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Lesquerella: A Winter Oilseed Crop for the Southwest

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Figure 1. Lesquerella plants with buds, flowers, leaves (left), pods, and mature seeds (right)

Lesquerella as an alternative crop

Lesquerella (*Lesquerella fendleri*) is a member of the mustard family and is native to the southwestern United States and northern Mexico. The oil in lesquerella seeds, as a component of engine oil at concentrations as low as 0.25%, has superior performance compared to castor, soybean, and rapeseed methyl esters in reducing wear and damage in fuel injected diesel engines (Goodrum and Geller, 2005). Lesquerella can also be used as an ingredient for a number of other bioproducts such as lubricants, motor oils, plastics, inks, and adhesives. The seed coat and seed meal contain a gum that is useful in coatings and food thickeners (Dierig et al., 2010). The hydroxylated oil in lesquerella is similar to castor oil but does not contain the deadly poison ricin. Therefore, lesquerella is a safer alternative to castor in the United States and can be handled both at the farm level and the oilseed processing level with industry standard equipment and technology.

The lesquerella plant reaches 6 to 12 inches in height and produces many stems. The leaves are silvery-gray, narrow, and 1 to 2 inches long. Flowers are yellow in color and seeds are contained in pea-sized and bladder-like pods along the stem that are tan at maturity (Figure 1 and 2). The seed size of lesquerella (800,000 seeds/lb) is smaller than alfalfa and most clover species.

Planting date and planting method

Although lesquerella is classified botanically as a short-lived perennial, it is produced as a winter annual crop in the southwest. The temperature range for germination is 41-95oF, with 68-83oF being optimal (Adam et al., 2007). The crop has adequate tolerance to freezing temperatures across the growing region. The recommended planting dates are October in Arizona and late September in Texas and New Mexico. Late planted lesquerella (January to February) does not require as much time as early (i.e., September and October) plantings to form a closed canopy. However, late plantings reduce plant biomass, the number of flowers, and crop yield compared to early plantings in Arizona and Oregon (Nelson et al., 1996; Dierig et al., 2010; Roseberg, 1993). Earlier planting in Arizona also allows earlier harvest, before the monsoon rains, which avoids rain-induced shattering and further reductions in crop yield.

Figure 2. A lesquerella field at Maricopa Ag Center, Maricopa, AZ

Lesquerella can be produced under center pivot irrigation systems or in flood-irrigated level basins. Soil preparation and planting methods for establishing lesquerella are crucial because of its small seed size. The seed can be broadcast on level fields using a granule applicator (used for fertilizer, herbicides, and other pelleted or dry materials) and buried at a shallow depth using a ring roller, cultipacker or land roller. Alternatively, a Brillion seeder (commonly used to plant alfalfa) can be used to broadcast and place the seed at a shallow depth in one pass across the field. Sandy loam soils are best for this type of planting because light-textured soils can cover the seed without burying it too deep. It is critical to have a firm soil surface at planting so seeds are uniformly distributed and not placed too deep to prevent seedling emergence. The recommended planting rate of 7 to 11 lbs/A is equivalent to 5.6 to 8.8 million seeds/A (Brahim et al., 1996). It has been shown that a population of 400,000 plants/A is optimum for seed yield. Lower populations can be used without lowering seed yield if the seed distribution is reasonably uniform.

Water and nitrogen management

Fields should be kept moist for about 10 to 14 days to avoid soil crusting until emergence is complete. Three irrigations are usually required for stand establishment after a fall planting on sandy loam soils in Arizona. Lesquerella requires 25 to 30 inches of water (irrigation plus rainfall) during the growing season. Water use by the plant is low until late February during the time when the plants are establishing themselves and the temperatures are relatively cool. The greatest water use occurs between late February and May when lesquerella produces 90% of its growth.

Lesquerella requires about 120 lbs/A of nitrogen (depending on nitrogen content of the soil and water) which is best applied in split applications: 60 lb/A at planting and 60 lb/A at the onset of flowering in February (Nelson et al., 1999; Adamsen et al., 2003). Although a nitrogen rate of 120 lbs/A can reduce seed oil content, total oil yield can still be improved by applying nitrogen. Currently, no information is available on the response of lesquerella to phosphorus or other nutrients.

Weed management

Lesquerella seed yield can be severely reduced by weed competition due to its slow growth during establishment and its short stature. Significant weed infestations, even if controlled late in the crop cycle, physically obstruct the operation of combines making harvest difficult if not impossible. Hand weeding in a broadcast planted crop such as lesquerella results in some crop injury and is expensive. Note at the time this publication was written (June, 2010) no herbicides were registered for in-crop weed control in lesquerella. The discussion of herbicide research below should not be construed as recommendations for herbicide use in lesquerella production.

