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DISCUSSION: REVEGETATION WITH NATIVE GRASSES

I. A DISAPPOINTING HISTORY

by Burgess L. Kay, R. Morton Love, and Robert D. Slayback

The pristine vegetation of California contained perennial grasses and a variety of other herbaceous species (Barry, 1981). Why aren't these plants currently recommended by University and U.S. Department of Agriculture agronomists and range scientists who are actively involved in establishing vegetation following construction or other soil disturbances? The best way to explain current recommendations is to examine the history of seeding and plant introduction. The recent interest of CNPS in native perennial grasses (*Fremontia*, April 1981) calls for some historical information on efforts to plant those grasses in California.

The University of California has a long history of involvement in wildland plants. In 1878, Dr. Eugene W. Hilgard, Professor of Agriculture and Agricultural Chemistry, and Dr. Edward J. Wickson, Professor of Horticulture in the college of Agriculture at U.C. Berkeley received seed of a bunchgrass, *Oryzopsis miliacea* (smilograss), from Dr. S.M. Curl, who maintained an experimental grass garden in the Morton District, North Island, New Zealand. In 1879-1880, they sent seed of this Asian native to farmers for range trials in several parts of California. In 1912, Dr. P.B. Kennedy came to the U.C. Berkeley Division of Agronomy from the University of Nevada and initiated trial plots of legumes and grasses, native and exotic, throughout the state. During his time, smilo looked particularly promising as a range forage grass following brush clearing in San Diego County. It has since become naturalized in the coastal mountains at least as far north as Santa Barbara County; to the casual observer it looks as natural and at home as any of the native bunchgrasses. Seed of smilo was commercially available in the 1950s and 60s but is not currently available. Kennedy also introduced hardinggrass (*Phalaris tuberose* var. *stenoptera*), from Australia, which is now widespread in California.

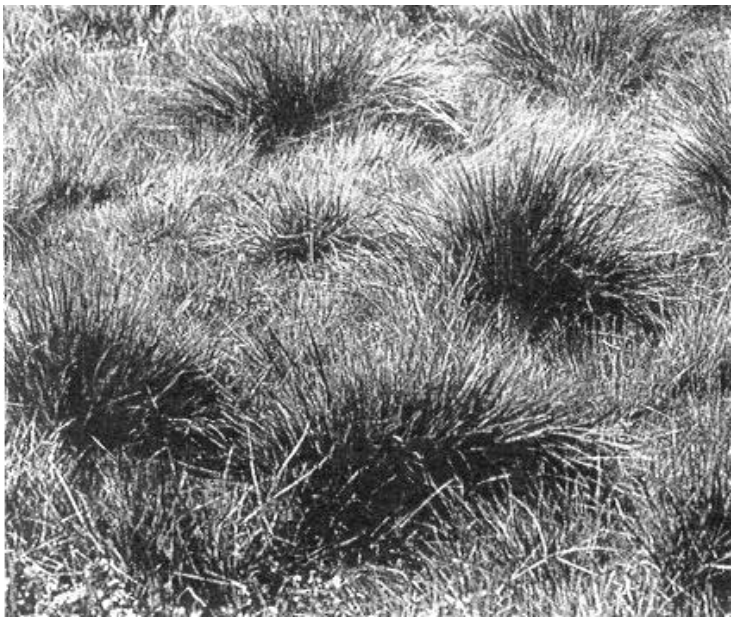
Like most agronomy departments, in its early years the Division of Agronomy (located on the Berkeley campus then) was essentially a cereal division, although by the 1920s work was also carried on with dry beans, alfalfa, and white clover. When Burle J. Jones farm advisor in Shasta County, was appointed Extension Agronomist in 1937, he decided that attention to rangeland improvement was long overdue. After conferring with Prof. B. A. Madson, chairman of the Division of Agronomy (then at Davis), he embarked on a well-planned program of adaptation trials of native and exotic range plants in cooperation with county farm advisers throughout the state. He collected seed of native perennial grasses including *Stipa* species and laboriously hand-threshed, cleaned, and packaged the seed for the plots.

