



FORB AND SHRUB SEED PRODUCTION GUIDE FOR UTAH

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CREDITS

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TABLE OF CONTENTS

	Page
FORB AND SHRUB SEED PRODUCTION GUIDE FOR UTAH	1
Introduction	1
Economics of Forb and Shrub Seed Production	1
Establishment of Seed Production Fields	2
Site Selection	2
Species Selection and Seed Source	2
Time of Seeding	3
Seedbed Preparation and Weed Control	3
Planting Methods	3
Seeding Depth	4
Row Spacing	4
Seeding Rate and Transplant Spacing	4
Inoculation	4
Irrigation	4
Fertilization	4
Managing the Established Stand	5
Stand Density	5
Weed Control	5
Irrigation	5
Fertilization	5
Insect Management, Disease, and Animal Pest Control	6
Residue Management	6
Seed Harvesting	6
Seed Conditioning	7
Seed Storage	7
Seed Testing and Labeling	7
Seed Certification	8
Diagram of a typical seedlot label	10
SELECTED FORB SPECIES CONSIDERED FOR SEED PRODUCTION IN UTAH	11
Aster, blueleaf	11
Aster, Pacific	11
Balsamroot, arrowleaf	12
Bee plant, Rocky Mountain	13
Burnet, small	14

	Page
Cinquefoil, gland	15
Eriogonum wild buckwheat sulfur flower	16
Eriogonum wild buckwheat, Wyeth	16
Flax, blue (Lewis)	17
Globemallow, gooseberryleaf	18
Globemallow, scarlet	18
Globemallow, munro	19
Goldeneye, showy	20
Goldenrod, Canada	21
Groundsel, butterweed	22
Lomatium, Nuttall	24
Milkvetch, cicer	25
Penstemon, Eaton or firecracker	26
Penstemon, Palmer	27
Penstemon, Rocky Mountain	28
Penstemon, Wasatch	29
Sage, Louisiana	30
Sainfoin	31
Salsify, oyster-plant	32
Sunflower, common	32
Sweetanise	33
Sweetvetch, Utah or northern	34
Yarrow, western	35
 SELECTED SHRUB SPECIES CONSIDERED FOR SEED PRODUCTION IN UTAH ...	 37
Bitterbrush, antelope	37
Kochia, forage	38
Rabbitbrush, white stem rubber	39
Sagebrush, basin big	40
Sagebrush, mountain big	41
Sagebrush, Wyoming big	42
Saltbush, fourwing	45
Winterfat	44
 LINE DRAWING CREDITS	 45
 APPENDIX 1	 46
 APPENDIX 2	 49
 APPENDIX 3	 51
 SAMPLES OF SEED TAGS	 52

FORB AND SHRUB SEED PRODUCTION GUIDE FOR UTAH

INTRODUCTION

The production of seed on cultivated lands can be a practical way to ensure adequate seed supplies of many forb and shrub species utilized in restoration and revegetation projects. At present, wildland harvest from unmanaged natural stands is the major source of seed for most species. However, the supply of wild collected seed fluctuates from year to year, and resultant high prices and inconsistent availability make it difficult to include certain desirable species in restoration and revegetation projects.

Interest in forb and shrub seed cultivated production in Utah has increased substantially in recent years due to development and release of several new varieties and germplasm selections. The UDWR Great Basin Experiment Station at Ephraim, USDA Forest Service Shrub Science Laboratory at Provo, USDA Natural Resources Conservation Service Plant Materials Centers, and USDA-ARS Forage and Range Laboratory at Logan have been responsible for a number of forb and shrub releases. These and other public and private research groups have demonstrated the utility of specific forbs and shrubs in revegetation and restoration efforts. The Utah Crop Improvement Association (UCIA) and Utah Department of Agriculture have had a major role in directing efforts to obtain, develop, and disseminate knowledge of equipment and techniques necessary for forb and shrub seed production. Joint efforts by all agencies have resulted in Utah becoming a production and marketing center of seed for disturbed sites, rangeland, wildlife habitat, pasture lands, and watersheds.

Many seed companies and public agencies are anxious to find committed growers who can successfully produce seed of a wide range of species for restoration and revegetation. Forb and shrub seed

production in Utah can be profitable using management practices developed for cultivated seed crops. Growers need productive, well-drained soils and machinery adapted to planting, cultivating, and harvesting plants with diverse growth patterns and seed characteristics. Irrigation, weed control, insect management and fertilization are normally essential for reliable and profitable production of these species.

Species selection, farm site characteristics, agronomic practices, and market development are the primary considerations in a seed production enterprise. Optimum production begins with the selection of species that are adapted to the soils, winter-hardiness zones, and other climatic conditions of the planting site. Once established, the stand should remain productive for several years. Direct markets or contracts with seed brokers/ conditioners or dealers need to be researched before production begins.

ECONOMICS OF FORB AND SHRUB SEED PRODUCTION

All members of the marketing chain from the grower to the retailer must make a profit to stay in business. Economic analysis for each species is different, since high seed price may be coincident with low yields or high production inputs. Costs of land, water, machinery, fertilizers, pesticides, labor, time for stand establishment, etc., must be weighed against reasonable yield expectations in order to arrive at a break-even price for the seed produced. Estimated yields for each species are given in this publication, but prices tend to be cyclical depending on the supply of wildland collected seed, and public and private sector seed demand. This demand is responsive to natural phenomena such as fires and floods, and

government programs such as CRP or mining regulations which mandate restoration and revegetation of disturbed ecosystems. Demand for these species is also increasing for utilization in naturalized park, highway, and residential landscapes, and for general restoration practices.

Representative seed production budgets are outlined in the publication “Grass Seed Production Guide for Utah” (Extension Circular 437, Utah Cooperative Extension Service, USU, Logan, Utah, 22 p.). Tables 1 and 2 from that publication are reproduced in Appendix 1. Most aspects of these budgets are applicable to forb and shrub as well as grass seed production. They itemize purchase and operational inputs for both seedling and production years, including annualized establishment costs, to arrive at a break even price per pound of clean seed. Prospective growers should apply these budgets to their own situation. See Appendix 2 for a series of questions that will help a potential grower decide whether he should produce forb or shrub seed and what he needs to know to do it successfully and make a reasonable profit.

Many of the forbs and shrubs listed in this guide are amenable to small plot culture, meaning that people with an acre or less of available land (or a large backyard) could produce a significant amount of seed. Planting, weed control, and harvesting may be done by hand for such small areas. Economic returns could be attractive since land, labor, and operational inputs are at reduced or no out-of-pocket cost.

ESTABLISHMENT OF SEED PRODUCTION FIELDS

Site Selection

Easily worked, well-drained soils are the most desirable for seed production. Fields should be free of any noxious weeds such as quackgrass and morning glory. Areas should be selected that are not subject to excessive wind which may inhibit pollination and cause shattering of mature seed. To retain genetic purity and to meet certification standards, fields need to be isolated from non-certified fields or native

stands of the same species. Adequate water must be available when needed, though generally forb and shrub species are more drought tolerant and need much less water than alfalfa or small grains. Overall, sites should be matched with growing requirements of the selected species insofar as is possible. Elevation differences are often unavoidable, but soil characteristics, water requirements, and frost free days are some of the variables that must be considered.

Non-cultivated sites such as hillsides or wastelands can produce harvestable seed of many species. Such areas usually require removal of weeds before hand seeding (or transplanting) the desired species. Competition with other species may delay establishment and seed yields may be lower than in more intensely cultivated fields, but the minimal inputs required can make it economically feasible. Hand harvest may be necessary to avoid contamination with seed of other species.

Species Selection and Seed Source

The choice of a species to grow for seed production depends on marketing opportunities, the production site available, and grower expertise. After researching market potential and/or contracts, the grower must evaluate whether the desired species is reasonably adapted to the farm (or backyard) site. As outlined in this publication, some species require more time, effort, and expertise to grow than others, and growers must decide the economic realities for their own operation.

Some companies may wish to have seed of specific ecotypes of species produced, and will therefore provide the stock seed. Such seed must be labeled properly (see section on Seed Labeling and Testing and Seed Certification) to assure germplasm identity, purity, and quality. Several species have released varieties and/or germplasms which are applicable to a broader market and may be obtained as Foundation, Registered, or the proper generation of Source Identified, Selected, or Tested seed. Seed analysis and certification tags of stock seed should be saved to help the grower document the source and purity of

the seed produced. This helps maintain the identity and economic value of the seed when offered for sale.

A seed grower may also collect seed from a natural stand for planting. This should be done only under advisement from a company or agency where the production will be marketed, and it would be advantageous to have such seed Source Identified by a certification agency to establish germplasm origin.

A list of seed vendors that may have stock seed available and/or provide marketing opportunities is included in Appendix 3. Contact the Utah Crop Improvement Association (801-797-2082) or cooperating agencies for names of any additional vendors, or for assistance in obtaining appropriate stock seed.

Time of Seeding

Germination requirements, which vary by species, will determine the most ideal time for seeding. Species that require scarification (scratching or break-down of seed coat) and stratification (moist, cold treatment) to break seed dormancy before germination, or those that are slow to establish, are best seeded in the late fall for early spring emergence. Rapid germinators can be seeded in the late fall, early spring, or late summer when there is sufficient moisture and time to allow seedlings to become established prior to onset of summer heat or fall frost.

Seedbed Preparation and Weed Control

Well-worked soil and a firm seedbed is necessary for optimum stand establishment. This should be done in conjunction with mechanical and chemical weed control to eliminate populations of perennial noxious weeds and reduce amount of annual weed seed in the soil. Some of the most difficult weeds to control in forb and shrub seed production are perennial broadleaves such as morning glory, Canadian thistle and various knapweeds, and annual weeds such as malva, annual kochia, prickly lettuce, etc. Weed control prior to seeding is essential since most herbicides which are effective on weedy broadleaf species may also kill planted forb and

shrub species. Herbicides are available, however, which will control many grasses without injuring the broadleaf forbs or shrubs.

Weed control the seedling year will require cultivation plus hand roguing supplemented by spot application of selected herbicides. Mulching with organic materials or synthetic films can also be an effective weed control measure. Proper weed control prior to seeding and in the seedling year will reduce labor cost in succeeding years and will facilitate meeting seed certification standards.

Planting Methods

To ensure proper seeding depth, soil-to-seed contact, and proper row spacing, specialized seeding equipment is recommended. Grain drills may be adapted for use by plugging some holes to achieve desired row spacing, but seed metering and planting depth are difficult to regulate, and straight rows (necessary to accommodate cultivation equipment) are difficult to maintain.

Several brands of single-row garden and field seeders have proven to be very effective in seeding various shapes and sizes of seed. The selected planting unit must be able to place seed at precise depths and to accurately and consistently meter and disperse seed. Several individual seeding units can be positioned on a tractor tool bar to accommodate various row spacings. Commonly used single-row planters are the Planet Jr. (shoe opener) or corn planters (disc opener). A single-row Planet Jr. hand push seeder and a set of three Planet Jr. units mounted on a tool bar are available for use by certified seed growers. Contact the Great Basin Experiment Station in Ephraim (801-283-4441) or the Utah Crop Improvement Association.

Many species may be successfully established with bare root or containerized transplants which have been grown in a cold frame, greenhouse, or nursery, or with dormant seedlings collected from the wild (wildlings). Transplants can be hand or mechanically transplanted into moist soil followed by sufficient irrigation to ensure establishment. Proper transplanting assures higher seedling survival and

shortens time required for plants to mature, and plants can be correctly spaced to aid in future weeding and harvesting processes. However, transplanting containerized stock may inhibit tap root development in some species such as sagebrush, leading to reduced seed production and stand life under moisture stress conditions. Roots of all transplants must be placed straight down in a hole deep enough so the roots are not placed in a “J” shape.

Seeding Depth

Forb and shrub seeds vary considerably in size. Small seeds are particularly sensitive to excessive planting depths. Care should be taken to ensure proper seed placement in the soil. Small seeds should not be seeded deeper than $\frac{1}{8}$ inch, and in the case of sagebrush or forage kochia seed, should be left near the surface. Depth of seeding can be closely controlled when using a Planet Jr., John Deere flex planter, or other types of single row seeders. When using a grain drill it may be necessary to release all spring tension or pull out the drop tubes so seed dribbles on the surface of the ground and is then covered slightly by the drag chains. Larger seeds such as small burnet, sainfoin, and cicer milkvetch can be seeded up to $\frac{1}{2}$ inch deep. Depth bands on disc openers, whether on a grain drill or single row seeder, are an excellent way to regulate planting depth. Seed should be planted a little deeper in light textured soils than in heavy textured soils.

Row Spacing

Row spacing depends on species grown, method of tillage or cultivation, type of irrigation, and methods of seed harvest. Mature stature and growth form of the species should be considered in selecting row spacing. Some forbs and most shrubs reach considerable size horizontally and sufficient area between rows for maintenance operations must be provided.

Seeding Rates and Transplant Spacing

Most forb species are seeded at a rate of 10 to 25 live seeds per foot of row. This allows for variability in germination and emergence that often occurs even with ideal land preparation and seed placement.

Seedlings should be thinned, leaving the strongest plants at the desired spacing in the row. Shrubs and some forbs are generally direct seeded in hills or transplanted at the desired distance for mature plants. Forbs and shrubs planted at recommended rate and distance will generally produce solid rows of seed-bearing plants that are able to compete with and control most weeds.

Inoculation

It is best to inoculate all legume seed to promote nitrogen fixation, using *Rhizobium* inoculum specific to the species. Inoculum should be applied to seed just prior to seeding. Using a sticker such as milk, then drying seed before planting, will aid in uniform inoculation. Contact the Great Basin Experiment Station or Utah Crop Improvement Association for sources of inoculum.

Irrigation

Proper irrigation improves chances of successful germination and seedling establishment. Spring or late summer seedings usually require timely irrigation, and late fall seedings may require spring irrigation to ensure establishment if soils dry rapidly. Soil crusting can be avoided by keeping the soil surface moist with frequent, light irrigations during seedling emergence.

Amount and timing of irrigation is of the utmost importance for seedling health since some species may be harmed by excessive irrigation. Either furrow irrigation or sprinkler irrigation can be used where managed properly. Flood irrigation is normally not recommended. Frequency of irrigation will vary according to soil conditions, climatic conditions, species, and stage of plant development.

Fertilization

Nitrogen fertilization prior to or during seeding is not generally recommended. Excess nitrogen can encourage and benefit weeds more than the seeded species. However, adequate amounts of required nutrients such as phosphorus, potassium and trace elements must be available for rapid establishment

and maximum seed production and should be worked into the soil before planting. A soil test is recommended to ascertain nutrient levels in the area to be planted. Contact Utah State University Analytical Laboratory, USU, Logan, Utah 84322-4830; phone: (801) 797-2217. Private soil labs and the Brigham Young University soil lab are also available.

MANAGING THE ESTABLISHED STAND

Stand Density

Seed production for most species will diminish if stands become excessively dense. Between row areas need to be cultivated, not only to control weeds, but to prevent crop plants from filling in the area. Within row thinning may be necessary to maintain proper density. Cultivation and thinning is generally done in the fall following harvest or early in the spring.

Weed Control

Seed production fields need to be kept as weed-free as possible. Control of weeds and volunteer forb and shrub crop plants is essential in order to comply with genetic purity seed certification standards and to ensure optimum seed production. Weeds compete for light, moisture, and nutrients and cause problems with harvest and seed conditioning.

Previous cropping and weed management will, to a large degree, determine the degree of weed control required for seed production fields. Because most forbs and shrubs are susceptible to foliar broadleaf herbicides, chemical control of broadleaf weeds is very limited. Most weedy grasses, however, can be controlled with special herbicides that will not injure broadleaf crops. Proper use of pre-emergence herbicides has been fairly effective for controlling many weeds in established forb and shrub seed fields. Spot spraying with appropriate herbicides can be effective in the control of morning glory, thistle, quackgrass, and other perennials. Always read the labels on herbicides and follow manufacturers directions.

Cultivation is effective in controlling weed seedlings between rows of established plants. Cultivating to a depth of 1 to 1½ inches is usually sufficient. Deeper cultivation may damage root systems of forb and shrub crops and create new weed problems by bringing dormant weed seed to the surface. Hand roguing will be necessary between plants within rows.