Preemergence: Research conducted in Arizona found that Prefar or bensulide (registered for use in the Brassica leafy vegetable crop group) can be applied preemergence after planting and incorporated with the first irrigation at a rate of 4 to 6 qt/A for control of germinating weed seeds (McCloskey and Dierig, 2009; Dierig et al., 2010). After the first several irrigations when the majority of lesquerella seedlings have 4 to 6 true leaves and are about ¼ inch in diameter (about 30 days after planting in Arizona experiments), the preemergence herbicides Prowl H2O (a micro-encapsulated, water based formulation of pendimethalin) at a rate of 2 to 3 pt/A or Kerb 50-W (pronamide) at a rate of 2 to 4 lb/A can be applied to control weed seeds that have not yet germinated. At this growth stage, healthy lesquerella plants have developed a root system and the zone of active root growth is below the soil zone into which the herbicides are leached. GoalTender at 2.5 to 4 pt/A or Chateau at 2 to 3 oz/A can also be applied without surfactants or adjuvants (to minimize foliar absorption) at the 4 to 6 true leaf stage for residual weed control but these herbicides will reduce the density of lesquerella plants up to 30 to 40 percent. At planting rates of 7 to 11 lb/A, this reduction in density does not normally reduce yield and is preferable to the significant yield losses caused by weed competition. At the 4 to 6 leaf stage, using a petroleum-based formulation of pendimethalin or adding a non-ionic surfactant, crop oil concentrate or methylated seed oil to spray solutions of GoalTender or Chateau may cause more significant injury and yield loss.

Postemergence – Grasses: Postemergence herbicide options for controlling emerged weeds in lesquerella are limited and the greatest challenge is controlling broadleaf weeds. Grass specific herbicides such as Poast and SelectMax can be used in a manner similar to registrations of these products on Canola and Brassica vegetables: Poast at 1.5 to 2.5 pt/A or SelectMax at 9 to 12 fl oz/A. These products should be used early in the crop cycle to control small grass weeds that were emerged at the time of preemergence herbicide applications or to control small grass weeds that escape preemergence control. Lesquerella exhibits excellent tolerance to these products and Fusilade DX up to their maxium labeled rates; Fusilade DX at 24 fl oz/A, SelectMax at 32 fl oz/A and Poast at 2.5 pt/A.

Postemergence – Broadleaf: For postemergence broadleaf weed control in lesquerella, Stinger (clopyralid) at rates of 11 to 21 fl oz/A caused very little injury to the crop and provided good control of weeds in the legume family but controls a limited number of other weed species. GoalTender at 1 pt/A plus a nonionic surfactant and 2,4-DB or Butyrac 200 at 1 pt/A sometimes caused slight injury that reduced seedling densities but did not reduce yield (McCloskey and Dierig, 2009; Roseberg, 1996). Butyrac should not be used when air temperatures exceed 80 to 85 F and should not be applied just before irrigation. These restrictions on Butyrac use will probably limit its application to fall planted lesquerella. Chateau at 1 to 2 oz/A applied with a nonionic surfactant caused moderate injury (28 to 34% stand loss) and reduced yield 25% when applied postemergence but may still be useful in protecting lesquerella from weed competition. Special Local Need (SLN) registrations for the use of Prefar, GoalTender, Prowl H2O, Stinger, and 2,4-DB on lesquerella are needed in Arizona as is more research on lesquerella weed management.

Insect management

Insect damage in commercial production of lequerella is not expected to be severe enough to require chemical control based on 15 years of lesquerella research at the Maricopa Ag Center. However, there are several insects that are potential problems and fields should be constantly monitored for lygus, harlequin bugs, chinch bugs, and aphids.

Harvest and yield

Lesquerella has indeterminate growth and continues to flower as long as water is supplied and temperatures are warm. However, lesquerella senescence should be induced by withholding irrigation when canopy flowering declines, temperatures increase, and seeds mature in May and June. When plants begin to transition from a dull, gray-green color to brown, a desiccant (e.g. paraquat) is applied to complete the process at a faster rate. This allows the crop to be harvested using a conventional combine about 3 to 4 weeks after the last irrigation, usually in June. Heavy rains after desiccation can cause seed shattering and yield loss since plants are more vulnerable when drying compared to when they are green.

Current lesquerella seed yields are approximately 1500 lbs/A, but the crop has the potential of yielding 2000 to 2500 lbs/A through a combination of plant breeding and improved agronomic practices. Maximum seed oil is reached 27 to 30 days after flowering; harvesting too early results in lower oil content. The latest improved cultivar to be released in 2010 has an oil content of 36% and could be further improved.

Fit of lesquerella in the current cropping systems

Lesquerella could fit into southwestern growers' cropping systems as an alternative crop because it has planting and harvesting periods similar to wheat and other small grain crops. Many growers already have the equipment for producing lesquerella. For example, lesquerella can be planted with Valmar granule applicators and Brillion seeders (commonly used to plant alfalfa) and harvested with conventional grain combines with a slight modification of the sieves (the same as for alfalfa).

Scale-up production issues

An important challenge for lesquerella commercialization and scale-up production is finding suitable herbicide options and obtaining registrations. Another unanswered question is if additional pollinators (such as bees) are needed to reach optimal crop yield in large production fields because lesquerella is an outcrossing species. When lesquerella is produced on a larger scale, more research on potential pests or diseases may be required.

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