 1901. **Notes on the redcedar.** Pap. 31. Washington, DC: U.S. Department of Agriculture, Forestry Division. 37 p.

Presents selections on distribution, associated species, products, growth, development, enemies, natural reproduction, forest management, nomenclature and classification, botanical description, and morphology.

679. Monk, R.W. 1960. **Growth and survival of some ornamental plants on salinized soils and substrates and the resistance of their protoplasm as related to salt tolerance.** Dissertation Abstracts International, B. Science and Engineering. 21(6): 1319.

Eight species of annuals and 21 species of trees and shrubs (including ponderosa pine, blue spruce, Douglas fir, eastern redcedar, black locust, honey locust, golden willow, black walnut, and little-leaf linden) were studied in solution cultures and field plots, respectively. Black locust and honey locust were among the six perennials surviving the highest salt level (10,000 p.p.m.), golden willow was one of the two surviving the second level (8,000 p.p.m.), while eastern redcedar, Douglas fir, green ash, and honeysuckle survived the third level (6,000 p.p.m.). Tests by the plasmolytic or 2,3,5-triphenyltetrazolium-chloride method showed good correlation between plant species surviving and the resistance of plant tissue to salt. Ca, Mg, Na, K, and P were determined on samples from the terminal 6 inches of leaves and stems of all trees and shrubs. All those grown in treated cultures contained a greater quantity of Na, and all except Tamarix contained a greater quantity of Ca, than controls. In all tree and shrub species except Tamarix, an inverse relationship was found between salt concentration and rate of diameter growth.

680. Myster, R.W.; Pickett, S.T.A. 1993. **Effects of litter, distance, density and vegetation patch type on postdispersal tree seed predation in old fields.** Oikos. 66(3): 381-388. 57 refs.

A study was made in autumn 1989 of the spatial and temporal variation and difference in seed predation among six tree species (*Acer rubrum*, *Fraxinus americana*, *Cornus florida*, *Quercus rubra*, *Carya tomentosa,* and *Juniperus virginiana*) in two old fields (one of the fields had not been used for farming for 7 years and the other had not been used for 17 years) at a site in New Jersey. Five seeds of each species were placed on anchored squares (13 X 13 cm) of waterproof sandpaper, either in the open or in cages (0.25 X 0.25 X 1.0 m), to exclude mammalian predators. Litter of *Quercus* spp. or *Solidago* spp. was placed on some of the sandpaper squares, at its naturally occurring density. For *A. rubrum* and *F. americana,* two other seed densities (25 and 125 seeds/square of sandpaper) were used in addition. The seed predator guild consisted of gray squirrels (*Sciurus carolinensis*), white-footed mice (*Peromyscus* *leucopus*), white-tailed deer (*Odocoileus virginianus*), and raccoon (*Procyon lotor*). Very few *J. virginiana* seeds were lost to predation. Predation for all other species was reduced by additions of *Quercus* spp. litter or *Solidago* spp. litter. *Carya tomentosa* seed predation also decreased with increasing distance from the forest edge. The initial seed density affected seed predation rates of *A. rubrum* but not of *F. americana*. Predation was greater in patches of woody vegetation than in herbaceous patches, and was less in the more recently abandoned field. The order of seed preference was *A. rubrum* > *Cornus florida* > *Carya tomentosa* > *Q. rubra* > *F. americana* > *J. virginiana* in the more recently abandoned field, and *Q. rubra* > *A. rubrum* > *F. americana* > *Carya tomentosa* in the other field.

681. Nunes, F.P. 1958. **Data for a study on the behaviour of exotic species in Mozambique.** Pointe Noire, Congo: 2d Session Inter-African Forestry Conference. 10 p.

Gives notes on the behavior of a number of *Eucalyptus* spp., *Cupressus lusitanica*, *C. goveniana*, *C. macrocarpa* and *C. sempervirens*, *Juniperus bermudiana*, *J. sinensis*, and *J. virginiana*, *Syncarpia laurifolia*, and *Callitris calcarata*.

682. Oosting, H.J. 1942. **An ecological analysis of the plant communities of Piedmont, North Carolina**. American Midland Naturalist. 28: 1-126.

Since redcedar grows in every habitat and is associated with all plant communities, it can have no bearing on the trend of events (succession). Infrequently, it may be the first tree pioneer in old fields. It is never a dominant, never a dependent, and rarely in significant numbers.