Irrigation

Forb and shrub seed crops do not require as much moisture as most agronomic field crops. All irrigation of forb and shrub crops should be considered supplemental to natural precipitation. Stands are typically denser under cultivation and so usually require somewhat more water than natural stands. Timing of water application or rainfall is critical. Development of the flower and seed crop, not vegetative growth, is the primary factor determining timing and amount of water applied. Excessive irrigation may result in good leaf and stem production and poor seed production. Also, some species become susceptible to foliage and root diseases under excessive irrigation.

Moisture must be sufficient in the spring and early summer to support flower formation, pollination and seed development. If soil moisture is low during this period, the results may be poor flower stalk growth, abnormal flowering, poor pollination, arrested seed development, and reduced seed yields. Because sprinkler irrigation or heavy rain during peak pollination can be detrimental to pollination, continuous or extended irrigation during pollination should be avoided. Irrigation should be applied as necessary during the seed-fill period.

Shrubs should not be encouraged to continue to grow late into the fall with excessive nitrogen fertilization and irrigation. Winter damage can occur if plants do not naturally harden-off and become dormant. It is advisable to irrigate crops in the late fall if natural rainfall is sparse. Without sufficient winter moisture, many shrubs and forbs may be injured by desiccation and low temperatures.

Fertilization

Fertilization of seed production fields, particularly with nitrogen, is often essential to maintain high seed yields. Fall, or fall/early spring split applications of fertilizer have given the best results for seed production. Late spring applications may be required for some forbs. Legumes may require periodic applications of phosphate. Periodic soil testing or visual evaluations of optimum plant growth is essential to ensure nutrient requirements are met.

The amount of fertilizer required is usually less than for many agronomic crops. Species with deep tap roots should have fertilizer banded close to the plant row, while broadcast application is appropriate for those with more fibrous roots. Shrubs are often best fertilized in the late fall or early spring by broadcasting granules from the base out to the dripline of the plant. Optimum rates for specific sites will need to be determined, but an ounce or two of actual N per plant would be a reasonable starting point.

Composted manure or other organic fertilizers can be beneficial for nutrients as well as for soil tilth, but nutrient analyses would be necessary to determine amounts to apply. Excessive application of non composted manure, especially from poultry, can “burn” plants or induce too much vegetative growth and can introduce many new weed seeds.

Insect Management, Disease and Animal Pest Control

Insects, diseases, and other pests sometimes become more prevalent and serious when a species is planted in a field monoculture situation. Fields should be inspected regularly to note any insect damage. Insects can prey upon the foliage, roots, flowers, and seed. Where insect problems develop, quick action should occur. County Extension Agents, USU integrated pest management specialists, pesticide dealers, or commercial spray operators can provide the latest information for insect control. Always read the label on packages of pesticides and follow the manufacturer’s directions carefully.

Insect populations must be managed to ensure the

presence of pollinating insects and maintenance of insect predators that feed on damaging insect species. Many plants such as globemallow, milkvetch, penstemon, sunflowers and other composites, Utah sweetvetch, and bitterbrush require insect pollination to develop seed crops. It is advantageous to plant these species adjacent to natural areas where such insects are abundant, or consider bringing in honey bees, bumble bees, leafcutter bees, etc. Pesticide applications must be carefully administered to maintain desirable populations of pollinators and predators.

Foliar and root diseases caused by fungi, bacteria, etc., can at times be devastating to plants in a seed field. Some chemicals may be effective in disease control, but often a change in cultural practices such as preventing over-watering or maintaining proper fertility will decrease disease incidence.

Fencing or other controls may be necessary to exclude domestic animals and wildlife. Many species of birds and mammals will eat foliage, seed stalks, and mature seed of certain forb and shrub species. In fact, ecotypes of many species have been selected specifically for their proven palatability.

Residue Management

Soon after the crop is harvested, seed stalks and other spent foliage from most forb and some shrub species should be removed to allow for regrowth and fall management practices. Removal of residue is important in controlling rodents and insects. Field mice can cause considerable damage during winter if residue is left to protect them. Heavy residues can be removed from the field by baling or other means. Many residues can be worked into the soil after shredding with a rotary mower.

Some seed production fields may produce aftermath or a forage crop that can be fall grazed or harvested as hay. If the forage is cut for hay, a short stubble should be left to catch snow and to protect the soil and plants during winter. Utilization of late regrowth should not occur until after a killing frost so root reserves are not depleted. Burning is not recom-

mended as residue management for most forb and shrub species. Some shrub species may benefit from periodic pruning or livestock grazing to thin the canopy and invigorate regrowth.

Seed Harvesting

Seeds of most species do not mature evenly. Judgment must be used to determine the most ideal time to harvest. Seeds of some forbs may begin to ripen at the basal end of the seed head or stalk. Generally, when the first seeds begin to shatter, the majority of the seeds are mature enough to harvest. The grower must often compromise between seed maturity and shattering when deciding time to harvest.

Direct combining is most effective for species in which seeds mature uniformly and shatter easily. Once a majority of the seeds of such species are mature, it is important to harvest the crop as rapidly as possible because wind and rain can dislodge the entire crop. Species that mature seeds unevenly, but are generally non-shattering, are usually best harvested by first swathing and drying in the windrow, followed by combining. Swathing and combining is best done early in the morning when dew is present to help prevent loss of mature seeds. Combine cylinder or rotor speed and air flow must be optimally set for each species. This may be a trial and error process, but information is available from NRCS Plant Material Centers, Great Basin Experiment Station, and experienced seed growers.

Most shrub species and some forb species require alternate methods of harvesting, such as hand beating or stripping into a hopper or tarp at the base of plants, or a rotary brush stripper or reel type harvester. This operation may need to be done more than once as seed matures. Hand harvesting methods are appropriate for small fields. Regardless of the method used, inspection and care must be taken to ensure that seeds are not damaged.

Seed Conditioning

After harvest, seeds must be at proper moisture content to be processed and stored. Seed that is direct

combined or hand harvested generally has a higher moisture content than seed that is swathed, dried, and combined. Seeds may need to be spread on a clean surface with good air movement and/or added moderate heat to reduce moisture. Moisture content of 10 to 15 percent is required for conditioning and is considered safe for storage of most species.

Seed conditioning techniques have been developed to clean most seeds. The most commonly used seed conditioning equipment for forb and shrub seeds is a debearder, air screen separator, and gravity table. Experience is the best teacher in cleaning and conditioning seeds, and contacting experienced conditioners for help is advisable. The percent of seed purity and viability for many species can vary considerably depending on proper harvesting techniques (including waiting until seed is mature) and degree of expertise and care taken in the conditioning process. Several seed companies in Utah which handle reclamation seeds are approved certified seed conditioners as well as seed brokers and dealers, and will buy uncleaned seed.

Seed Storage

In arid climates such as Utah, no special storage conditions are required for most species other than making sure the seed is dry when put into storage. This may on occasion necessitate some means of artificial drying after harvest. Seeds of most forb and shrub species can then be stored for at least 2 to 3 years in a dry, cool, ventilated condition without significant loss of viability. A few exceptions are noted in the information for individual species.

The following steps should be taken after harvest and drying (if necessary) to properly store seeds: (1) store in clean bags that will allow free flow of air; (2) seed must remain dry; (3) temperatures and humidity should be kept relatively low; and (4) seed should be kept in rodent-free storage areas.

SEED TESTING AND LABELING

Every lot of seed offered for sale to consumers is required by law to be properly and truthfully labeled

(Fig. 1). The labeler (person or company that offers the seed for end user sale) provides the common and scientific name, variety (if applicable), lot number, state of origin, year of harvest (optional), net weight of seed, and labeler name and address. Seed analysis information is also required on the label, which is reported by a seed laboratory after analysis of the seed sample they are provided. This sample should be representative of the whole seed lot. Help with sampling and/or proper sampling procedures is available from Utah Department of Agriculture Field Representatives. Seed from certified fields will be sampled under the direction of a UCIA representative.

In Utah, shrub and forb seed germination tests are good for one year, after which a new test is required. The notation “TZ” following the germination percentage indicates that a staining technique utilizing tetrazolium chloride was used to give a quick evaluation of the viability of the seed (including hard or dormant seed). This procedure can substitute for the actual germination test in Utah and some other states.

Government, commercial, and private seed-testing laboratories in the United States and Canada are required to use standard procedures for testing seed quality. These procedures are published in the Association of Official Seed Analysts (AOSA) Handbook. Detailed studies are required before analysis procedures for a species are accepted and published. Procedures for many forbs and shrubs have not been standardized and published, so some inconsistency between labs may be experienced.

The Utah State Seed Laboratory is located in the Utah Department of Agriculture Building at 350 North Redwood Road, Box 146500, Salt Lake City UT 84114-6500, phone (801)538-7182. Lab personnel will perform standard seed tests and can answer most questions relative to shrub and forb seed sampling and analysis.

Agronomic seed crops are usually sold on a bulk weight basis, whereas shrub and forb seed is more commonly marketed on a pure live seed (PLS) basis. Results of seed analysis reports are used to calculate PLS. To arrive at a PLS value, percent purity is

multiplied by percent germination. For example, if a seedlot has a purity of 50% and a total germination (germination plus hard or dormant seed) or “TZ” of 80%, its PLS percentage would be calculated by multiplying 50% (.50) X 80% (.80) = .40 or 40 percent. A 50-pound bag of this seed lot would contain 20 pounds of pure live seed (20 PLS lbs), calculated by multi-plying bulk weight (50 lbs) by the PLS percentage.

SEED CERTIFICATION

A seed laboratory does not verify that the identity of a certain variety or ecotype listed on a seed sample is correct as claimed. For instance, the lab cannot determine whether a mountain big sagebrush (*Artemisia tridentata* spp. *vaseyana*) seed sample is the variety ‘Hobble Creek’ or just common wild collected seed. In fact, the lab cannot normally differentiate between the different subspecies of big sagebrush, or between members of certain groups of species such as the penstemons.

Verification for the variety or germplasm identity portion of the seed analysis label is provided by official seed certification agencies, a service provided in almost all states. This is accomplished through records of seed origin, and field and cleaning facility inspections. Certified seed generally has better market potential, and is often specified for many reclamation and restoration projects. Certified seed by definition has known germplasm identity, high genetic purity, high germinating ability, and minimum amounts of other crop seed, weed seed, and inert matter.

The Association of Official Seed Certifying Agencies (AOSCA) has published “Pre-Variety Germplasm Certification Standards” for the certification of germplasm accessions which have not been released as a variety, and “Woody Plants and Forbs Certification Standards” for certification of seed of forbs and shrubs which have been released as a variety. These standards offer a reliable way for the seed industry to offer seed of varieties, races or ecotypes to the buyer with genetic identity maintained in field production, conditioning, and storage along with accurate original collection site information.

According to these certification standards, a race, ecotype, or accession of a native or naturalized species may be identified as one of four categories of certified seed, and may be either wildland collected or field produced.

- a) Source Identified (yellow tag)—Original collection site known, but germplasm has not been evaluated at a common site in comparison with other germplasm collections, accessions, or ecotypes of the same species.
- b) Selected (green tag)—Shows promise of superior and/or identifiable traits as contrasted with other germplasm accessions, ecotypes, or variety/cultivars of the same species when compared at a common site. Selection criteria and supporting comparative data are required.
- c) Tested (blue tag)—Requires progeny testing to prove that superior and/or identifiable traits of interest are heritable in succeeding generations. Testing procedures (number of sites, generations, required, etc.) are outlined for each species by certification agencies.
- d) Variety (Foundation class, Registered class, and Certified class generations; represented with white, purple, and blue tags respectively) —Applies to a Tested germplasm which, in the estimation of the developer, has sufficient marketplace potential to warrant release as a variety in compliance with federal and state seed laws.

The number of generations allowed for field planting of Source Identified, Selected, and Tested classes is normally three. Seed from the original collection site (Generation 0) is equivalent to Breeder seed of a released variety; the first generation harvested from a seed production field is referred to as G1 (equivalent to Foundation Class).

Fields planted from G1 seed or plants are designated G2 (equivalent to Registered Class) and G3 (equivalent to Certified Class) would be harvested from fields planted with G2 plants or seeds.

In Utah, seed certification is a service performed by the Utah Crop Improvement Association (UCIA) in cooperation with the Utah Agricultural Experiment Station at Utah State University and the Utah Department of Agriculture. Anyone may apply to grow certified seed, but the UCIA must be contacted before planting to consider land eligibility, germplasm/variety origin, and ensure familiarity with certification procedures. Application forms and copies of the seed certification standards may be obtained by contacting: Utah Crop Improvement Association, Utah State University, Logan UT 84322-4855; Phone: 801-797-2082.

After planting, fields must be rogued to remove other species and off-types. Weeds (particularly prohibited or restricted noxious weeds) must be controlled. Seed fields will be inspected at least once before harvest by a UCIA representative. Seed identity and freedom from contamination must be maintained during harvest and storage. Conditioning facilities are inspected and a sample of the cleaned seed is submitted to an approved seed laboratory for analysis. If the seed sample meets the certified seed analysis standards, certification is completed by proper labeling. Only seed produced in accordance with the regulations of the UCIA and labeled with an official tag or bulk certificate can be represented as Utah Certified Seed.

In Utah and many other states the certification tag is separate from and in addition to the analysis label. Tag colors for the different classes are as explained above; examples of each type of certified seed tags are reproduced on the back cover of this publication.

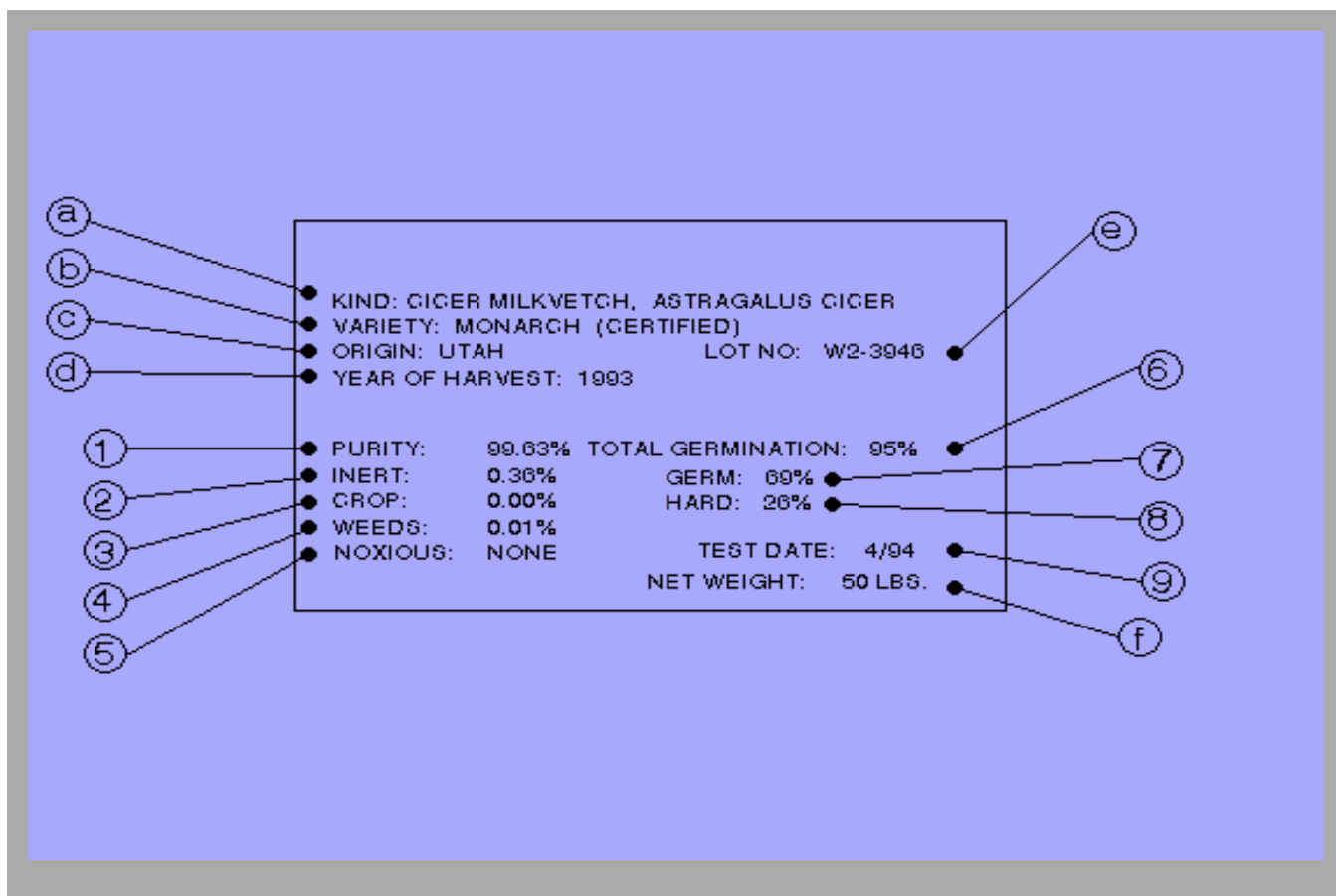


Figure 1. Diagram of a typical seedlot label (labeler's name and address deleted). The seed conditioner/dealer (labeler) provides the following information: (a) common and scientific name, (b) variety (or "variety not stated" when variety is not known or no variety where none are released), (c) seed origin, (d) year of harvest (optional), (e) lot number, and (f) net weight. The seed testing laboratory provides results of: (1) purity percentage, (2) inert matter percentage, (3) percentage of other crop seed, (4) percentage of weed seed, and (5) presence of noxious weed seed, and (6) total viable seed percentage (the sum of #'s 7 & 8, or if followed by "TZ" is the viable seed percentage according to the tetrazolium chloride test; in this case #'s 7 & 8 are left blank), (7) actual germination percentage, (8) hard or dormant seed percentage, and (9) test date.