Search for Grasses

In 1940, Dr. R.M. Love was hired by the U.C. Division of Agronomy at Davis to find replacement species for California rangelands. Assisted by D.C. Sumner, he collected seed of native perennial grasses. Special attention was devoted to *Stipa pulchra* (purple

stipa), *S. cernua* (nodding stipa) (Stebbins and Love, 1941), and *S. lepida* (foothill stipa), including interspecific hybridization (Love 1946, 1951, 1954, 1959). First-generation hybrids are completely sterile, but natural hybridization is common where two or more species overlap and the first generation hybrids exhibit strong hybrid vigor.

Love selected promising strains of *S. pulchra* and *S. cernua*; these were certified by the California Crop Improvement Association in 1948 (Love 1948). He also worked with the native *Bromus marginatus* and its close South American relative *B. stamineus* and released an improved cultivar of the latter the same year. All were in seed production for a few years. In spite of Love's enthusiasm (Love 1948, 1951) lack of interest in both the public and private sectors resulted in these efforts being abandoned.



The dark green plants are natural sterile hybrids between two species of stipa. Note the difference in vigor between those and one of the parents, the small lighter-colored plants.

For the record it should be noted that Love spent about fifteen years working on the other native perennial grasses including *Melica californica*, *M. imperfecta*, *Danthonia californica* (California oatgrass*), Poa scabrella* (pine bluegrass), *Sporobolus airoides* (alkali sacaton*), Oryzopsis hymenoides* (Indian ricegrass), *Agrostis diegoensis* (thingrass), *Stipa californica*, *S. coronata*, *S. lemmoni*, and *S. speciosa*. Other species tested are listed in accompanying box. Seeds of these species were collected from their natural habitats, increased at Davis and the Gill Tract (Albany), and grown along with exotic species in range plot trials throughout the state.

From 1937 to 1951, in fifty-one California counties, the U.C. Agricultural Extension Service and the Division of Agronomy at Davis (now the Department of Agronomy and Range Science) seeded thousands of test plots, testing more than two hundred forage species including natives and non-natives (Jones and Love, 1945). Other agencies with similar programs were the California (now Pacific Southwest) Forest and Range Experiment Station (Forest Service, USDA), the Soil Conservation Service (USDA), and

the California Division (now Department) of Forestry. Since then, the USDA, through the Plant Materials Center at Pleasanton and later at Lockeford, and the University of California Department of Agronomy and Range Science at Davis have continued to introduce and field-test materials.

Seed Problems

Seed production of the native plant materials proved very difficult. Yields were low compared with other forage species and thus increased the cost. Seed characteristics such as the geniculate twisted awns and sharp-pointed callus of *Stipas* sp. made harvesting and processing difficult and planting next to impossible with conventional equipment.

Seeded in pastures, the natives were sometimes less palatable to livestock than the resident annuals but were eventually eaten because of their early and late growth. They were often difficult to establish because their seeds were relatively small and the seedlings lacked competitive vigor. They were difficult to manage because they did not tolerate heavy grazing as well as other introduced and naturalized species. This is probably because California natives evolved with very little pressure from grazing animals compared with many of the tested species.

Seed field of Stipa pulchra on the U.C. Davis Farm, April 17, 1948. Total seed yield was about 350 pounds per acre.

large variety of European species which are dominated by annual grasses (Robbins, 1940). These introduced plants are superbly adapted to the California climate and soils, are relatively tolerant of heavy grazing, and just as important, can maintain themselves with no grazing. Many are very aggressive on disturbed sites and offer rapid and effective soil protection. They also can survive fire; in grasslands, only a small percentage of seeds on the soil surface are destroyed by fire (Bentley and Fenner, 1958; Kay, 1960; Mckell et al. 1962).

Demand for seed of natives in the 40s and early 50s was small and short-lived because of its cost and difficulty of handling. Other species were easier to handle, better adapted to reseeding, and more palatable to livestock. Thus, the market for native seeds was never established. Also, the California farmer has too many crop choices to bother with seed production of native grasses when the market is so uncertain. Today seed is available only if contracted as a special order from wild-seed collectors. The price is many times that of the introduced species currently used.