683. Owensby, C.E.; Blan, K.R.; Eaton, B.J.; Russ, O.G. 1973. **Evaluation of eastern redcedar infestations in the northern Kansas Flint Hills.** Journal of Range Management. 26(4): 256-260. 9 refs.

The associations between cattle stocking rate, rainfall, and invasion of *Juniperus virginiana* were investigated during 1959-1969 together with possible methods of control. *J. virginiana* appeared to invade all upland sites equally irrespective of slope, exposure, or rainfall, but the numbers generally decreased as the stocking rate increased. Small trees were eliminated by fire or cutting, and fenuron granules at 2 tablespoons/inch basal diameter effectively controlled larger trees. Foliar sprays were less effective than granules.

684. Palmer, E.J. 1921. **The forest flora of the Ozark region.** Journal of the Arnold Arboretum. 2: 216-232.

Presents physiography of the Ozark Uplift and the associated vegetation. Redcedar occurs throughout the region but is abundant only along the bluffs.

685. Quarterman, E. 1950. **Ecology of cedar glades. I. Distribution of glade flora in Tennessee.** Bulletin of the Torrey Botanical Club. 77: 1-9.

686. Quarterman, E. 1950. **Major plant communities of Tennessee cedar glades.** Ecology. 31: 234-254.

687. Rains, M.T. 1977. **Brush dams reduce sediment production and create favorable planting sites.** Southern Journal of Applied Forestry. 1(4): 4-7. 2 refs.

Brush dams for gully plugging can be loosely constructed (18-24 inches high) from locally collected cedar (*Juniperus virginiana*) poles and tops. Experience with cedar brush dams is described in establishing loblolly pine (*Pinus taeda*) for erosion control in northern Mississippi. Estimated data are presented for: reduction in annual soil loss on loess, loam, sand, and clay soil types compared with sites without dams, for different numbers of dams per acre; and height growth behind dams compared with growth on nearby slopes. It is concluded that brush dams are effective for temporarily reducing sediment production from eroding lands and for aiding the establishment of pine seedlings planted for permanent erosion control.

688. Read, R.A. 1952. **Tree species occurrence as influenced by geology and soil on an Ozark north slope.** Ecology. 33: 239-246.

Describes relationships between species occurrence and types of soil, derived from surface geologic formations in the northern Arkansas Ozarks. Eastern redcedar, oaks, elm, and shagbark hickory predominated on St. Joe limestone.

689. Read, R.A.; Walker, L.C. 1950. **Influence of eastern redcedar on soil in Connecticut pine plantations.** Journal of Forestry. 48(8): 337-339. 9 refs.

Physical and chemical properties of surface soil beneath *Juniperus virginiana* in pine plantations in Connecticut were found to be different from those beneath adjacent pines. Properties of the surface soil below redcedars were apparently influenced by the high Ca content of the litter (2 percent compared with less than 1 percent for white and red pines), its decomposition products, and subsequent incorporation in the soil by earthworms. In the older pine plantation studied, earthworm activity was confined to the area directly beneath the few redcedars in the stand.

690. Reva, M.L.; Reva, N.N. 1972. ***Juniperus virginiana* in the steppe zone of the Ukraine.** Byulleten Glavnogo Botanicheskogo Sada. 84: 13-19. 15 refs. Russian.

Describes the performance of *J. virginiana* as individual specimens and in pure and mixed stands on two estates in the south Ukraine. The oldest trees are 95 years old, and most of the stands are 30-60 years old. Results indicate that *J. virginiana* is fully acclimatized in this region, producing abundant natural regeneration and equaling *Quercus robur* and *Gleditsia triacanthos* in its resistance to drought. It competes successfully with steppe and weed vegetation, but is very sensitive to shade and should be grown only in pure stands.

691. Rolfe, G.L.; Boggess, W.R. 1973. **Soil conditions under old field and forest cover in southern Illinois.** Soil Science Society of America. 37(2): 314-318. 24 refs.

Soil conditions were compared under variously eroded old fields abandoned in the 1930's and carrying seral hardwoods and *Juniperus virginiana* with grasses and herbs. Conditions were (a) old-field plantations of *Pinus echinata* aged 30-35 years, (b) native hardwood stands, and (c) for three soil types. Under (c), the amount of organic matter and the concentrations of exchangeable Ca and Mg were higher and soil bulk density was lower than under (a) and (b). Under (b), bulk density, hydraulic conductivity, and concentrations of Ca and Mg were improved in comparison with (a), but the content of organic matter was higher under (a). No significant differences in pH were noted. It is concluded that the introduced pine seral stage has considerably ameliorated soil conditions since the fields were abandoned, and there is a trend towards conditions typical of native hardwood stands.