SELECTED FORB SPECIES CONSIDERED FOR SEED PRODUCTION IN UTAH

ASTER, BLUELEAF (*Aster glaucodes*)

ASTER, PACIFIC (*Aster chilensis*)

Origin Native
perennials.

Establishment

Seeding Rate 20 to 40 pure live seeds per linear foot; seed is difficult to meter and maintain proper planting depth. These species can be somewhat hard to establish.

Row Spacing Blueleaf 36 inches; Pacific 36 to 42 inches.

Seeding Depth 1/16 to 1/8 inch.

Seeding Methods Single-row seeder.

Time of Seeding Fall seeding is recommended. Spring and late summer seeding only where there is sufficient water and time available to assure establishment.

Weed Control Fields should be cleared of weeds and weed seed by mechanical and herbicide fallowing. Careful hand weeding usually necessary during seedling establishment.

Fertilization None.

Irrigation Frequent, light irrigations required for establishment, especially with spring and late summer seeding.

Soils Loam to clay loam-textured soils.



Stand Management

Pest Control

Weeds Hand weeding, cultivation, and pre-emergence herbicide as needed.

Insects No known problems

Diseases No known problems

Fertilization Test soil periodically. Fertilize moderately. Avoid over-fertilization.

Irrigation 12 to 16 inches of precipitation or irrigation per year. Adequate soil moisture is critical for spring growth and during flowering. Furrow or sprinkle irrigate.

Stand Density Plants are rhizomatous. Cultivation between and across rows will be necessary every 2 to 3 years to maintain plant vigor.

Pollination Insects

Seed Production

Years to Produce Seed Crop Following

Planting Little or no seed produced the first year, 50 to 70 percent seed production the second year, and 90 to 100 percent the third growing season.

Production per Acre 100 to 200 pounds at 40 percent purity.

Longevity of Seed Production Fields 6+ years if stand density managed properly.

Flowering Date Blueleaf aster—July to August; Pacific aster—July to October. Continuous flowering in both species.

Seed Maturity-Harvest Date Blueleaf aster September 15 to October 1. Pacific aster October 1 to November 1.

Seed Retention Fair.

Seed Handling

Methods of Seed Harvest Combine, rotary or reel-type harvester or hand strip or beat. For highest yields, field should be harvested more than once as seed matures.

Seed Cleaning Dry -> debearder -> air screen separator.

Seed Storage Store in a dry, open warehouse.
No special storage condition requirements.

Seed Characteristics

Seeds/lb Blueleaf aster 540,000; Pacific aster 2,668,000.

Longevity 3 years.

Viability 80 to 90 percent can be expected if seed is cleaned to 90 percent purity. Fairly rapid germination.

Afterripening Maximum germinability not reached for one month following seed harvest. 2 to 4 weeks of cool, moist conditions required prior to germination.

Purity Can be cleaned to about 90 percent purity, but sometimes sold at lower purity.

AOSA Rules Seed quality testing rules have not been established for either species.

Released Varieties None.

BALSAMROOT, ARROWLEAF (*Balsamorhiza sagittata*)

Origin Native perennial.

Establishment

Seeding Rate 4 or 5 pure live seeds per hill, 1 foot apart, or 10 to 20 pure live seeds per linear foot of row.

Row Spacing 36 to 42 inches.

Seeding Depth ¼ to ½ inch.

Seeding Methods Single-row seeder, or hand plant.

Time of Seeding Fall seeding is required. Germination erratic; new plants may appear 2–3 years after planting.

Weed Control Mechanical and herbicide fallowing to remove weeds and weed seeds prior to planting.



Fertilization None.

Irrigation As needed for seedling establishment.

Soils Well-drained, coarse to medium-textured soils.

Stand Management

Pest Control

Weeds Hand weed the first year until plants are sufficiently established to be well identified, then light cultivation can occur. Thereafter, mechanical cultivation, pre-emergence herbicides, and spot hand spraying. Once established, this species is very competitive.

Insects Insect larvae may injure seed heads necessitating chemical control.

Diseases No known problems.

Fertilization Test soil. Apply low rates as needed. Annual application usually not required.

Irrigation 15 to 20 inches of water is required each year. This can come from rain, snow, or irrigation. If soils are dry in the spring, irrigation is recommended. Care must be taken to ensure soil does not become saturated for long periods of time. No irrigation after mid-flowering.

Stand Density When cultivating, care must be taken to ensure that the large taproot is not injured.

Pollination Insect and wind pollinated.

Seed Production

Years to Produce Seed Crop Following

Planting 3 to 5 years to obtain full production.

Production per Acre 75 to 125 pounds per acre at 90 percent purity.

Longevity of Seed Production Fields 20 to 30 years.

Flowering Date Mid April to early May.

Seed Maturity-Harvest Date Late May to early June. Seed is mature when petals dry.

Seed Retention Mature seed drops easily with the slightest disturbance. Seed maturity needs to be closely watched as good seeds fall first.

Seed Handling

Methods of Seed Harvesting Hand beat into a container or use combine.

Seed Cleaning Fan screen separator. Easy to clean due to size of seed.

Seed Storage Seed is susceptible to insect damage. Seed needs to be treated with an appropriate pesticide dust before storage in dry and cool conditions.

Seed Characteristics

Seeds/lb 55,000.

Longevity 5 to 7 years.

Viability 80 to 90 percent; germination may be erratic due to dormant seed.

Afterripening Maximum germinability not reached for 2 to 3 months after seed harvest.

Purity 95 to 99 percent.

AOSA Rules None.

Released Varieties None.

BEE PLANT, ROCKY MOUNTAIN (*Cleome serrulata*)

Origin Native annual.

Establishment

Seeding Rate 20
pure live seeds
per linear foot of
row

Row Spacing 24 to
36 inches.

Seeding Depth $\frac{1}{8}$ to
 $\frac{1}{4}$ inch.

Seeding Methods
Grain drill or
single-row seeder.

Time of Seeding Fall seeding required.

Weed Control Mechanical and herbicide fallow to control weeds and weed seeds prior to planting.

Fertilization None



Irrigation As needed for establishment.

Soils Well-drained, gravelly loam to sandy to clay loam-textured soils.

Stand Management

Pest Control

Weeds Hand weed as needed.

Insects No known problems.

Diseases No known problems.

Fertilization None.

Irrigation Water at start of flowering and again as seed develops. 8 to 10 inches of precipitation or irrigation required from seeding to seed set.

Stand Density No management necessary; annual plant.

Pollination Exclusively insect pollinated. Manage to ensure insects are present.

Seed Production

Years to Produce Seed Crop Following

Planting Annual production.

Production per Acre 200 to 325 pounds at 95 percent purity.

Longevity of Seed Production Fields Current season; annual plant.

Flowering Date July 15 to September 15.

Continuous flowering. Some flowering will be occurring during harvest.

Seed Maturity-Harvest Date September 15 to 20.

Seed Retention Good.

Seed Handling

Methods of Seed Harvesting Combine or hand strip.

Seed Cleaning Dry -> debearder -> air screen separator.

Seed Storage Store in dry location. No special storage requirements.

Seed Characteristics

Seeds/lb 65,000

Longevity 5+ years.

Viability Good (80 to 95 percent).

Afterripening Maximum germinability not reached for 2 to 3 months after harvest. 2 to 6 weeks of cool, moist conditions required

prior to start of germination.
Purity 95 percent.

AOSA Rules Seed quality testing rules have not been established.

Released Varieties None

BURNET, SMALL (*Sanquisorba minor*)

Origin Introduced perennial.

Establishment

Seeding Rate 10 pure live seeds per linear foot of row.

Row Spacing 28 to 36 inches.

Seeding Depth ¼ to ½ inch.

Seeding Methods Grain drill or single-row seeder.

Time of Seeding Fall seeding is recommended. Spring and late summer seeding only where there is sufficient water and time to assure establishment.

Weed Control Eliminate weeds and weed seeds with mechanical and chemical fallowing prior to planting. Hand weeding may be required during early seedling establishment.

Fertilization None.

Irrigation As needed for establishment.

Soils Fine to coarse-textured soils.

Stand Management

Pest Control

Weeds Cultivation, pre-emergence herbicide, hand weeding.

Insects No known problems.

Diseases No known problems.

Fertilization Test soil. Add moderate amounts with split application spring/fall.

Irrigation 14 to 18 inches of precipitation or irrigation annually. Three irrigations usually

required; early summer, pre-flower, and late flower.

Stand Density Cultivate between rows yearly.

Pollination Wind and Insects

Seed Production

Years to Produce Seed Crop Following

Planting With fall seeding, 35 to 60 percent production the first year. Substantially less with spring seeding. Full production the second growing season.

Production per Acre 500 to 700 pounds at 95 percent purity.

Longevity of Seed Production Fields 5 to 12 years.

Flowering Date August 1 to September 1.

Seed Maturity-Harvest Date September 15 to October 15.

Seed Retention Good.

Seed Handling

Methods of Seed Harvesting Combine.

Seed Cleaning and Handling Dry -> air screen separator -> gravity table (if needed).

Seed Storage Store in a dry location. No special storage condition requirements. Protect from mice.

Seed Characteristics

Seeds/lb 55,000.

Longevity 16+ years.

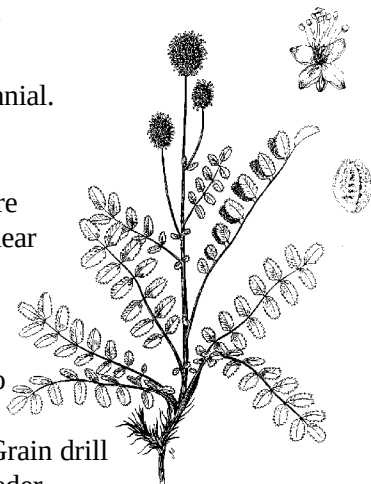
Viability Excellent (90 percent); fairly rapid, even germination.

Afterripening Maximum germinability not reached for 1 month following seed harvest. There are no known stratification requirements.

Purity Seed is easily cleaned to 95 percent or better purity.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties 'Delar'.



CINQUEFOIL, GLAND (*Potentilla glandulosa*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 30 pure live seeds per linear foot of row.

Row Spacing 28 to 30 inches.

Seeding Depth Surface to 1/16 inch deep.

Seeding Methods Broadcast by hand and lightly cover or use single row seeder at shallow setting.

Time of Seeding Fall or early spring.

Weed Control

Eliminate weeds prior to planting.

Fertilization Low to moderate rates.

Irrigation Water as required to establish seedlings.

Soils Light to moderate texture, well drained, moderately fertile, near neutral pH. Locate plantings on sites that are similar to natural rearing conditions.

Stand Management

Pest Control

Weeds Hand weeding and mechanical tillage.

Insects A number of insects are attracted to this plant, and most appear beneficial. No known insect pests.

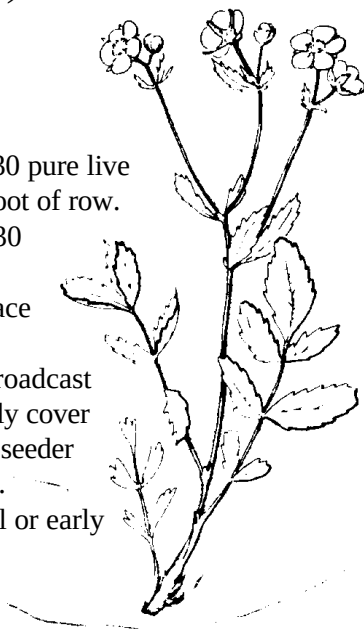
Diseases No known problems.

Fertilization Apply low to moderate amounts annually.

Irrigation Plants normally grow in areas receiving 14 to 25 inches of annual rainfall. One irrigation in late spring or early summer is normally required.

Stand Density Cultivate between rows yearly.

Pollination Insects



Seed Production

Years to Produce Seed Crop Following

Seeding If fall seeded, 10 to 20 percent the first growing season. Stands may reach full production in the second year.

Production per Acre 75 to 130 pounds seed with 95 percent purity.

Longevity of Seed Production Stand 10 to 12 years.

Flowering Date June through July.

Seed Maturity-Harvest Date July to August.

Seed Retention Seeds are enclosed in a capsule that opens when completely dry. Mature seeds will remain on the plant for 2 to 3 weeks after ripening.

Seed Handling

Methods of Seed Harvesting Hand stripping or mechanical harvesting using a reel or flail type harvester. Combining is possible, but seeds are extremely small and proper screens must be used and air flow must be properly adjusted to avoid loss of the seeds.

Seed Cleaning Air dry, rub or debeard the capsules to free the seed. Separate the seed from debris using air separator.

Seed Storage Store in dry open conditions.

Seed Characteristics

Seeds/lb 700,000 to 1,000,000.

Longevity 3 to 5 years.

Viability 75 to 85 percent. Seeds easily germinate.

Afterripening Seeds require 2 to 3 weeks to afterripen for maximum germination..

Purity Seed lots are easily cleaned to 95 percent or higher levels.

AOSA Rules None.

Released Varieties None.

**ERIGONIUM WILD BUCKWHEAT,
SULFUR FLOWER**
(*Eriogonum umbellatum*)

**ERIGONIUM WILD
BUCKWHEAT, WYETH**
(*Eriogonum heracleoides*)

Origin Native perennials.

Establishment

Seeding Rate 15 to 20
pure live seeds per
linear foot of row,
or 4 or 5 pure live
seeds in hills 2 to 3 feet apart.

Row Spacing 30 to 36 inches between rows.

Seeding Depth Surface of disturbed soil to ¼
inch deep.

Seeding Methods Hand plant or single row
seeder.

Transplant Spacing Stands may be established
by transplanting with plants spaced 30 to 36
inches apart within and between rows.

Time of Seeding Fall or early winter. Spring
plantings not recommended unless conducted
early when cold temperatures still prevail.

Weed Control Eliminate weeds by mechanical
and chemical fallow prior to planting.

Fertilization Generally low to moderate
amounts.

Irrigation As needed to assure establishment.

Soils Moderate-textured soils with good
drainage, slightly basic to neutral soil pH.
Stands can be established on marginal
farmlands and managed wildlands.

Stand Management

Pest Control

Weeds Mechanical and hand tillage as
needed. After 2 years plants are quite
competitive.

Insects Insects normally infest flowers and
developing seeds damaging 10 to 35
percent of the fruits. Control measures
have not been developed.

Diseases No known problems.



Fertilization Avoid over fertilization, especially
with sulfur eriogonum. Applications every 2
years is usually sufficient.

Irrigation 12 to 16 inches (sulfur eriogonum),
and 14 to 20 (Wyeth eriogonum), of annual
precipitation and irrigation is usually
sufficient. Irrigate once in mid to late spring
or early summer if fields become unusually
dry. Over-irrigation can weaken mature
stands.