Erosion control

Barley (*Hordeum vulgare*) was probably the first non-native plant used for erosion control. Seed was readily available, and the seedlings developed rapidly because of the large size of the seed. The U.S. Forest Service also used common field mustard (*Brassica campestris*), which is adventive from Europe. This produced a colorful, deep-rooted crop but minimal soil protection. Its widespread use continued through the 1940s, when it was replaced by annual ryegrass (*Lolium* sp.).

Now on the market are seeds of some of the well established introduced annual grasses. *Bromus mollis* is sold as Blando brome and *Festuca megalura* (*Vulpia myuros* var. *hirsuta*) Zorro annual fescue. Annual ryegrass is also used because of its low cost. Look-alike non-native bunchgrasses are Palestine or Berber orchardgrass (*Dactylis glomerata*) and smilo. Most commonly recommended and productive perennial grass for range seeding is Perla koleagrass (*Phalaris tuberose* var. *hirtiglumis*).

We do not suggest the destruction of native plants or their habitats, but when any site is severely disturbed it should be stabilized as rapidly as possible to prevent serious erosion. The best way to do this is to establish a herbaceous plant cover. The plants noted above will do this much more rapidly, effectively, and at a lower cost than any native plants tested to date.

We prefer the term “resident” to describe these established annual grasses rather than “introduced” which suggests they are of recent origin. They have been here for many generations and in our opinion are here to stay. They obviously are better adapted than the natives they replaced, or the replacement wouldn’t have been as fast or complete. It doesn’t make sense, in California grasslands, where European annuals dominate the herbaceous vegetation, to spend excessive amounts of erosion control money for native plant materials that control erosion less effectively than the less expensive introduced plants. For example, seeding at the rate of thirty-two pounds per acre with *Stipa pulchra* resulted in only one plant per seven square feet (McClaran, 1981). This is an excessive cost and will not prevent erosion.

Perhaps it should be emphasized that we are talking about the initial stabilization of severely disturbed sites on steep slopes where the absence of a plant cover will result in

severe erosion. Examples are freeway construction and hillside subdivisions. Less erodable areas do not require such urgent seeding and would be logical places to seed wildflowers or other native plants. Also in later years, following a successful erosion-control seeding of herbaceous species, it is possible to introduce other landscape programs such as native shrubs. This is common practice on California freeways where the annual grasses are killed in about the third year and replaced with shrubs.

We recommend native plants for reseeding if tests have shown them to be successful. Examples are California poppy (*Eschscholzia californica*), which is frequently added to seeding mixtures on less erodable sites. Our recent tests with wildflowers resulted in commercial seed production and the availability of inoculating bacteria for native lupines (*Lupinus benthamii*, *L. densiflorus* var. *aureus*, *L. succulentus*, and *L. vallicola* subsp. *apricus*). All of our recommendations for revegetation in California desert areas are native shrubs and grasses.

If members of CNPS know of herbaceous native plants that can provide the rapid growth and soil protection necessary for soil stabilization in critical areas, we are interested to learn of them and of a source of seed.

Native Plants Tested

The following native plants were tested one or more years for reseeding possibilities by the University of California Division of Agronomy and/or the Soil Conservation Service