692. Rothenberger, S.J. 1989. **Extent of woody vegetation on the prairie in eastern Nebraska, 1855-1857**. In: Bragg, T.B.; Stubbendieck, J., eds. Proceedings, 11th North American prairie conference: prairie pioneers: ecology, history, and culture; 1988 August 7-11; Lincoln, NE. Lincoln, NE: University of Nebraska Printing: 15-18.

Early surveyors' notes from five counties bordering the Platte River in eastern Nebraska were utilized to measure the extent of original woody vegetation in this region. These data were compared to field studies from the same area made from 1979 to 1983, were used to determine areas of prairie - forest transition, and were used to tabulate the extent of woody vegetation in the lower Platte River Valley at the time of European settlement (1855-1857). Using a modified importance value based on relative density and relative dominance of witness trees, the highest ranking presettlement tree species were cottonwood (*Populus deltoides* Marsh. spp. *monilifera* (Ait.) Eckenw.), bur oak (*Quercus macrocarpa* Michx.), elms (*Ulmus* spp.), willows (*Salix* spp.), and black oak (*Quercus velutina* Lam.). The original survey indicated the presence of single trees and tree clusters within the original prairie vegetation of eastern Nebraska. Trees are presently more widespread, and their composition differs from the original woody vegetation. Presently, cottonwood, bur oak, American linden (*Tilia americana* L.), and rough-leaved dogwood (*Cornus drummondii* Meyer) are more common than they were 130 years ago. Includes discussion of occurrences of eastern redcedar during the 130 year period between surveys.

693. Ryker, R.A. 1958. **Conifers vs. hardwoods on old-field sites.** Sta. Note 22. Columbus, OH: U.S. Department of Agriculture, Forest Service, Central States Forest Experiment Station. 2 p.

After 11 years, findings corroborate earlier results. The most successful softwood species, in order, are: loblolly pine, shortleaf pine, white pine. Height growth of the pines and eastern redcedar was similar on the slightly eroded and severely eroded sites.

694. Rykiel, E.J.; Cook, T.L. 1986. **Hardwood-redcedar clusters in the post oak savanna of Texas.** Southwestern Naturalist. 31(1): 73-78.

695. Sabuco, J.J. 1990. **Exploring the native range. Part I.** American Nurseryman. 172(10): 28-30, 32-37.

In this survey of American native trees and shrubs for landscaping, the following tall-growing species are recommended and described: *Acer spicatum*, *Amelanchier alnifolia*, *Cornus alternifolia*, *Hamamelis virginiana*, *Juniperus virginiana*, *Pinus strobus* cv. *Umbraculifera*, *Styrax americana*, and *Viburnum prunifolium*.

696. Schmidt, T.L. 1991. **Factors influencing establishment of eastern redcedar (*Juniperus virginiana* L.) on rangeland.** J. Ser. 10137. Lincoln, NE: University of Nebraska, Agriculture Research Division. 4 p.

697. Schmidt, T.L.; Stubbendieck, J. 1993. **Factors influencing eastern redcedar seedling survival on rangeland.** Journal of Range Management. 46(5): 448-451. 22 refs.

Subplots of 10 transplanted eastern redcedar (*Juniperus virginiana*) seedlings were replicated at two sites in west-central Nebraska. Plots were established in 1987 and 1988 under three different grazing levels: actively grazed; actively grazed until 1987 and then fenced from grazing; and not grazed for more than 50 years. Split-plots within the three grazing levels were established on three different aspects: north-facing, south-facing, and flat. Seedling survival was evaluated 6, 18, and 30 months after establishment. The year that the seedling was established influenced survival after 18 months. Grazing effects and aspect were significant factors in the survival of seedlings for all three evaluation periods. Highest survival in relation to grazing occurred where seedlings were transplanted into plots that were grazed until 1987 and then fenced (57 percent ± 1.5 percent). Lowest survival rates in relation to grazing were for areas that were not grazed for more than 50 years (40 percent ± 3.0 percent). North-facing slopes had the highest survival after 30 months (65 percent ± 2.4 percent). South-facing slopes had the lowest survival after 30 months (34 percent ± 2.9 percent). Land managers may be able to reduce eastern redcedar seedling establishment on grazed rangelands through different grazing practices.