Stand Density Cultivate between and within
rows during the first season to assure proper
spacings. Further control measures may not
be required as mature plants maintain desired
spacings by natural competition.

Pollination Insects.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Usually 30 to 50
percent production the second year. Full
production the third and fourth growing
seasons.

Production per Acre 200 to 400 pounds for
sulfur eriogonum and 200 to 300 pounds for
Wyeth eriogonum at 95 percent purity.

Longevity of Seed Production Fields 7 to 12
years.

Flowering Date June to July.

Seed Maturity-Harvest Date Mid July to mid
August, depending upon rearing conditions.
Seeds grown at lower elevations (5,000 ft.)
may ripen by July 1st while seeds grown at
higher elevations may mature as late as mid
August.

Seed Retention Good, seeds may remain on the
plant for 2 to 3 weeks following maturation.

Seed Handling

Methods of Seed Harvest Modified mechanical
strippers or hand beating and stripping.
Sulfur eriogonum may be harvested with
small combines having adjustable cutting
bars.

Seed Cleaning Dry -> screen -> chopping or
rubbing procedures to remove seeds from
papery bracts -> and rescreen. Use gravity
table, air screen, or air blowers to remove

unfilled seeds and debris.

Seed Storage Store in a dry location, protect from mice. If insects have infested filled seeds, treat with insecticide powder.

Seed Characteristics

Seeds/lb Sulfur - 120,000; Wyeth - 141,000.

Longevity 10 to 15 years.

Viability Excellent (over 90 percent if seeds are mature); seeds germinate uniformly.

Afterripening Seeds require 30 to 40 days following seed harvest to reach maximum germinability.

Purity Seeds may be cleaned to 95 to 98 percent purity though immature seeds and flower bracts are often difficult to remove.

AOSA Rules Seed quality testing rules have not been developed.

Released Varieties 'Sierra' sulfurflower erigonum.

FLAX, BLUE (LEWIS) (*Linum perenne*)

Origin Native and introduced perennial.

Establishment

Seeding Rate 20 to 30 pure live seeds per linear foot of row.

Row Spacing 36 inches.

Seeding Depth $\frac{1}{16}$ to $\frac{1}{8}$ inch; care must be taken to maintain this depth.

Seeding Methods Drill or single-row seeder.

Time of Seeding Fall seeding is recommended.



Weed Control Mechanical and herbicide fallowing used to remove weeds and weed seed before planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Fine to coarse textured, well-drained soils.

Stand Management

Pest Control

Weeds Hand weeding and light cultivation the first growing season. Thereafter, mechanical cultivation, pre-emergence herbicide, and spot hand weeding.

Insects No known problems.

Diseases No known problems.

Fertilization Test soils. Apply moderate rates to increase seed production, not vegetative growth.

Irrigation 12 to 16 inches precipitation and irrigation annually. Spring irrigate if soil moisture is low. Because flowering occurs over an extended period, one irrigation at start and one at height of flowering is recommended.

Stand Density Cultivate between rows yearly.

Pollination Insects and wind.

Seed Production

Years to Produce Seed Crop Following

Planting With fall seeding, a 5 to 10 percent crop can be produced the first growing season, 60 to 80 percent the second year and 90 to 100 percent seed production the third year.

Production per Acre 250 to 300 lbs at 95 percent purity.

Longevity of Seed Production Fields Seed production declines after 5 years.

Flowering Date June through September.

Height of flowering June 15 to July 25.

Seed Maturity-Harvest Date July 15 to August 15.

Seed Retention Flowering occurs over extended period. Seeds fall as capsules dry and open. Harvest when 60 to 80 percent of capsules are dry.

Seed Handling

Methods of Seed Harvesting Direct combine, windrow/combine or hand beating.

Seed Cleaning Dry -> air screen separator -> debearder -> air screen separator -> gravity table.

Seed Storage Store in a dry location. No special storage conditions required. Protect from mice.

Seed Characteristics

Seeds/lb 278,000.

Longevity 7 to 10 years.

Viability High (90 percent); uniform germination.

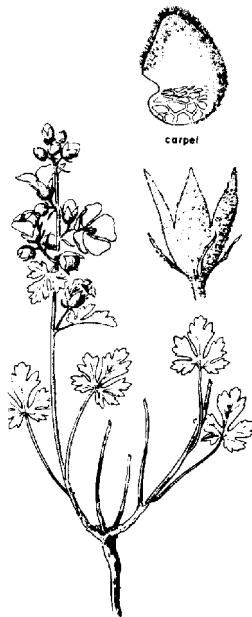
Afterripening Maximum germinability not reached for 1 to 2 months after seed harvest. 2 to 4 weeks of cool, moist conditions required prior to germination.

Purity 95 to 99 percent purity.

AOSA Rules Rules are established and in use.

Released Varieties 'Appar'.

LOBEMALLOW, GOOSEBERRYLEAF (*Sphaeralcea grossulariaefolia*)



LOBEMALLOW, SCARLET (*Sphaeralcea coccinea*)

Origin Native perennials.

Establishment

Seeding Rate 20 to 50 pure live seeds per linear foot of row.

Row Spacing 28 to 36 inches.

Seeding Depth 1/8 to 1/4 inch.

Seeding Methods Single-row seeder.

Time of Seeding Fall seeding and/or acid scarification is required.

Weed Control Control weeds by mechanical and chemical fallowing prior to seeding.

Fertilization None.

Irrigation Normally needed to establish new plantings.

Soils Sandy loam to clay textures.

Stand Management

Pest Control

Weeds Hand weed as needed. Utilize cultivation and pre-emergence herbicide as needed.

Insects No known problems.

Diseases No known problems.

Fertilization Low to moderate amounts generally required.

Irrigation 11 to 14 inches of precipitation and irrigation annually. Two irrigations usually needed; spring and /during flowering-seed set period.

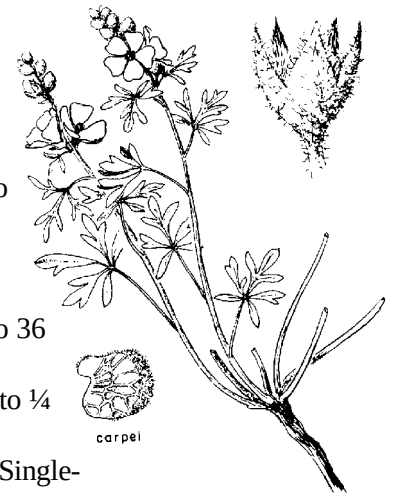
Stand Density Cultivate following seed harvest if stands become too dense. Excessive plant density is generally not a problem.

Pollination Insects

Seed Production

Years to Produce Seed Crop Following

Planting No seed production in the seedling



year, 30 to 60 percent crop the second year and 100 percent crop the third growing season.

Production per Acre Gooseberryleaf: 100-150 lbs at 80 percent purity. Scarlet: 75-100 lbs at 80 percent purity.

Longevity of Seed Production Fields 4 to 6 years.

Flowering Date May 15 to July 1.

Seed Maturity-Harvest Date Gooseberryleaf - July 10 to July 30; Scarlet - July 5 to August 5. Harvest when lower capsules dry.

Seed Retention Good.

Seed Handling

Methods of Seed Harvesting Windrow followed with combining, or hand strip

Seed Cleaning Dry -> debearder -> air screen separator -> gravity table.

Seed Storage Store in a dry location. No special storage requirements.

Seed Characteristics

Seeds/lb 500,000 - Gooseberryleaf; 500,000 - Scarlet.

Longevity 16+ years.

Viability 90 percent; germination is erratic due to considerable hard seed.

Afterripening Maximum germinability not reached for 1 month following seed harvest. Acid scarification or 1 to 3 months of cold, moist stratification is required to germinate seeds.

Purity About 80 percent; gravity table can take purity to over 90 percent.

AOSA Rules Seed quality testing rules are not established.

Released Germplasm Scarlet - 'ARS 2936'; Gooseberryleaf - none.

Released Varieties Scarlet - none; Gooseberryleaf - none.

GLOBEMALLOW, MUNRO (*Sphaeralcea munroana*)

Origin Native perennial

Establishment

Seedling Rate 20 to 40 pure live seeds per linear foot of row.

Row Spacing 28 to 36 inches.

Seeding Depth 1/8 to 1/4 inch.

Seeding Methods Single row seeder.

Time of Seeding Fall seeding recommended. Can be spring or late summer seeded if sufficient time and water is available to ensure establishment and seed has been acid scarified or cold stratified.

Weed Control Control weeds by mechanical and chemical fallowing prior to seeding.

Fertilization None.

Irrigation As needed for seedling establishment.

Soils Sandy loam to clay-textured soils.

Stand Management

Pest Control

Weeds Hand weed as needed. Cultivation and pre-emergence herbicide can be used when appropriate.

Insects No known problems.

Diseases No known problems.

Fertilization Low to moderate amounts may be beneficial.

Irrigation 11 to 14 inches of precipitation and irrigation annually. Minimum of two irrigations, spring and during flowering seed set period.

Stand Density Excessive plant density generally not a problem.

Pollination Insects.



Seed Production

Years to Produce Seed Crop Following

Planting No seed production in the seedling year, 50 to 75 percent crop the second year, and 100 percent crop the third growing season.

Production per Acre 300 to 400 lbs at 80 percent purity.

Longevity of Seed Production Fields 3 to 5 years.

Flowering Date May 15 to July 1.

Seed Maturity-Harvest Date July 5 to August 5. Windrow when lower capsules dry and start to open.

Seed Retention Good.

Seed Handling

Methods of Seed Harvesting Windrow followed with combining.

Seed Cleaning Dry -> debearder -> air screen separator -> gravity table.

Seed Storage Store in a dry location. No special storage conditions required.

Seed Characteristics

Seeds/lb 500,000.

Longevity 1 6+ years.

Viability 90 percent; germination erratic due to hard seed.

Afterripening Maximum germinability not reached for 1 month following seed harvest. Stratification/scarification requirements similar to scarlet and gooseberry leaf globemallow.

Purity About 80 percent; higher if gravity table is used.

AOSA Rules Seed quality testing rules have not been established.

Released Germplasm 'ARS 2892'.

Released Varieties None.

GOLDENEYE, SHOWY

(*Viguiera multiflora*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 40 pure live seeds per linear foot of row.

Row Spacing 28 to 36 inches.

Seeding Depth $\frac{1}{8}$ to $\frac{1}{4}$ inch.

Seeding Methods

Single-row seeder.

Seed is difficult to meter and maintain planting depth.

Time of Seeding Fall planting recommended.

Weed Control Mechanical and herbicide following before planting.

Fertilization None.

Irrigation As needed to ensure establishment.

Soils Sandy loam to clay loam-textured soil.



Stand Management

Pest Control

Weeds Cultivation and pre-emergence herbicide can be used following establishment.

Insects Plants support large insect populations, however, control measures are not required.

Diseases No known problems.

Fertilization Test soil. Moderate amounts may be required.

Irrigation 15 to 20 inches of precipitation and irrigation required. Requires up to four irrigations: spring, pre-flower, mid-flower, and late flower.

Stand Density Cultivate yearly between rows.

Pollination Wind and insects.

Seed Production

Years to Produce Seed Crop Following

Planting Establishment year, 35 to 60 percent seed crop can be produced and full production thereafter.

Production per Acre 150 to 200 lbs at 40 to 50 percent purity.

Longevity of Seed Production Fields 5 to 7 years.

Flowering Date July 15 through August.

Seed Maturity-Harvest Date August 20 to September 10. A small amount of flowering will be occurring during seed harvest.

Seed Retention Fair retention. Harvest should take place when majority of seed is mature (once the majority of the yellow petals have dried and started to fall).

Seed Handling

Methods of Seed Harvesting Combine, or rotary or reel type harvester.

Seed Cleaning Debearder -> air screen separator -> gravity table.

Seed Storage Store in a dry location. No special storage conditions required.

Seed Characteristics

Seeds/lb 1,055,000.

Longevity 4 to 6 years.

Viability Medium (40 to 60 percent) due to immature seeds. Mostly fairly even and rapid germination of mature seeds, but can be erratic at times.

Afterripening Maximum germinability not reached for 1 month following seed harvest. Stratification requirements unknown.

Purity 90 to 95 percent, sometimes sold at lower purity.

AOSA Rules Seed quality testing rules have not been established.

Released Varieties None.

GOLDENROD, CANADA

(*Solidago canadensis*)

Origin Native perennial.

Establishment

Seeding Rate Plant 20 to 30 pure live seeds per linear foot of row or square foot of bed.

Row Spacing Individual rows 30 to 40 inches apart or beds 20 to 60 inches in width with interspaces between beds of 30 to 40 inches.

Seeding Depth On surface of disturbed soil to 1/16 to 1/4 inch deep.

Seeding Methods Drill with single or multiple rows seeder. A culti-pack imprint seeder can be used to plant beds.

Time of Seeding Fall, spring, or early summer plantings. Summer plantings normally require supplemental water to assure seedling establishment.

Weed Control Eliminate weeds prior to planting.

Fertilization Low to moderate amounts.

Irrigation As needed for establishment.

Soils Medium texture, fertile soils that are neutral or slightly basic.

Stand Management

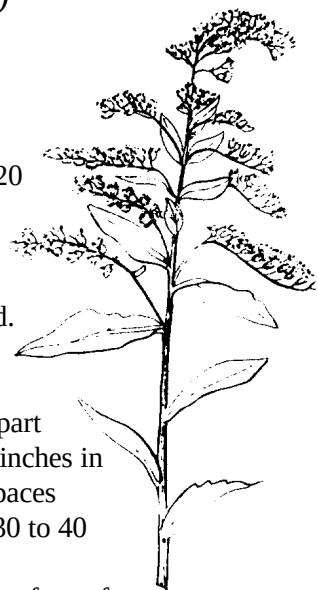
Pest Control

Weeds Hand and mechanical cultivation between rows. Mowing can be used on taller weeds within beds. Chemicals have not been widely tested with this species. Burning and mowing following seed harvest can be helpful in controlling weeds and weed seed development.

Insects Numerous insects are associated with this species, though most appear to be beneficial.

Diseases No known problems.

Fertilization Plants require moderate amounts of



fertilizer. Annual applications usually required.

Irrigation Stands require 12 to 16 inches of annual precipitation and irrigation. Early and mid summer irrigation is normally required to sustain late summer seed maturation.

Stand Density Grow in areas that closely match native site conditions. Yearly mechanical tillage is necessary to prevent plants from spreading out of beds. Mechanical tillage across the beds may be necessary every 3 to 4 years to prevent excessive sodding which will decrease seed production.

Pollination Wind and insects.

Seed Production

Years to Produce Seed Crop Following

Seeding 20 to 35 percent production the second year. Full production attained the third growing season.

Production per Acre Yields range from 200 to 400 pounds with 20 to 40 percent purity.

Longevity of Seed Production Fields Longevity of irrigated fields have not been determined, but non irrigated stands have persisted beyond 10 years.

Flowering Date June through July.

Seed Maturity-Harvest Date August 1st to mid October.

Seed Retention Seeds develop and mature over an extended period. As seeds ripen they are slowly dislodged. Seeds must be harvested at more than one date to maximize seed production.

Seed Handling

Methods of Seed Harvest Hand beating into hoppers or mechanical harvesting using reel-type flail units that are capable of removing mature seed but do not damage immature fruits.

Seed Cleaning Debeard -> air screen separator. Repeat both processes to increase seed purity.

Seed Storage Store in dry open warehouse.

Seed Characteristics

Seeds/lb 600,000 to 900,000.

Longevity 2 to 4 years.

Viability Medium (40 to 60 percent). Many seeds do not fully develop. Sound or viable seeds germinate following short periods of stratification.

Afterripening Seeds normally require up to 30 days to afterripen for maximum germinability.

Purity Seed lots are normally cleaned to 20 to 40 percent purity, but can be cleaned to higher purity.

AOSA Rules None.

Released Varieties None.

GROUNDSEL, BUTTERWEED (*Senecio serra*)

Origin Native perennial.

Establishment

Seeding Rate Plant 20 to 30 pure live seeds per linear foot of row or square foot of beds.

Row Spacing Plant in rows 30–40 inches apart or beds 12 to 24 inches wide with 30 to 40 inches interspace between beds.