Agropyron smithii – Western wheatgrass
Agropyron spicatum – Bluebunch wheatgrass
Agropyron trachycaulum [*A. pauciflorum*] – Slender wheatgrass
Agrostis diegoensis – Thingrass
Agrostis hallii – Halls bentgrass
Agrostis scabra
Borthrichloa barbinodis – Silver beardgrass
Bouteloua curtipendula – Side-oats grama
Bouteloua gracilis – Blue grama
Bouteloua hirsute – Hairy grama
Bouteloua rothrockii – Rothrock grama
Bromus carinatus – California brome
Bromus marginatus – Mountain brome
Calamagrostis nutkaensis – Pacific reedgrass
Danthonia californica – California oatgrass
Danthonia imtermedia – Timber oatgrass
Elymus condensatus – Giant wild rye
Elymus glaucus – Blue wild rye
Eragrostis orcuttiana
Festuca idahoensis – Idaho fescue
Festuca rubra – Red fescue
Hilaria rigida – Big galleta
Koeleria cristata – Junegrass
Melica aristata – Bearded melic
Melica bulbosa --Oniongrass
Melica californica – California melic
Melica imperfecta – California melic
Muhlenbergia porteri – Bush muhly
Oryzopsis hymenoides – Indian ricegrass
Plantago purshii var. *picta* – Plantain
Poa sanbergii [*P. secunda*] – Sandbergs bluegrass
Poa scabrella – Pine bluegrass
Puccinella airoides – Zawadke alkaligrass
Sitanion jubatum – Big squirreltail
Sporobolus airoides – Alkali sacaton
Sporobolus cryptandrus – Sand dropseed
Stipa columbiana – Columbia needlegrass
Stipa comata – Needle-and-thread
Stipa coronata
Stipa lemmonii – Lemmon's stipa
Stipa lepida – Foothill stipa
Stipa occidentalis – Western needlegrass
Stipa pulchra – Purple stipa
Stipa speciosa – Desert needlegrass
Trifolium ciliolatum
Trifolium tidentatum
Vicia americana – American vetch

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II. A PROMISING FUTURE

by Michel P. McClaran and James W. Bartolome

Agronomists Kay, Love, and Slayback have presented a thorough case against the use of native perennial grasses for range reseeding, citing the sensitive nature of these species to heavy grazing and their low competitive vigor and palatability compared to introduced annuals and perennials. For these and other reasons native perennials were not suggested for range reseeding in the April 1981 issue of Fremontia.

Erosion control is yet another matter. Unjustifiably, the authors eliminate natives for such use when the state "It doesn't make sense to spend excessive amounts of money for native plant materials that control erosion less effectively." In reality, native grasses have not been evaluated for their ability to control erosion. In our study (McClaran 1981) erosion was not a problem, and therefore erosion control was not an objective. Our objective was to develop methods for establishing perennials in the face of a high density of annuals. The stabilizing abilities of native and introduced grasses have not been compared, therefore the exclusion of perennials as a possible erosion control agent is premature. As for the allegation of "excessive costs," this is primarily a function of the lack of a native seed supply.

As mentioned in the Fremontia article, the objectives of revegetation are broader than range reseeding and erosion control. These may include large scale landscaping (e.g. rights-of-way and park grounds), native plant gardening, and mitigating environmental disturbance. The reasons for using natives in these situations, as well as for erosion control, are far removed from providing the "casual observer" with a bunchgrass aspect. As part of the original California flora, these grasses provided the necessary forage for the settlement and development of the state, and should be conserved, propagated, and appreciated from this historical perspective. The still untapped gene resources present in these native species are another reason for their conservation and propagation. These objectives can not be met by "look-alike" plants or plants which are native by default.

The use of natives in this broader context brings with it a redefinition of success. Kay, Love, and Slayback define success in terms of productivity ("yields"), forage ("less palatable and could not tolerate heavy grazing"), and cost ("doesn't make sense to spend excessive amounts of money on native plant materials"). Yet for native grasses success should be tied more closely to the presence and perpetuation of these species. With such an interpretation success is much easier to achieve than when it is defined as producing a monospecific stand of a selected plant. For example, the introduction of a small but viable population where none was previously would be highly successful.

These different objectives present shifting goals for future research. For example we need to develop techniques for mixing native and introduced seed for soil stabilization, selecting appropriate species for particular environments, and maintaining established natives. This type of research need not be independent of the work cited by the authors; it can be integrated into their current revegetation program.

These comments do not justify the exclusive use of native species for revegetation. Instead they illustrate that the elimination of the potential use of native grasses in erosion control is premature, because they have not been tested for the use. Introduced species, although they may provide a similar aspect or appear better adapted, do not posses the same intrinsic qualities as native, and this difference is often of major importance. Because the management objective for using natives can be different than for introduced species, the criteria for success are also different. Future research in techniques for using natives is similar enough to be incorporated into existing revegetation research programs.

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