698. Smith, C.C.; Hamrick, J.L.; Kramer, C.L. 1990. **The advantage of mast years for wind pollination.** American Naturalist. 136(2): 154-166. 34 refs.

Mast years are defined as years of large seed crops within species of perennial plants with synchronous extreme annual fluctuation in reproductive effort. A model describing the relationship between pollen production and fruit production during mast years is outlined, using data on *Pinus contorta* from 17 sites in the western U.S.A. Problems related to the seven assumptions on which the model is based are examined. Relaxing five of these alters, but does not eliminate, the advantages of mast years. To retain the benefits of mast years, male and female reproductive effort must vary synchronously and the cost of producing a female must be nearly the same, whether or not fertilization occurs. These assumptions tend to be true for gymnosperms and angiosperms of boreal forests, but false for wind-pollinated angiosperms and one gymnosperm (*Juniperus virginiana*) of temperate deciduous forests.

699. Smith, S.D.; Stubbendieck, J. 1990. **Production of tall-grass prairie herbs below eastern redcedar.** Prairie Naturalist. 22(1): 13-18. 20 refs.

Above-ground forage production under *Juniperus virginiana* and in the interstitial zone was measured in tall-grass prairie sites at Raymond and Ashland, Nebraska, in 1985 and 1986. Dominant grasses in the interstitial zone were *Andropogon gerardii*, *Bouteloua curtipendula*, *Schizachyrium scoparium*, *Dichanthelium* (*Panicum*) *oligosanthes* var. *scribnerianum*, *Carex eleocharis*, and *Agropyron smithii* (*Elymus smithii*) whereas canopy zone grasses included *Bromus japonicus*, *Poa pratensis*, and *C. heliophila*. Canopy zone biomass production averaged 83 percent less than the interstitial zone. Reductions in light (averaging 85 percent) and available soil water (11.5 percent) are suggested as two possible explanations.

700. Spurr, S.H. 1940. **The influence of two Juniperus species on soil reaction.** Soil Science Society of America. 50: 289-294.

Both *Juniperus virginiana* and *J. communis* altered the pH of old field soils in the vicinity of New Haven. The first species raised the pH of the upper part of the mineral soil and lowered it at a depth of 6 inches. *J. communis*, on the other hand, lowered the pH at both depths. Tentatively, it was concluded that the addition of litter was a highly important factor influencing the pH of the upper part of mineral soil, and withdrawal of soluble substances by the roots appeared to be of similar importance at a 6-inch depth.

701. Stefanescu, P. 1960. **Afforestation with *J. virginiana* under the site conditions of the degraded areas in the plains and hill zone of Transylvania.** Revista Padurilor. 75(6): 321-324. 3 refs. Rumanian.

Gives details of trial plantings made in 1956 with planting stock of different ages and sizes, with and without protective shade. Better survival and growth were obtained with 1-year than with 2-year seedlings, with small (less than 25 cm) than with large (greater than 25 cm) 2-year seedlings, and with shaded than with unshaded plots.

702. Steyermark, J.A. 1940. **Studies of the vegetation of Missouri. I. Natural plant associations and succession in the Ozarks of Missouri**. Field Museum of Natural History, Chicago Botanical Series. 9(5): 349-475.

A redcedar climax occurs over an eroded limestone substratum eventually covered by a sugar maple-white oak association.

703. Stoeckeler, J.H.; Rudolf, P.O. 1949. **Winter injury and recovery of conifers in the Upper Midwest**. Sta. Pap. 18. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Lake States Forest Experiment Station. 20 p.

In several localities in Wisconsin, Minnesota, North Dakota, and South Dakota, redcedar in either natural or planted stands suffered only light damage during the severe winter of 1947-1948.

704. Tolstead, W.L. 1941. **Plant communities and secondary succession in south-central South Dakota.** Ecology. 22: 322-328.