Seeding Depth Plant on surface of disturbed soil to ¼ to ½ inch deep.

Seeding/Transplanting

Methods Single row seeder. For planting beds, use a culti-pack imprint seeder. Stands can be quickly established using root sprigs as transplant stock.

Time of Seeding Fall or early spring seedings. Spring transplanting.

Weed Control Eliminate major weed



populations prior to planting.

Fertilization Generally low or moderate amounts.

Irrigation For late spring plantings, supplemental irrigation is normally required to maintain moisture in the soil surface and sustain seedling establishment.

Soils Moderately fertile, slightly basic, medium to slightly heavy textured soils with good water holding capacity.

Stand Management

Pest Control

Weeds Mechanical cultivation between beds or row. Within beds, hand weeding or mowing is possible in young developing stands. In mature stands, hand weeding can be used before and after seed is harvested. Mowing and controlled burning can also be used after seed is harvested. Mature stands provide extensive competition and will eliminate most other species.

Insects Numerous insects are associated with this plant, but no detrimental problems have been observed.

Diseases No known problems.

Fertilization Moderate amounts may be necessary to sustain seed production.

Irrigation One or two irrigations are normally required including an early summer application. Stands normally require 16 to 20 inches of annual rainfall and irrigation.

Stand Density Plants are rhizomonous and spread quickly, but can be maintained in rows or beds. Plantings should not be allowed to become sod-bound as seed production decreases and plantings become patchy. Repeated tillage and/or burning can control vegetative spread.

Pollination Wind and insects.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Two-year-old plantings produce 20 to 35 percent of normal yield. Full production attained the third growing season.

Production per Acre Yields range from 200 to 450 pounds having 20 to 40 percent purity.

Longevity of Seed Production Fields

Longevity of irrigated fields have not been determined, but non irrigated stands have persisted beyond 10 years.

Flowering Date July through August.

Seed Maturity-Harvest Date September through October. Seeds mature over an extended period and must be harvested at two to three dates to maximize seed production.

Seed Retention Seed retention is good, but seeds can be dislodged by moderate winds; consequently, they must be harvested as they ripen over a 1 to 2 month period.

Seed Handling

Methods of Seed Harvest Seeds can best be harvested with a flail or reel-type combine that is capable of dislodging mature seeds without damaging immature fruits. Seeds can also be harvested by hand beating into small hoppers.

Seed Cleaning Cleaning seed lots to a purity of more than 20 to 30 percent is generally not practical or necessary. Debearding is required to separate seeds from floral debris and remove portions of the pappus attached to the fruit. Seeds are then cleaned with an air separator.

Seed Storage Store in dry open warehouse.

Seed Characteristics

Seeds/lb 600,000.

Longevity 2 to 4 years.

Viability 80 to 85 percent. Seeds usually germinate easily and uniformly.

Afterripening Full germinability is generally reached 20 to 30 days following harvest. Late maturing seeds often fail to fill.

Purity Seed is cleaned to at least 20 to 30 percent purity.

AOSA Rules None.

Released Varieties None.

LOMATIUM, NUTTALL (*Lomatium nuttallii*)

Origin Native perennial.

Establishment

Seeding Rate Plant 20 to 30 pure live seeds per linear foot of row.

Row Spacing 28 to 30 inches.

Seeding Depth Surface of disturbed soil to ¼ inch deep.

Time of Seeding Fall seeding recommended but stands can be established by early spring planting.

Seeding Methods Grain drill or single row seeder.

Weed Control Eliminate weeds prior to seeding with chemicals and mechanical tillage.

Fertilization Low to moderate amounts required.

Irrigation Apply as needed to ensure seeding establishment.

Soils Light to heavy textured, well-drained, basic soils.

Stand Management

Pest Control

Weeds Mechanical tillage and hand weeding required after plants become established.

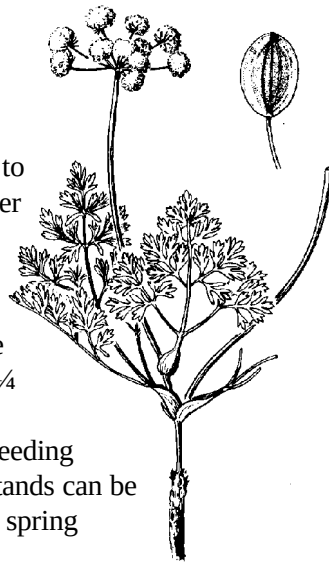
Insects No major insect problems affecting fruit development or seed storage.

Diseases No known problems.

Fertilization Low to moderate rates required depending upon soil conditions. Early spring application recommended.

Irrigation Plants require 13 to 16 inches of annual precipitation and irrigation. Late spring irrigation is often required to produce maximum seed crop. Mid or late summer irrigation may be required to maintain late season growth. Standing water should be avoided when sites are irrigated.

Stand Density Cultivate annually. Plants may be lightly grazed following seed harvesting.



Plants normally produce good seed crops without extensive management.

Pollination Insects.

Seed Production

Years to Produce Seed Crop Following

Seeding With fall seeding, 20 to 30 percent production the second year. Full production the third growing season.

Production per Acre 200 to 400 pounds.

Longevity of Seed Production Fields

Undetermined under irrigation, but dryland stands persist for 15 to 20 years.

Flowering Date May to June.

Seed Maturity-Harvest Date Late June to early July.

Seed Retention Seeds ripen uniformly and persist on the plants for 2 to 3 weeks following maturation.

Pollination Insects.

Seed Handling

Methods of Seed Harvesting Hand stripping, beating, or combine harvesting.

Seed Cleaning Dry until seeds have separated from stems, air screen. Chop, rub or tumble to separate tightly attached seeds from stems followed by air screening.

Seed Storage Dry location. No special storage provisions.

Seed Characteristics

Seeds/lb 42,200.

Longevity 5 to 10 years.

Viability Between 60 to 80 percent. Seeds germinate uniformly.

Afterripening Most seeds are dormant for 1 to 2 months following harvest.

Purity Seed is easily cleaned to 90 percent purity.

AOSA Rules None.

Released Varieties None.

MILKVETCH, CICER (*Astragalus cicer*)

Origin Introduced perennial.

Establishment

Seeding Rate 15 to 20 pure live seed per linear foot of row.

Row Spacing 36 to 42 inches.

Seeding Depth $\frac{1}{4}$ to $\frac{1}{2}$ inch.

Seeding Methods

Grain drill or single-row seeders.

Time of Seeding Because of stratification requirements, fall seeding is necessary.

Weed Control Mechanical and chemical fallowing to eliminate weeds and weed seed.

Fertilization None.

Irrigation As needed for establishment.

Soils Sandy loam to clay loam-textured soils.

Stand Management

Pest Control

Weeds Hand weed first growing season until seedlings are well established. Cultivation and pre-emergence herbicide can then be used. Grass herbicides can be used once plants are mature.

Insects No known problems.

Diseases No known problems.

Fertilization Test soil. Fertilize similar to alfalfa seed production requirements. Split spring/fall applications are preferred.

Irrigation 16 to 20 inches of precipitation and irrigation required annually. Minimum of three irrigations generally required—spring, prior to flowering, and prior to seedset. Do not sprinkle irrigate during pollination.

Stand Density Plants are rhizomatous. Cultivation between and across rows required at least every 3 years to control plant density.

Pollination Insect pollinated; majority done by bumble bees. Do not control insect pests

during pollination.

Seed Production

Years to Produce Seed Crop Following

Planting No seed produced the first year, 40 to 60 percent crop the second year, and 80 to 100 percent the third.

Production per Acre 500 to 700 pounds at 95 percent purity.

Longevity of Seed Production Fields 20+ years.

Flowering Date June 15 to August 1.

Seed Maturity-Harvest Date September 1 through April 1. Seed can be harvested once seed pods have dried and turned black.

Seed Retention Excellent. Dry pods do not open for 6 to 9 months. Pods will hang on plants through winter.

Seed Handling

Methods of Seed Harvesting Swath to dry leaves and stems, then combine. Seed can also be direct combined following hard frost or chemical defoliant and drying of leaves. Where crop is covered by snow, combining can occur in the spring.

Seed Cleaning Dry -> debarker -> air screen separator. Gravity table can be used to remove morning glory and undesirable seed.

Seed Storage Store in a dry open warehouse.

Seed Characteristics

Seeds/lb 114,000.

Longevity 16+ years.

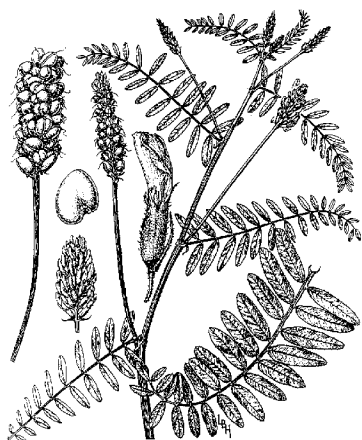
Viability Excellent (95 percent). Slow germinator.

Afterripening Maximum germinability not reached for 1 to 3 months following seed harvest. Cool, moist conditions required for 1 month prior to germination.

Purity 95 percent attainable.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties 'Lutana', 'Monarch', 'Windsor'.



PENSTEMON, EATON OR FIRECRACKER

(*Penstemon eatonii*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 30 pure live seeds per linear foot of row. Seed can be difficult to meter.

Row Spacing 30 inches.

Seeding Depth 1/16 to 1/8 inch.

Seeding Methods Single-row seeders.

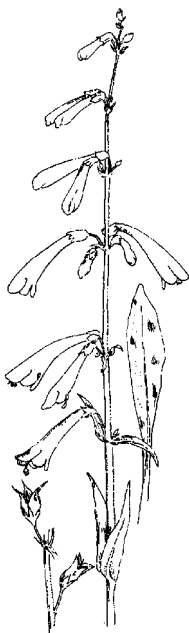
Time of Seeding Fall seeding is required.

Weed Control Mechanical and herbicide fallow to remove weeds and control weed seed prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Well drained, rocky to sandy loam-textured soils. Plants susceptible to soil-borne *Fusarium* and *Rhizoctonia* root rot associated with agriculture production, especially alfalfa and potatoes. Diseases are especially severe in loam to clay-textured soils.



Stand Management

Pest Control

Weeds Hand weed first season. Thereafter, light mechanical cultivation and pre-emergence herbicide can be used.

Insects No known problems.

Diseases Very susceptible to fungal root rots (see Soils above) and foliage blights, especially with excessive irrigation.

Fertilization Test soils. Low to moderate amounts required.

Irrigation 12 to 16 inches of precipitation and irrigation required annually. Irrigate in early summer if sufficient soil moisture is not available. Irrigate well at start of flowering. Sprinkle irrigation not recommended during height of pollination. Do not over-irrigate.

Stand Density Very little reproduction occurs. No cultivation needed.

Pollination Exclusively insect pollinated; manage to ensure that pollinators are present.

Seed Production

Years to Produce Seed Crop Following

Planting Little or no seed production the first year, 50 to 75 percent the second year, and full seed production the third year.

Production per Acre 250 to 300 lbs at 70 to 80 percent purity.

Longevity of Seed Production Fields 5 to 6 years.

Flowering Date May 1 to July 15. Flowers occur over an extended period. Height of flowering June 20 to July 10.

Seed Maturity-Harvest Date July 1 through August 30.

Seed Retention Good. Seed capsules remain on the plant but split open at the top as seed matures.

Seed Handling

Methods of Seed Harvesting Swath, dry in swath, then combine; or cut seed stalks and dry in warehouse.

Seed Cleaning Dry -> debearder or hammermill -> air screen separator -> gravity table.

Seed Storage Store in a dry location. No special storage conditions required. Protect from mice.

Seed Characteristics

Seeds/lb 351,000.

Longevity 7 to 10 years.

Viability Excellent (90 to 95 percent), however germination can occur over an extended period.

Afterripening Maximum germinability not reached for 1 month following seed harvest. Stratification requirements are unknown.

Purity Generally cleaned to 70 percent purity. Can be cleaned to 95+ percent purity.

AOSA Rules Seed quality testing rules are established and in use.

Released Germplasm 'Richfield', Selected Class germplasm.

Released Varieties None.

PENSTEMON, PALMER (*Penstemon palmeri*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 30 pure live seeds per linear foot of row. Seed can be difficult to meter.

Row Spacing 36 inches.

Seeding Depth 1/16 to 1/8 inch.

Seeding Methods Single-row seeder.

Time of Seeding Fall seeding is preferred for uniform spring germination.

Weed Control Mechanical and herbicide fallow to remove weeds and weed seed.

Fertilization None.

Irrigation As needed for establishment.

Soils Well drained gravelly to sandy loam-textured. Susceptible to soil-borne *Fusarium* and *Rhizoctonia* root rot associated with agriculture production. Virgin soils or soils that have not grown alfalfa or potatoes are preferred. Very susceptible to disease in loam to clay soils, especially those that are not well drained.

Stand Management

Pest Control

Weeds Hand weed first season. Thereafter, light cultivation and pre-emergence herbicide and hand weeding.

Insects No known problems.

Diseases Very susceptible to root rots and leaf blight in wet conditions.



Fertilization Test soil. Low to moderate amounts recommended.

Irrigation 11 to 15 inches of precipitation required annually. Needs spring moisture to establish and develop seed stalks. Irrigate in spring if needed. Additional irrigation at start of flowering. Sprinkler irrigation not recommended during pollination. Do not over-irrigate.

Stand Density Management Does not volunteer readily; cultivation not needed to control density.

Pollination Flowers are insect pollinated. Manage to maintain high insect population.

Seed Production

Years to Produce Seed Crop Following

Planting Little or no seed production the first year, 50 to 60 percent the second year and full seed production the third year.

Production per Acre 300 to 500 lbs. at 95 percent purity.

Longevity of Seed Production Fields 3 to 4 years if diseases are controlled.

Flowering Date May 1 to July 30. Flowers over an extended period. Maximum flowering July 1 to July 20.

Seed Maturity-Harvest Date August 15 through December 30. Some flowering may occur to date of harvest.

Seed Retention Good. Seed matures within an upright capsule. Capsule remains on the seed stalk and slowly opens to allow seed dispersal.

Seed Handling

Methods of Seed Harvesting Seed will mature in capsule prior to capsule opening. Capsules can be hand stripped, or seed stalks can be swathed and left in the swath to dry prior to capsule opening. Combine when capsules begin to open.

Seed Cleaning Dry -> debearder -> air screen separator -> gravity table.

Seed Storage Store in a dry location. No special storage condition required. Protect from mice.

Seed Characteristics

Seeds/lb 610,000.

Longevity 4 to 6 years.

Viability 85 to 90 percent; germination somewhat uneven.

Afterripening Maximum germinability not reached for 1 to 3 months following seed harvest. Stratification requirements unknown.

Purity 95 percent purity.

AOSA Rules Seed quality testing rules have been established and in use.

Released Varieties 'Cedar'.

PENSTEMON, ROCKY MOUNTAIN

(*Penstemon strictus*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 30 pure live seeds per linear foot of row. Seed can be difficult to meter.

Row Spacing 36 inches.

Seeding Depth 1/8 to 1/4 inch.

Seeding Methods

Single-row seeders.

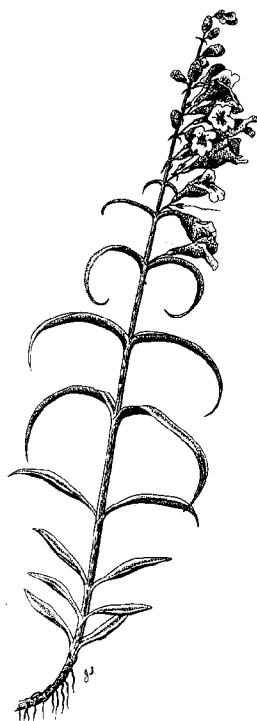
Time of Seeding Fall seeding is preferred for uniform spring germination.

Weed Control Fallow fields mechanically and chemically as needed to remove weeds and control weed seed.

Fertilization None.

Irrigation As needed for establishment.

Soils Silty clay loam to sandy loam-textured soils.



Stand Management

Pest Control

Weeds Hand weed first season. Thereafter, light cultivation and hand weeding as required.

Insects No known problems.

Diseases No known problems.

Fertilization Test soil. Low to moderate amounts required.

Irrigation 14 to 18 inches annually. Minimum of two irrigations; late spring and at start of flowering; additional irrigations as needed.

Stand Density Little volunteer reproduction occurs. Cultivation generally not required except to control weeds.

Pollination Flowers are insect pollinated. Manage to maintain high insect populations.

Seed Production

Years to Produce Seed Crop Following

Planting Little the first year, 50 to 75 percent the second year and full seed production the third year.

Production per Acre 200 to 300 pounds per acre at 95 percent purity.

Longevity of Seed Production Fields 4 to 6 years.

Flowering Date Starts mid June.

Seed Maturity-Harvest Date Early September.

Seed Retention Good.

Seed Handling

Methods of Seed Harvesting Hand strip or combine harvest. Harvest as capsule begins to open.

Seed Cleaning Debearder -> air screen separator -> gravity table.

Seed Storage No special storage requirements. Protect from mice.

Seed Characteristics

Seeds/lb 262,000.

Longevity 4 to 6 years.

Viability 85 to 90 percent; germination somewhat uneven.

Afterripening Maximum germinability not reached for 1 to 2 months following seed harvest. Stratification requirements

unknown.

Purity 95 percent purity easily attainable.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties 'Bandera'.

PENSTEMON, WASATCH (*Penstemon cyananthus*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 30
pure live seeds per
linear foot of row.

Row Spacing 30
inches.

Seeding Depth 1/16 to
1/8 inch.

Seeding Methods

Single-row seeder.

Time of Seeding Fall
seeding is required.

Weed Control Mechanical and herbicide fallow
to remove weeds and control weed seed.

Fertilization None.

Irrigation As needed for establishment.

Soils Well drained loam to sandy loam-textured
soil.

Stand Management

Pest Control

Weeds Hand weed first season. Thereafter,
light cultivation and pre-emergence
herbicide can be used.

Insects No known problems.

Diseases No known problems.

Fertilization Test soil. Low to moderate
amounts required.

Irrigation 14 to 18 inches of precipitation and
irrigation annually. Minimum of three
irrigations; early summer, start of flowering,
and mid point of flowering. Sprinkler
irrigation not recommended during flowering.

Stand Density Density remains fairly constant.



Cultivation generally not necessary to
maintain stand density and row spacing.

Pollination Flowers are insect pollinated.

Manage to maintain high insect population.

Seed Production

Years to Produce Seed Crop Following

Planting Little or no seed production the
first year, 50 to 80 percent the second year
and 90 to 100 percent seed production the
third year.

Production per Acre 300 to 400 lbs at 90
percent purity.

Longevity of Seed Production Fields 5 to 6
years.

Flowering Date Flowering occurs over extended
period, June 1 through August. Maximum
flowering June 1 to July 15.

Seed Maturity-Harvest Date August 1 to
September 1.

Seed Retention Excellent. Capsules slow to dry
and open. Once open, seed disperses easily.

Seed Handling

Methods of Seed Harvesting Combine, hand
strip, or beat into a hopper.

Seed Cleaning Dry -> debearder -> air screen
separator -> gravity table.

Seed Storage Store in a dry location. No special
storage requirements. Protect from mice.

Seed Characteristics

Seeds/lb 235,000.

Longevity 4 to 6 years.

Viability 85 to 90 percent; germination is
somewhat erratic and can occur over an
extended period.

Afterripening Maximum germinability not
reached for 1 to 3 months following seed
harvest. 2 to 4 weeks of cool, moist
conditions required for germination.

Purity Generally cleaned to 95 percent purity.

AOSA Rules Seed quality testing rules are
established and in use.

Released Varieties None.

SAGE, LOUISIANA (*Artimesia ludoviciana*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 30 pure live seeds per linear foot of row. Seed is difficult to meter and maintain planting depth.

Row Spacing 36 to 42 inches, or plant in beds 30 to 48 inches wide with an equal space between beds.

Seeding Depth 1/16 to 1/8 inch.

Seeding Methods Single-row seeder, or broadcast on beds followed by cultipacker or harrow.

Time of Seeding Fall seeding. Spring and late summer seeding only where there is sufficient water and time available for assured establishment.

Weed Control Mechanical and chemical fallow to control weeds and weed seeds.

Fertilization None.

Irrigation As needed for establishment.

Soils Sandy loam to clay loam.



Stand Management

Pest Control

Weeds Hand weeding required first year. Cultivation and pre-emergence herbicide can be used thereafter along with some hand weeding.

Insects No known problems.

Diseases No known problems.

Fertilization Test soil for needs. Fertilize at low to moderate rates.

Irrigation 14 to 16 inches of precipitation and irrigation required annually. A minimum of one irrigation in late spring and before flowering; window of seed maturation may be narrowed by withholding water during flowering. Can be furrow or sprinkler irrigated.

Stand Density Plants are strongly rhizomatous. Annual cultivation between and across rows may be required to control excessive plant density.

Pollination Wind and insects.

Seed Production

Years to Produce Seed Crop Following

Planting 5 to 15 percent seed crop can be produced the first season, 70+ percent the second, and 100 percent the third growing season.

Production per Acre 1200 to 1500 pounds at 10 percent purity.

Longevity of Seed Production Fields 10+ years.

Flowering Date July 1 through August. Varies with accession.

Seed Maturity-Harvest Date Mid August to October.

Seed Retention Good. Varies with accession.

Seed Handling

Methods of Seed Harvesting Combine, hand strip, or beat into hoppers.

Seed Cleaning and Dry -> debearder -> air screen separator -> gravity table.

Seed Storage Store in a dry open warehouse. No special storage conditions required.

Seed Characteristics

Seeds/lb 2,500,000.

Longevity Good for 2 years.

Viability 75 to 85 percent; fairly rapid germination.

Afterripening Maximum germinability not reached for 2 months following seed harvest, 1 to 2 weeks of cool, moist conditions required prior to germination.

Purity May be cleaned to as high as 90 percent, but sometimes sold at lower purity.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties 'Summit'.

SAINFOIN (*Onobrychis sativa*)

Origin Introduced perennial.

Establishment

Seeding Rate 10 to 20 pure live seeds per linear foot of row.

Row Spacing 36 inches.

Seeding Depth ¼ - ½ inch.

Seeding Methods Grain drill or single-row seeders.

Time of Seeding Fall seeding is recommended. Spring seeding where sufficient water is available for establishment.

Weed Control Mechanical and herbicide fallow to remove weeds and control weed seed.

Fertilization Same as alfalfa.

Irrigation As needed for establishment.

Soils Sandy loam, loam to clay loam-textured soils.

Inoculation Inoculate seed with sanfoin compatible inoculum.

Stand Management

Pest Control

Weeds Hand weed in seedling stage. Thereafter, cultivation and pre-emergence herbicide can be used.

Insects No known problems.

Diseases Control of seed bruchid weevil may be necessary.

Fertilization Test soil. Apply at low to moderate rate with split spring/fall application. Fertilize only for seed development. Excess fertilization will promote vegetative growth at the expense of seed production.

Irrigation 14 to 18 inches of precipitation and irrigation annually. Irrigation in late spring when soil moisture is not sufficient. Irrigate at time of early flowering and seed set. Needs moisture after harvest to maintain stand.



Stand Density Management Cultivate annually between rows to control excessive plant density.

Pollination Insects.

Seed Production

Years to Produce Seed Crop Following

Planting 5 to 15 percent the first year, especially when fall seeded, 65 to 85 percent the second year and 90-100 percent seed production the third year.

Production per Acre 500 to 750 pounds at 95 percent purity.

Longevity of Seed Production Fields 8+ years.

Flowering Date June 1 through August 15.
Height of flowering July 1 to July 15.

Seed Maturity-Harvest Date August 1 to September 30.

Seed Retention Good—little shattering.

Seed Handling

Methods of Seed Harvesting Combine harvest.

Seed Cleaning Dry -> debeard lightly -> air screen separator. Legume is enclosed in the staminal sheath which is not removed.

Seed Storage Store in a dry location. No special storage conditions required. Protect from mice.

Seed Characteristics

Seeds/lb 26,000.

Longevity 10 to 15 years.

Viability Excellent (90 to 95 percent); fairly rapid, even germination.

Afterripening Maximum germinability not reached for up to 1 month following seed harvest. No stratification requirements.

Purity Generally cleaned to 95 to 98 percent purity.

Seed Unit Legume plus staminal sheaths.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties 'Eski', 'Remont'.

SALSIFY, OYSTER-PLANT (*Tragopogon porrifolius*)

Origin Introduced biennial
(winter annual).

Establishment

Seeding Rate 20 pure live
seeds per linear foot of
row.

Row Spacing 24 inches.

Seedling Depth ¼ to ½
inch.

Seeding Methods Single-
row seeders.

Time of Seeding Early
September if irrigation
available; seedlings form rosette to
overwinter.

Weed Control Mechanical and herbicide
fallowing to remove weeds and weed seeds
prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Fine to coarse-textured.



Stand Management

Pest Control

Weeds Hand weed and light cultivation the
first growing season. Early, light
cultivation the second season.

Insects No known problems.

Diseases No known problems.

Fertilization None.

Irrigation 10 to 14 inches of rain, snow, or
irrigation per year. Irrigate when soil is dry
in the spring. No irrigation after the start of
flowering.

Stand Density Management not required with
this biennial.

Pollination Insects.

Seed Production

Years to Produce Seed Crop Following

Planting This species flowers the next year
and then dies.

Production per Acre 350 to 500 pounds.

Longevity of Seed Production Fields Plants die
after producing seed in the year following
planting.

Flowering Date Early to late June.

Seed Maturity-Harvest Date Early to mid July.

Seed Retention When mature, seed will dislodge
with little disturbance.

Seed Handling

Methods of Seed Harvesting Hand beat, hand
pull heads, or combine.

Seed Cleaning Debearder -> air screen
separator.

Seed Storage Store in dry location. Protect from
mice.

Seed Characteristics

Seeds/lb 307,000.

Longevity 3 to 5 years.

Viability 65 to 75 percent, fairly even
germination.

Afterripening Maximum viability not obtained
for 2 to 3 months after seed harvest.

Purity 90 to 95 percent.

AOSA Rules None.

Released Varieties None.

SUNFLOWER, COMMON (*Helianthus annuus*)

Origin Native annual.

Establishment

Seeding Rate 5 to 10
pure live seeds per
linear foot of row.

Row Spacing 24 inches.

Seeding Depth ⅛ - ½
inch.

Seeding Methods

Grain drill or
single row seeders.

Time of Seeding Fall
seed on dryland sites to take



advantage of early spring moisture; can be spring planted if irrigation available.

Weed Control Mechanical and herbicide fallow to control weeds and weed seeds prior to seeding.

Fertilization None.

Irrigation As needed for establishment. Generally little or no irrigation is required.

Soils Sandy to clay loam-textured soil.

Stand Management

Pest Control

Weeds Cultivate as needed during early part of growing season.

Insects No known problems.

Diseases No known problems.

Fertilization None.

Irrigation 10 to 12 inches of precipitation and irrigation during growing season; irrigate early to ensure vegetative growth and flower formation.

Pollination Insects and wind.

Seed Production

Years to Produce Seed Crop Following

Planting Annual—first year.

Production per Acre 300 to 450 pounds at 95 percent purity.

Longevity of Seed Production Fields 1 year.

Flowering Date August 1–September 15.

Seed Maturity-Harvest Date Mid September.

Seed Retention Fair.

Seed Handling

Methods of Seed Harvesting Combine harvest.

Seed Cleaning Air screen separator.

Seed Storage Store in a dry open warehouse. No special storage conditions required.

Seed Characteristics

Seeds/lb 89,000.

Longevity 2 years.

Viability 85 to 90 percent; fast easy germination

Afterripening Maximum germinability not reached for 1 to 2 months following seed harvest.

Purity 95 percent.

AOSA Rules There are no seed quality testing rules.

Released Varieties None.

SWEETANISE

(*Osmorhiza occidentalis*)

Origin Native perennial.

Establishment

Seeding Rate 20 to 30 pure live seeds per linear foot of row.

Row Spacing 28 to 36 inches.

Seeding Depth ½ to ¾ inch.

Seeding Method Single row seeder.

Time of Seeding Fall is preferred. Seeds require cold moist stratification to germinate uniformly.

Weed Control Eliminate weeds by mechanical or chemical tillage prior to seeding.

Fertilization Moderate amounts.

Irrigation Apply as needed to ensure seedling establishment.

Soils Moderate to heavy textured soils, with good water holding capacity and near neutral pH. Plants grow and persist better planted on or close to native sites.

Elevation Should be grown only above 7000 ft.



Stand Management

Pest Control

Weeds Hand and mechanical weeding is required.

Insects No known problems.

Diseases No known problems.

Fertilization Moderate amounts of fertilizer required annually.

Irrigation Plants normally grow in areas receiving 16 to 25 inches of annual moisture. Late spring or early summer irrigation is required if soil moisture becomes depleted

during mid or late stages of floral development.

Stand Density Cultivate between rows annually.

Pollination Insects.

Seed Production

Years to Produce Seed Crop following Seeding

With fall seeding, 30 to 40 percent seed crop the second year. Full production within the third year.

Production per Acre 100 to 200 pounds at 90 percent purity.

Longevity of Seed Production Fields

Persistence under irrigation has not been fully determined. Plants maintained under dryland production persist for over 15 years.

Flowering Date June to July.

Seed Maturity-Harvest Date August 1 to mid September depending upon elevation.

Seed Retention Seeds are supported at the ends of small fruiting stems. No other floral tissue surrounds the fruit as a protective structure. Green or immature seeds remain tightly attached to the stems, but can be easily dislodged when they are ripe.

Seed Handling

Methods of Seed Harvesting Seeds can be removed by hand collection using paddles or hand stripping to dislodge the seed into small hoppers. Combine harvesting is possible if seeds ripen uniformly throughout the stand.

Seed Cleaning Dry -> debearder -> air screen separator.

Seed Storage Store in dry locations and protect from rodents.

Seed Characteristics

Seeds/lb 29,800.

Longevity 5 to 8 years.

Viability 80 to 90 percent. Seeds germinate quite uniformly following a brief stratification period.

Afterripening Seeds normally require 1 to 2 months to afterripen for maximum germination.

Purity Seeds can be cleaned to 95 percent purity or greater.

AOSA Rules None.

Released Varieties None.

SWEETVETCH, UTAH OR NORTHERN (*Hedysarum boreale*)

Origin Native perennial.

Establishment

Seeding Rate 10 pure live seeds per linear foot of row, or plant 3 to 4 pure live seeds in hills 2 to 4 feet apart.

Row Spacing 4 to 5 feet.

Seeding Depth ¼ to ½ inch.

Seeding Methods Single-row seeders.

Time of Seeding

Because of stratification requirements, fall seeding is recommended; germination is often erratic.

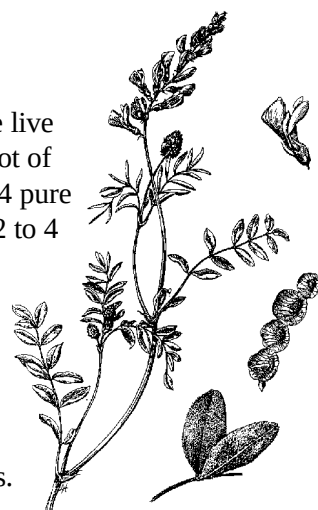
Weed Control Mechanical and herbicide fallow to control weeds and weed seeds prior to seeding.

Fertilization None.

Irrigation As needed for establishment.

Soils Well-drained sandy loam to silty clay basic loam.

Inoculation Seed should be inoculated with *Hedysarum* inoculant prior to planting.



Stand Management

Pest Control

Weeds Hand weed until stand is established. Light cultivation and pre-emergence herbicide thereafter.

Insects Chemical insect control may be necessary following flowering to prevent infestation of bruchid weevil larvae in developing seed.

Diseases Fungal rust (orange and black spots) on the leaves may be more

prevalent under excessive sprinkler irrigation.

Fertilization Test soil for needs. Up to 30 pounds of available phosphate/acre every other year. May require some nitrogen depending on field conditions.