Prairie communities are the major climax types in the region described, and tree communities occur only in special habitats. *Pinus scopulorum* is found on limy sandstone outcrops on the edges of valleys; and deciduous woodlands of *Populus* *sargentii, Fraxinus pennsylvanica, F. lanceolata, Ulmus americana, Celtis occidentalis, Salix amygdaloides, Acer negundo, Quercus macrocarpa,* and *Juniperus virginiana* occur in the valleys. In 1936 and 1937, drought destroyed 75-85 percent of the deciduous trees in ravines with silt-loam soils where permanent ground water was not accessible, but trees and shrubs near springs or streams did not suffer materially. The communities of *Pinus scopulorum* did not suffer losses from drought.

705. Traci, C. 1960. **The growth of some exotic tree species on degraded soils in the Aries Valley.** Revista Padurilor. 75(5): 292-294. 2 refs. Rumanian.

Presents notes on increment of 25-year stands of *Quercus borealis, Pseudotsuga taxifolia, Pinus banksiana, P. strobus,* and *Juniperus virginiana* on sites of varying soils, slopes, and altitudes. All, except *P. banksiana*, have done fairly well at 600-700 m altitudes, and *J. virginiana* merits large-scale planting on eroded soils.

706. Tyndall, R.W. 1992. **Historical considerations of conifer expansion in Maryland serpentine "barrens."** Castanea. 57(2): 123-131.

Conifers have spread rapidly in four protected serpentine areas in Maryland during the past 50 years. In three areas, more than 80 percent of grassland and savanna seral stages have succeeded to woodland and forest dominated by *Pinus virginiana* or this species with *Juniperus virginiana*. Before settlement was effected circa 1750, Native American fire hunting practices maintained vast areas of serpentine grassland and oak savanna. After settlement, livestock grazing apparently replaced Indian fires as the primary factor inhibiting woody plant succession in many areas including Soldiers Delight. Areas not grazed succeeded to forest, probably deciduous, and the regional abundance of these relatively fire-intolerant conifers probably increased substantially. Cessation of grazing and other disturbances such as logging by the mid-1900's apparently have allowed these conifers to spread rapidly in remaining serpentine openings. Although seasonal drought may slow the rate of conifer succession, extant grasslands and savannas will disappear without major perturbations such as logging and fire.

707. Tyndall, R.W.; Farr, P.M. 1989. **Vegetation structure and flora of a serpentine pine-cedar savanna in Maryland (USA).** Castanea. 54(3): 191-199.

The phytosociology and flora of a serpentine pine-cedar savanna were studied in Harford County, Maryland. This community comprises 69 vascular plant taxa, including 2 taxa that are restricted in Maryland to serpentine soil (*Talinum teretifolium* and *Cerastium arvense* var. *villosum*) and 1 species that is "highly state rare" (*Panicum flexile*). In the ground layer, 99 percent of the vegetative cover was perennial and half of it was graminoid. About 40 percent of herbaceous cover was produced by *Andropogon scoparius* and *Aristida purpurascens*. Fire suppression may have contributed to the abundance of *Pinus virginiana* and *Juniperus virginiana*.

708. Ugarte, E.A. 1987. **The hill prairies of northeast Iowa: vegetation and dynamics.** Dissertation Abstracts International, B. Science and Engineering. 48(4): 950-B.

Patterns of plant community organization in 35 hill prairies from northeastern Iowa were studied. The influence of grazing, invasion by woody species, and habitat factors on diversity and dominant species distribution was also investigated. The invasive process of the prairies by *Juniperus virginiana* was assessed by studying spatial distribution, age, and size structure of four populations under different ecological conditions. The results indicate that hill prairies from northeastern Iowa are part of a continuum that connects them to the tall grass prairie that once covered Iowa. They make up the driest part of the gradient and converge in structure with those hill prairies in Wisconsin, Illinois, and Minnesota. Five community types were distinguished and described. *Andropogon gerardii, A. scoparius, Sporobolus heterolepis,* and *Bouteloua curtipendula*, the most important grasses, as well as *Rhus glabra*, behaved differently under various conditions of topography, moisture availability, and grazing intensity. Invasion of hill prairies by *R. glabra* seems to be related to fire suppression. *R. glabra* is probably involved in a facilitation-like mechanism that promotes the establishment of *J. virginiana*, when grazing is eliminated. Progressive or massive invasions of hill prairies by *J. virginiana* can culminate in closed communities with total elimination of prairie species.

709. USDA Forest Service. 1951. **Rehabilitation of forest soils: litter and site index of loblolly pine.** Rep. SO-22. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 3 p.