Irrigation 15 to 18 inches of precipitation and irrigation required annually. Furrow or sprinkle irrigation. No sprinkler irrigation during flowering and pollination. Minimum of two irrigations needed; pre-flowering, and during seed fill.

Stand Density Stand density generally does not increase. However some accessions are rhizomatous and may need cultivation between plants to maintain spacing.

Pollination Bees and bumble bees required for pollination. Use caution in insect pest chemical control so pollinators are not injured.

Seed Production

Years to Produce Seed Crop Following

Planting No seed produced the first season. 10 to 35 percent the second year and 90 to 100 percent the third.

Production per Acre 75 to 200 pounds at 90 percent purity.

Longevity of Seed Production Fields 8+ years.

Flowering Date May 1 to July 15. Flowering occurs over an extended period.

Seed Maturity-Harvest Date July 5 to Aug. 1.

Seed Retention Seed produced in loment with two to eight segments. Loment will dry unevenly over the complete plant, and will drop off plant when dry.

Seed Handling

Methods of Seed Harvesting Combine harvest, or dislodge by stripping or beating and collecting in hopper or on tarp.

Seed Cleaning Dry -> debearder or hammermill -> air screen separator. Seed may be removed from loment sheath with debearder. Care must be taken to insure that seed does not heat in this process as slight heat will kill the seed. Seed sometimes marketed in the loment sheath.

Seed Storage Store in a dry open warehouse.

No special storage conditions required.

Seed Characteristics

Seeds/lb 34,000.

Longevity Good for 6 years.

Viability 80 to 90 percent; seeds germinate somewhat unevenly in plantings.

Afterripening Maximum germinability not reached for 1 to 2 months following seed harvest. Seed requires cool, moist conditions for up to 1 month prior to germination.

Purity 95 to 99 percent.

Seed Unit Generally marketed out of the loment sheath.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties 'Timp'.

YARROW, WESTERN (*Achillea millefolium*)

Origin Native perennial.

Establishment

Seeding Rate Direct seed 10 to 30 pure live seeds per linear foot of row.

Row Spacing 36 to 42 inches.

Seeding Depth Surface to 1/16 inch deep.

Seeding Methods Single-row seeders. Hand transplanting a good option.

Transplant Spacing 1 plant every 30 to 36 inches in rows 3-4 ft. apart.

Time of Seeding Fall seed. Spring and late summer seed only where there is sufficient water and time to bring up and establish seedlings prior to summer heat or fall frost.



Time of Transplanting Spring or early summer with irrigation.

Weed Control Fallow and use herbicide to remove weeds and control weed seeds prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Loam to clay loam.

Stand Management

Pest Control

Weeds Hand weeding required first growing season. Cultivation and pre-emergence herbicide can be used in combination with hand weeding thereafter.

Insects No known problems.

Diseases No known problems.

Fertilization Test soil for needs. Low to moderate fertilization.

Irrigation Furrow or sprinkle irrigation. 12 to 16 inches of precipitation or irrigation annually. Normally one irrigation per season is needed in early May. Excess water will reduce seed production.

Stand Density Cultivate between rows every spring. Some cross cultivation within rows may be required to maintain no more than one plant per 28 to 32 inches of row.

Pollination Insects.

Seed Production

Years to Produce Seed Crop Following

Planting-Transplanting In the planting year 10 to 40 percent seed crop can be produced and 85 to 100 percent the second growing season. With transplanting, 50 to 75 percent seed crop can be produced the first year.

Production per Acre Up to 350 pounds at 20 to 40 percent purity.

Longevity of Seed Production Fields 10 to 15 years.

Flowering Date Continuous flowering, May 1 through September 1. Majority of flowering occurs May 1 through June 30.

Seed Maturity-Harvest Date August 15 to September 30.

Seed Retention Seed matures unevenly, however, majority of seed matures together. Seed retention is good.

Seed Handling

Methods of Seed Harvesting Combine harvest.

Seed Cleaning Dry -> barley debearder -> air screen separator -> and if needed, over a gravity table.

Seed Storage Open dry warehouse. No special storage conditions required.

Seed Characteristics

Seeds/lb 4,124,000.

Longevity Viability drops off slowly after 4 years to about 6 years.

Viability 85 to 90 percent. Easy germination, but requires daylight stimulus.

Afterripening Maximum viability not reached for up to 1 month following seed harvest. Some sources may require up to 2 weeks of cool, moist stratification.

Purity Generally cleaned to 90+ percent purity.

AOSA Rules Seed quality testing requirements are established and in use.

Released Varieties There are a large number of commercial horticultural varieties. There are, however, no range or wildland releases.

SELECTED SHRUB SPECIES CONSIDERED FOR SEED PRODUCTION IN UTAH

BITTERBRUSH, ANTELOPE (*Purshia tridentata*)

Origin Native perennial.

Establishment

Seeding Rate 5 to 10 pure live seeds per hill 14 feet apart; thin to the best 1 or 2 plants after emergence.

Row Spacing 14 feet between rows.

Seeding Depth ¼ to ½ inch.

Seeding Methods Hand seeding.

Time of Seeding Fall seed.

Time of Transplanting Spring.

Plant Materials Bareroot, wildling, or container grown stock.

Transplant Spacing 14 feet between plants. An option is to space plants closer for increased early production, then thin to about 14 feet at maturity.

Weed Control Mechanical and herbicide fallowing prior to seeding or transplanting.

Fertilization None.

Irrigation Water to establish transplants or seedlings.

Soils Gravely to sandy loam to loam-textured soil.

Stand Management

Pest Control

Weeds Cultivation and pre-emergence herbicide. Hand weeding may be necessary next to plants for first 2 years.

Insects Spray with appropriate insecticide at end of flower, during milk, and soft

dough stages.

Diseases No known problems.

Fertilization Test soil. Low amount may be added.

Irrigation 15+ inches annual precipitation required. Irrigation may be needed where insufficient precipitation occurs early in the season. Good soil moisture is essential prior to, and during flowering.

Stand Density Cultivate soil between plants annually.

Pollination Insects.

Seed Production

Years to Produce Seed Crop Following

Seeding-Transplanting Transplants—10 percent seed crop after 5 years; 85 to 100 percent after 7 to 8 years. Direct seeding—10 percent seed crop after 6 to 7 years; 85 to 100 percent 9 to 10 years.

Production per Acre 200 to 300 lbs/acre, 95 percent purity.

Longevity of Seed Production Stand 25+ years.

Flowering Date May 15–June 10.

Seed Maturity-Harvest Date July 1–August 1.

Seed Retention When seed is mature it will fall readily with wind and other disturbances.

Seed Handling

Methods of Seed Harvesting Hand beating into hopper or tarp.

Seed Cleaning Air screen separator -> debearder -> air screen separator.

Seed Storage No special storage conditions required.

Seed Characteristics

Seeds/lb 15,400 at 100 percent purity.

Longevity 20+ years.

Viability 90 percent.

Afterripening Maximum germinability not



reached for 5 to 6 months following seed harvest. Up to 2 months of moist, cool conditions required prior to germination.

Purity 95+ percent.

AOSA Rules Seed quality testing rules are established and in use.

Released and/or Recognized Germplasms
'Fountain Green', 'Maybell'.

Released Varieties 'Lassen'.

KOCHIA, FORAGE (*Kochia prostrata*)

Origin Introduced perennial.

Establishment

Seeding Rate Plant 10 to 20 pure live seeds per linear foot of row.

Row Spacing 36 to 50 inches between rows.

Seeding Depth On surface of disturbed soil to 1/8 inch deep.

Seeding Methods

Grain drill or single-row seeder.

Time of Seeding Fall, or spring if irrigation available.

Time of Transplanting Spring.

Plant Materials Bare-root or container grown stock.

Transplant Spacing 15 to 18 inches between plants, 3-4 feet between rows.

Weed Control Mechanical and herbicide following prior to seeding or transplanting.

Fertilization None.

Irrigation Sufficient to establish seedlings and transplants.

Soils Loam to sandy clay to clay loam-textured basic soil.

Stand Management

Pest Control

Weeds Cultivation, hand weeding, and pre-emergence herbicide as needed.

Insects No known problems.

Diseases No known problems.

Fertilization Test soil. Low to medium amounts are sufficient.

Irrigation 10 to 16 inches of annual precipitation and irrigation required. Irrigation in spring and at the end of flowering if soil moisture is low. Late or excessive irrigation will delay seed ripening.

Stand Density Annual cultivation to control volunteer plants between rows.

Pollination Wind and insects.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Transplanting—10 percent seed crop the first year; 80 to 100 percent the second year following planting. Direct seeding—5 percent seed production the first year; 30 to 40 percent the second; 70 to 100 percent the third year following seeding.

Production per Acre 400 to 800 lbs/acre at 85 to 95 percent purity.

Longevity of Seed Production Fields 6 to 8 years.

Flowering Date August 1 to September 15.

Seed Maturity-Harvest Date October 1 to December 15. Frost will speed up seed maturity.

Seed Retention Once seed is mature it will fall with wind and other disturbance.

Seed Handling

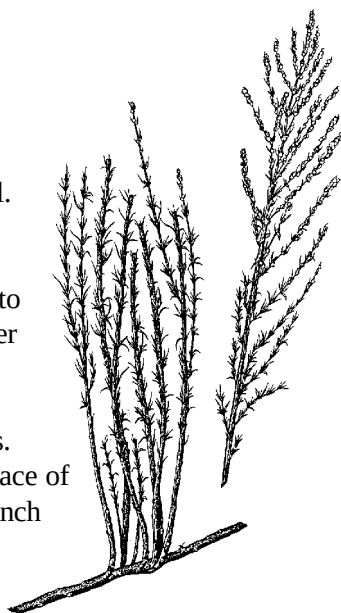
Methods of Seed Harvesting Direct combine, or swath, dry, and then combine. Hand stripping or brush or reel type stripper on scattered or low maintenance stands.

Seed Cleaning Dry -> Air Screen Separator -> debearder -> air screen separator -> dry to less than 7 percent moisture.

Seed Storage Hold seed at less than 7 percent moisture in a cool dry environment.

Seed Characteristics

Seeds/lb 520,000 at 100 percent purity.



Longevity Ambient air-dried: 1 to 2 years; Dried to 7 percent moisture: 3 to 5 years.

Viability 60 to 75 percent considered good, 35-40 percent acceptable. Can be as high as 90 percent if seeds have been allowed to fully mature before harvest; this is difficult with combine harvesting. Germination and emergence is rapid under favorable conditions.

Afterripening Maximum germinability not reached for up to 1 month following seed harvest.

Purity 85 to 95 percent attainable, 65 percent acceptable.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties 'Immigrant'.

RABBITBRUSH, WHITE STEM RUBBER

(*Chrysothamnus nauseosus*
ssp. hololeucus and *ssp.*
albicaulis)

Origin Native perennials.

Establishment

Seeding Rate Plant 5 to 10 pure live seeds per hill. Thin to one or two plants per hill after emergence.

Row Spacing 5 to 6 feet between rows and hills.

Seedling Depth On surface of disturbed soil to 1/8 inch deep.

Seeding Methods Hand seeding.

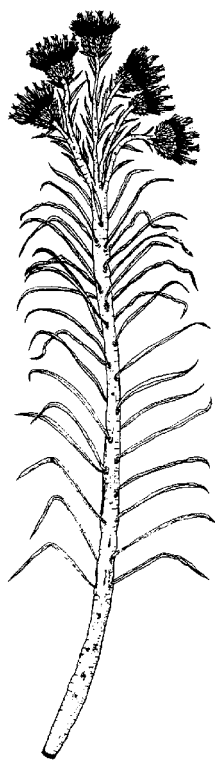
Time of Seeding Fall.

Time of Transplanting Early spring.

Plant Materials Bare root, wildling or container-grown stock.

Transplant Spacing 5 feet between plants.

Weed Control Mechanical and herbicide



following prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Clay to clay loam-textured soil.

Stand Management

Pest Control

Weeds Cultivation, hand weeding, spot herbicide, pre-emergence herbicide.

Insects No known problems.

Diseases No known problems.

Fertilization Generally not required.

Irrigation 11 to 15 inches of annual precipitation and irrigation required. Good spring moisture is critical; irrigate if soil moisture level is low.

Stand Density Cultivate annually.

Pollination Insects and wind.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Transplanting: 10 to 35 percent seed crop the second year following transplanting; maximum seed production by the third year. Direct seeding: 15 to 50 percent seed crop the third year following planting; 85 to 100 percent crop the fourth year.

Production per Acre 800 to 1000 lbs/acre at 90 percent purity.

Longevity of Seed Production Stands 10+ years.

Flowering Date August 15 to September 30.

Seed Maturity-Harvest Date October 15 to December 15.

Seed Retention When mature, dry seed will fall with wind and other disturbance. Seed holds fast when wet from storm, dew and high humidity.

Seed Handling

Methods of Seed Harvesting Hand beat into hopper or tarp.

Seed Cleaning Debearder -> pass over hardware screen. When it is desirable to increase purity, run through an air screen separator as needed.

Seed Storage Dry location.

Seed Characteristics

Seeds/lb 700,000 at 100 percent purity.

Longevity 2 to 3 years.

Viability 50 to 80 percent.

Afterripening Maximum germinability not reached for up to 1 month following seed harvest.

Purity Normally collected and marketed at 10 to 15 percent purity. Purity can be raised to 80+ percent.

AOSA Rules Seed quality testing rules are established and in use.

Released Varieties None.

SAGEBRUSH, BASIN BIG

(*Artemisia tridentata* spp.
tridentata)

Origin Native perennial.

Establishment

Seeding Rate Plant 5 to 10 pure live seeds in hills 7 feet apart. Thin to 1 or 2 plants after emergence.

Row Spacing 7 feet between rows.

Seeding Depth On surface of disturbed soil to 1/8 inch deep.

Seeding Method Hand seeding.

Time of Seeding Late Fall.

Time of Transplanting Spring.

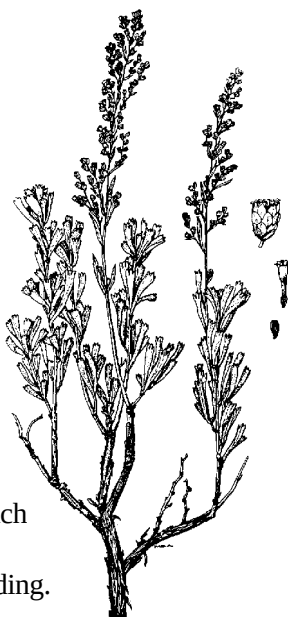
Plant Materials Bare root transplants, wildlings or container grown stock.

Transplant Spacing 7 feet between plants.

Weed Control Mechanical and chemical fallowing prior to planting.

Fertilization None.

Time of Seeding Late Fall.



Seeding Depth On surface of disturbed soil to 1/8 inch deep.

Irrigation As needed for establishment.

Soils Clay to clay loam-textured basic soil.

Stand Management

Pest Control

Weeds Cultivation and pre-emergence herbicide as needed.

Insects No known problems.

Diseases No known problems.

Fertilization None.

Irrigation 13 to 16 inches annual precipitation required. Irrigation may be necessary in late summer when plants start flowering.

Stand Density Cultivate annually.

Pollination Wind.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Transplanting: 20 to 40 percent seed crop produced during the second growing season; 80 to 90 percent the third and fourth year following transplanting. Direct seeding: No seed production the first year, 10 percent the second year, 30 to 50 percent the third year, 80 to 90 percent the fourth and fifth growing seasons.

Production per Acre 1000 to 2000 lbs/acre at 15 percent purity.

Longevity of Seed Production Stand 15+ years.

Flowering Date September 1 to October 30.

Seed Maturity-Harvest Date November 15 to January 15.

Seed Retention Once seed is mature and dry it will fall with little disturbance. Seed, however, holds fast when wet from storm, dew, and high humidity.

Seed Handling

Methods of Seed Harvesting Hand beat or strip into hopper.

Seed Cleaning Debearder -> screen. When more than 10 to 15 percent purity is desired, run material over an air screen separator.

Seed Storage No special storage conditions required.

Seed Characteristics

Seeds/lb 2,600,000 at 100 percent purity.

Longevity 3 years in a dry location.

Viability 50 to 80 percent.

Afterripening Maximum germinability not reached for 1 month following seed harvest. No stratification requirements.