A study in northern Mississippi indicated that litter under loblolly pine may weigh 6 tons per acre more than that under eastern redcedar, but that the proportion of Ca and of excess base is higher in the latter. Herbaceous cover appeared to be inferior to either species in soil-building characteristics. An empirical investigation of soil site relationships on the Bankhead National Forest in Alabama has led to a scheme of site valuation in which the loblolly site index is estimated at 77 + topographic score + aspect score + gradient/soil score. The last-named is read from a table; topographic score is 0 for flat or broad ridge tops, + 4 for bottoms or lower slopes, and - 2 for upper or middle slopes and narrow ridge tops; while aspect score is 0 for exposure within 22 $^{1}/_{2}$° of due west or east, + 8 for more northerly aspects, and - 3 for more southerly aspects.

710. USDA Forest Service. 1955. **Pines thrive and hardwoods fail on Ozark old fields.** Rep. SO-16. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 16-17.

In plantings made in 1950, loblolly, Virginia, and shortleaf pine have shown best development. *Liriodendron tulipifera*, black walnut, white oak, eastern redcedar, eastern white pine, and pitch pine showed either poor survival, or poor growth, or both; black locust was heavily infested with borers. In general, conifers grew best on loamy sands, and surviving hardwoods grew best on cherty silt-loam sites.

711. University of Toronto, Glendon Hall Faculty. 1966. **The effects of four plantations species on certain soil properties.** For. Res. Rep. 4/5. Toronto, ON: University of Toronto, Glendon Hall Faculty.

Experimental plantations of *Picea abies*, *Juniperus virginiana*, *Fraxinus americana,* and *Thuja occidentalis* were established in 1936 on level ground in Ontario, on a clay-loam soil with impeded drainage, previously cultivated for agricultural crops. Soil pits were excavated in 1966 in each plantation, the profiles were examined, and soil samples were analyzed. The upper 20 cm of soil from the *P. abies* plantation had markedly lower pH values (6-6.5) than that under the other species (7-7.5). There was a markedly higher content of organic C under *P. abies* and *J. virginiana* than under the other two species, and total N values tended to parallel organic C differences. Exchange cation values and P content showed no clear relation to species.

712. Voigt, G.K. 1965. **Nitrogen recovery from decomposing tree leaf tissue and forest humus.** Soil Science Society of America. 29(6): 756-759. 23 refs.

Recovery of N from decomposing leaf litter of *Alnus rugosa*, *Cornus florida*, *Liriodendron tulipifera, and Tsuga canadensis*. *Juniperus virginiana* and *Pinus resinosa* were studied under laboratory and greenhouse conditions. Weight loss and N deficits in decomposing tissue were more marked in hardwoods than in conifers. There was no pronounced species correlation between Ca concentration of the leaf litter and either weight loss or N deficit, but N deficit was increased in some cases by addition of $CACO_3$. Considerable variation in availability of N to *Pseudotsuga taxifolia* seedlings was observed in soil cultures where N originated from decomposing leaf tissue or from humus samples collected under each species. Recovery of N ranged from about 60 to over 90 percent of the original N content.

713. Vrcelj-Kitic, D. 1963. **Locations of *Juniperus virginiana* in Vojvodina and possibilities of increasing its cultivation.** Sumarstvo. 16(6/9): 275-281. 11 refs. Serbo-Croatian.

Presents notes on the soils on which this species is grown in Yugoslavia, with growth data from two sites.

714. Ware, S.; Redfearn, P.L., Jr.; Pyrah, G.L.; Weber, W.R. 1992. **Soil pH, topography and forest vegetation in the central Ozarks.** American Midland Naturalist. 128(1): 40-52.

In a detrended correspondence analysis (DCA) ordination, 81 forested sites in the southern Missouri (U.S.A.) Ozarks fell into three different groups. Groups I and II were upland, and Group III consisted of 17 bottomland stands with high importance of *Platanus occidentalis*. In Group I (34 upland stands), *Quercus alba*, *Q. velutina*, *Q. rubra*, and *Carya texana* codominated in various combinations; *Q. velutina* reached higher importance percentage (I.V.) at higher elevation above the streams and on more acid soils, whereas *Q. alba* was most important at lesser heights above the streams and on less acid soils. *Pinus echinata* and *Q. stellata* were concentrated at opposite ends of a DCA ordination of Group I, with *Q. stellata* (I.V.) highest on southern and western aspects and ridge tops and with *P. echinata* on various aspects. *Quercus* and *Carya* were reproducing well in all Group I stands and *Acer saccharum* was reproducing well in only a few. In Group II (30 upland stands generally with higher pH than Group I stands), a DCA ordination revealed a vegetational gradient correlated with aspect, with *Juniperus virginiana* stands on southern and western aspects at one end and stands with *Tilia americana* at the other end. *Quercus muehlenbergii* decreased in importance from the *Juniperus* end toward the *Tilia* end, whereas *Acer saccharum* increased over the same gradient. High abundance of *Fraxinus americana* and *Ulmus rubra* occurred where *Acer saccharum* was abundant. *Quercus rubra*, the only species important in both Group I and Group II, was abundant all across the Group II ordination, but was most important toward the *Tilia* end. *Quercus* spp. were not reproducing well in Group II stands, whereas *Acer saccharum* was, even in stands at the *Juniperus* end of the ordination. The differential reproduction of *Quercus* spp. vs. *Acer saccharum* on more acid vs. less acid to basic soils suggests that not only present composition but also potential (sapling layer) vegetation is related to soil pH.

715. Webb, R.S. 1990. **Growing redcedar in Florida.** Circ. 183A. Gainesville, FL: Florida Cooperative Extension Service. 5 p.

716. Welbourne, F.F., Jr. 1962. **The comparative ecology of two canyons and an upland area in west central Oklahoma.** Dissertation Abstracts International, B. Science and Engineering. 23(3): 810-811.

Devil's Canyon (a) and Howerton Canyon (b) support a forest-type vegetation, and the upland (c) around (a) supports a scrubby savanna type. On (a), which supports the most mesic vegetation and contains several disjunct species from the east, the dominant arborescent species are *Acer saccharum*, one of the disjuncts, and *Ulmus rubra*; (a) had the highest amounts of total N and P, organic C, and soil moisture, and the lowest mean weekly maximum temperature. In (b), which has fewer mesic species and no disjuncts, the dominant species is *Juglans nigra*; temperatures, total N, organic C, and soil moisture were intermediate between (a) and (c) and total P was lower than (a) and equal to (c). On (c), the vegetation consists almost entirely of *Quercus marilandica* and *Juniperus virginiana*; it had the lowest amounts of organic C, total N, and soil moisture, and the highest values for insolation, evaporation, and temperature. Differences in soil reaction and texture, and in amounts of exchangeable K between the three areas were small. Studies were made on the N and soil-moisture requirements of herbaceous species in the areas.

717. Wheeler, A.G., Jr. 1992. ***Chinaola quercicola* new record rediscovered in several specialized plant communities in the southeastern United States (*Heteroptera: Microphysidae*).** Entomological Society of Washington. 94(2): 249-252.

Described from a female collected in Florida in 1927, *Chinaola quercicola* Blatchley has been known only from the holotype, which was thought to have been destroyed. That specimen has been found, and populations of this native microphysid have been discovered in South Carolina and Virginia. Its occurrence in specialized community types including granite outcrops, a shale barren, and a pitch pine-scrub oak barren and its association with lichen-covered branches of redcedar, *Juniperus virginiana*, and scrub oak, *Quercus ilicifolia*, are discussed.

718. Wherry, E.T. 1922. **Soil acidity preferences of some eastern conifers.** Journal of Forestry. 20: 488-496.

Eastern redcedar reached maximum development on limestone barrens in Tennessee. It became prominent on basic igneous rocks, calcareous clays, and various other substrata where lime was available near the surface.

719. Wilde, S.A. 1946. **Soil-fertility standards for game food plants.** Journal of Wildlife Management. 10: 77-81.

Describes characteristics of Wisconsin soils supporting eastern redcedar, standards of soil fertility for nurseries, and site requirements.

Author Index by Citation Number

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Schmidt, Thomas L.; Piva, Ronald J.
1995. **An annotated bibliography of eastern redcedar.** Resour. Bull. NC-166. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 93 p.

Presents a listing of 719 citations related to eastern redcedar through September 1994. Major eastern redcedar subject headings include: physiology, nursery propagation, regeneration/planting, pests, weather-related factors, control, products, wildlife relationship, and ecological relationships.

KEY WORDS: Eastern redcedar, *Juniperus virginiana*.

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Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.

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