Purity Seed generally harvested and marketed at 10 to 15 percent purity. Purity can be increased to 90 percent if desired.

AOSA Rules Seed quality testing standards are established and in use.

Released Varieties None.

SAGEBRUSH, MOUNTAIN BIG (*Artimesia tridentata* spp. *vaseyana*)

Origin Native perennial.

Establishment

Seeding Rate Plant 5 to 10 seeds per hill 5 to 7 feet apart. Thin to one or two plants after emergence.

Row Spacing 5 to 7 feet between rows.

Seeding Depth On surface of disturbed soil to 1/8 inch deep.

Seeding Methods

Hand seeding.

Time of Seeding Late fall.

Time of Transplanting Spring.

Plant Materials Bare root transplants, wildlings or container grown stock.

Transplant Spacing 5 to 7 feet between plants.

Weed Control Mechanical and herbicide following prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Well-drained loam to gravely clay loam-textured soil.



Stand Management

Pest Control

Weeds Cultivation and spot herbicide treatment.

Insects No known problems.

Diseases Native rust disease may occur on leaves and small stems. Extent of damage or control measures not known.

Fertilization None.

Irrigation 16 to 20 inches annual precipitation required. Good soil moisture is necessary in late summer when plants start flowering and maturing seed.

Stand Density Management Fall and spring cultivation between plants.

Pollination Wind.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Transplanting: 30 to 50 percent seed crop produced the second year; 90 to 100 percent the third year following transplanting. Direct seeding: No seed production first year; maximum seed production in the fourth year after seeding.

Production per Acre 1000 to 2000 lbs/acre at 15 percent purity.

Longevity of Seed Production Fields 15 to 20 years.

Flowering Date July 15 to August 30.

Seed Maturity-Harvest Date October 15 to November 10.

Seed Retention Once seed is mature and dry it will fall. Seed holds fast when wet from storm, dew, and high humidity.

Seed Handling

Methods of Seed Harvesting Hand beat or strip into hopper.

Seed Cleaning Debearder-> screen. When more than 15 percent purity is desired, collected material is then run over an air screen separator.

Seed Storage Store in dry location.

Seed Characteristics

Seeds/lb 2,000,000 at 100 percent purity.

Longevity 3 years in a dry location.

Viability 50 to 80 percent.

Afterripening Maximum germinability is not reached for one month following seed harvest.

Purity Seed generally harvested and marketed at 8 to 15 percent purity. Purity can be increased to 90 percent if desired.

AOSA Rules Seed quality testing standards are established and in use.

Released Varieties 'Hobble Creek'.

SAGEBRUSH, WYOMING BIG (*Artimesia tridentata ssp. wyomingensis*)

Origin Native perennial.

Establishment

Seeding Rate Plant 5 to 10 pure live seeds in hills 4 to 5 feet apart. Thin to 1 or 2 plants after emergence.

Row Spacing 5 to 7 feet between rows.

Seeding Depth On surface of disturbed soil to 1/8 inch deep.

Seeding Method Hand seeding.

Time of Seeding Late fall.

Time of Transplanting Spring.

Plant Materials Bare root transplants, wildlings.

Transplant Spacing 4 to 5 feet between plants.

Weed Control Mechanical and herbicide following prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Gravely loam to sandy loam to sandy clay loam-textured basic soil.

Stand Management

Pest Control

Weeds Cultivation and spot herbicide.

Insects No known problems.

Diseases Native rust disease may occur on leaves and small stems; control probably not necessary.

Fertilization None.

Irrigation 10 to 12 inches annual precipitation and irrigation required. Irrigation should be used to supplement precipitation; early spring and late summer are critical times for good soil moisture.

Stand Density Management Fall and spring cultivation.

Pollination Wind.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Transplanting: 30 to 50 percent seed crop produced at second year; 90 to 100 percent the third year following transplanting. Direct seeding: one additional year to start and to reach maximum seed production.

Production per Acre 1000 to 2000 lbs/acre at 100 percent purity.

Longevity of Seed Production Stand 15 to 20 years.

Flowering Date August 10 to October 1.

Seed Maturity-Harvest Date November 1 to December 1.

Seed Retention Once seed is mature and dry it will fall. Seed holds fast when wet from storm, dew, and high humidity.

Seed Handling

Methods of Seed Harvesting Hand beat or strip into hopper.

Seed Cleaning Debearder -> screen. When more than 15 percent purity is desired, collected material is then run over an air screen separator.

Seed Storage Store in dry location.

Seed Characteristics

Seeds/lb 2,500,000 at 100 percent purity.

Longevity 3 years in a dry location.

Viability 50 to 80 percent.



Afterripening Maximum germinability not reached for 1 month following seed harvest.

Purity Seed generally harvested and marketed at 8 to 15 percent purity. Purity can be increased to 90 percent purity if desired.

AOSA Rules Seed quality testing standards are established and in use.

Released Varieties None.

Released Germplasms 'Gordon Creek'.

SALTBUSH, FOURWING (*Atriplex canescens*)

Origin Native perennial.

Establishment

Seeding Rate Plant 5 to 10 pure live seeds per hill, 3 to 5 feet apart. Thin plants to desired spacing and ratio of male to female plants when fruiting starts (about 3 years).

Row Spacing 8 to 10 feet between rows.

Seeding Depth 1/8 to 1/4 inch deep.

Seeding Method Hand.

Time of Seeding Fall.

Time of Transplanting Spring.

Plant Material Rooted cuttings. Plant five female plants to each male plant.

Transplant Spacing 8 to 10 feet between plants.

Weed Control Mechanical and chemical following prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Sandy loam to loam to clay-textured soil.

Stand Management

Pest Control

Weeds Cultivation, spot herbicide or hand roguing.



Insects A native bag worm has been known to defoliate plants; appropriate insecticide treatment may be necessary.

Fertilization None.

Irrigation 11 to 13 inches annual precipitation required. When insufficient precipitation occurs, supplemental irrigation is required.

Stand Density Cultivate following seed harvest and spring germination.

Pollination Wind.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Transplanting—40 percent production at second year; 80 to 90 percent the third year following transplanting. Direct seeding—4 years to reach full production.

Production per Acre 400 to 600 lbs/acre at 95 percent purity.

Longevity of Seed Production Stands 15+ years.

Flowering Date July 1 to August 30.

Seed Maturity-Harvest Date October 10 to February 28.

Seed Retention Excellent. Utricles will hang on plants through January. Some utricles will start to fall in February.

Seed Handling

Methods of Seed Harvesting Hand harvest.

Seed Cleaning De-wing with hammermill, 1/4 inch screen -> air screen separator.

Seed Storage Store in dry location.

Seed Characteristics

Seeds/lb 55,000 at 100 percent purity.

Longevity 20+ years.

Seed Fill 50 percent fill is acceptable.

Viability 60 to 80 percent of filled utricles.

Afterripening Maximum germinability not reached for up to 6 months following harvest. Up to 2 months of moist, cool conditions required prior to germination.

Purity 90 to 95 percent; percent of filled utricles varies with environmental conditions.

AOSA Rules Seed quality testing standards are

established and in use.

Released Varieties ‘Rincon’, ‘Wytana’.

WINTERFAT (*Ceratoides lanata*)

Origin Native perennial.

Establishment

Seeding Rate Direct seed
in hills 5 feet apart,
5–10 seeds per hill.
Thin to 1 or 2 plants
per hill after
emergence.

Row Spacing 5 feet.

Seeding Depth $\frac{1}{4}$ to $\frac{1}{2}$
inch.

Seeding Method Hand
seeding or hand
transplanting.

Time of Seeding Fall seed.
Spring and late summer
seeding only where there is
sufficient water and time to
bring up and establish seedlings
prior to summer heat or fall frost.

Time of Transplanting Spring.

Transplant Spacing One plant every 5 feet.

Plant Materials Bare root transplants or
wildlings.

Time of Transplanting Spring.

Weed Control Eliminate weeds and weed seed
with mechanical and chemical fallowing
prior to planting.

Fertilization None.

Irrigation As needed for establishment.

Soils Sandy clay loam to silty clay-textured soil.

Stand Management

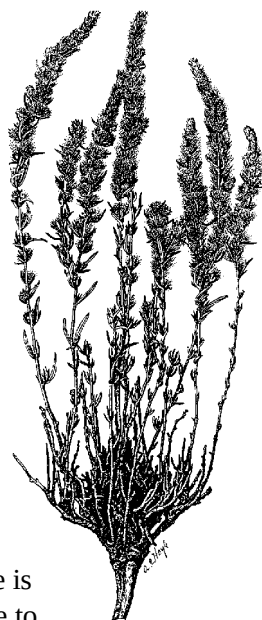
Pest Control

Weeds Mechanical cultivation, spot
spraying or hand weeding.

Insects No known problems.

Diseases No known problems.

Fertilization None.



Irrigation 10 to 12 inches annual precipitation
required. Supplemental irrigation may be
required during dry years.

Stand Density Cultivate following seed harvest
once in the spring.

Pollination Wind.

Seed Production

Years to Produce Seed Crop Following

Transplanting-Seeding Transplanting—
Full seed production reached the third year
following planting. Direct seeding— 4 years
to reach full production.

Production per Acre 300 to 500 lbs/acre at 50
percent purity.

Longevity of Seed Production Fields 10 to 15
years.

Flowering Date May 15 to August 15.

Seed Maturity-Harvest Date Seed matures
following first good frost. General harvest
dates—September 25 to October 25.

Seed Retention Medium retention. Seed is
dispersed by mid-November.

Seed Handling

Methods of Seed Harvesting Hand harvest.

Seed Cleaning Dry -> debearder or hammermill
-> screen -> dry when needed.

Seed Storage Store in dry location.

Seed Characteristics

Seeds/lb 112,000 at 100 percent purity.

Longevity 2 to 3 years.

Viability 35 to 70 percent.

Afterripening Maximum germinability not
reached for up to 2 months following seed
harvest. Stratification is not required.

Purity Acceptable purity, 40 to 80 percent.

AOSA Rules Seed quality testing standards are
established and in use.

Released Varieties ‘Hatch’.

LINE DRAWING CREDITS

1. Anderson, Bernice A., and Arthur H. Holmgren. 1976. Mountain Plants of Northeastern Utah. USU Extension Service Circular 319. 142 p: *Potentilla glandulosa*, *Erigonium heracleoides*, *Solidago canadaensis*, *Tragoposon porrifolius*, *Penstemon cyananthus*.
2. Hafenrichter; A. L., J. H. Schwendiman, H. L. Harris, R.S. MacLauchlan, and H. W. Miller. Grasses and Legumes for Soil Conservation in the Pacific Northwest and Great Basin States. USDA SCS Handbook No. 339. 69 p: *Astragalus cicer*.
3. Herman, F. J. 1954. Notes on Western Range Forbs. USDA Agricultural Handbook No. 293: *Aster chilensis*, *Sphaeralcea coccinea*, *Sphaeralcea munroana*, *Lomatium nuttallii*.
4. Hitchcock, C. Leo, Arthur Conquest, Marion Ownbey, and J. W. Thompson. Vascular Plants of the Northwest. Univ. of Washington Press: *Sphaeralcea grossulariaefolia*, *Osmorhiza occidentalis*.
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6. Jaeger, Edmond C. 1947. Desert Wild Flowers. Stanford University Press: *Penstemon eatonii*, *Penstemon palmeri*.
7. Judd, B. I. 1962. Principal Forage Plants of Southwestern Ranges. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Station paper No. 69, 93 p: *Atriplex canescens*, *Ceratoides lanata*.
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9. USDA. 1937. Range Plant Handbook. US Government Printing Office: *Viguiera multiflora*, *Senecio serra*, *Artivnesia ludoviciana*.
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11. Wasser, C. H. 1982. Ecology and culture of selected species useful in revegetating disturbed lands in the west. USDI, Fish and Wildlife Service. FWS/OBS - 82/56. 347 p: *Balsamorhiza sagittata*, *Sanquisorba minor*, *Linum perenne*, *Penstemon strictus*, *Onobrychis sativa*, *Hedysarum boreale*, *Achillea millefolium*, *Purshia tridentata*, *Kochia prostrata*, *Artemesia tridentata (ssp. tridentata and spp. vaseyana)*.

APPENDIX 1

ECONOMICS OF GRASS SEED PRODUCTION IN UTAH

(From: Grass Seed Production Guide for Utah, Extension Circular EC 437,
Utah State University)

A survey was conducted to compare the costs associated with establishing and maintaining grass stands for seed production in Utah with corresponding expenses in other competitive producing regions. Price information has been obtained for a period of approximately four growing and harvesting seasons. This information has been used to develop representative budgets for establishing and maintaining grasses for both irrigated and dryland production in Utah.

Budgets are developed for establishing the grass stand, and for operations associated with producing, cleaning, and marketing the seed crop.

Cost information is found in the budgets developed and given in Tables 1 and 2. The costs also include certification expenses, assuming certified seed is produced. The funds which accumulate interest include purchase costs, and all variable costs including labor costs.

To be economically viable, the cost of establishment of the grass stand must be recovered during the life of the stand. Therefore, a dual set of representative budgets is developed, with one representing the establishment budget and the other the annual seed production budget. The total cost of establishment is annualized and is included in the total cost of producing the seed. Break-even prices (total costs including annualized establishment costs

divided by the yield of clean seed) are then presented for both representative irrigated and dryland production conditions. Some seed in Utah is marketed and priced on a pure live seed (PLS) basis. Therefore, a break-even price is also derived for the average PLS standard of the grasses. The PLS percentage is calculated as percent pure seed times percent germination. The standard used in deriving the break-even prices uses a minimum 95 percent pure seed and an 80 percent minimum germination. This is representative of crested, intermediate, tall, and pubescent wheatgrasses, bluegrasses, and ricegrasses. Thickspike, bluebunch and western wheatgrasses in addition to orchardgrass, and the wildrye grasses generally have a slightly lower minimum pure seed standard. The bromegrasses and tall fescue would generally have a higher pure seed and percent germination standard. The break-even price would, of course, be lower for seed of higher PLS standard.

Under some dryland conditions it may take up to 2 years to establish the grass stand before a seed crop could be harvested in the third year. This would increase the break-even price from the \$1.32 per pound cleaned (or \$1.74 for the PLS standard) to approximately \$1.44 per pound cleaned (or \$1.90 using the PLS standard) which is much higher than the break-even price under irrigated conditions.

Table 1. Estimated Representative Establishment Costs for Irrigated Grass Used for Seed in Utah, 36 Inch Row Spacing, Per Acre Basis.

Item	Unit	Quantity	Price	Total
Purchases:				
nitrogen	lb.	50.00	.22	11.00
phosphate	lb.	18.00	.18	3.24
herbicide	oz.	40.00	.18	7.20
insecticide	oz.	16.00	.15	2.34
seed	lb.	5.00	1.75	8.75
water	share	.80	13.00	10.40
Total Purchases				42.93
Costs				
	Times	Fixed	Var.	Labor
Operations:				
fertilizer application				3.00
herb./insect. application	3	.76	.32	.26
plowing	1	12.87	6.86	2.15
disking	1	6.76	3.14	.95
harrowing	1	2.16	1.27	.48
planting	1	6.72	3.65	1.64
irrigation	4	8.90	.45	.90
cultivation	2	2.85	1.68	.63
roguing				7.00
Total Operating Costs				82.92
Interest on variable costs and purchases (12% for 6 months)				4.48
Total establishment purchase, operating & interest costs (42.93+82.92+4.48)				130.33
Capitalized cost (9 year stand)				24.45

Table 2. Annual Costs for Production of Irrigated Grass Seed in Utah, Per Acre Basis.

Item	Unit	Quantity	Price	Total
Purchases:				
nitrogen	lb.	60.00	.22	13.20
herbicide	oz.	32.00	.10	3.20
insecticide	oz.	16.00	.15	2.40
water	share	.80	13.00	10.40
Total Purchases				29.20
Costs				
	Times	Fixed	Var.	Labor
Operations:				
fertilizer application	2			5.00
herb./insect. application	3	.76	.32	2.50
irrigation	4	8.90	.45	14.30
cultivation	2	2.85	1.68	7.47
roguing				7.00
windrowing	1	13.59	2.07	16.21
combining	1	custom		25.00
hauling	1		.15/cwt	.75
cleaning		custom	.15/lb.	75.00
certification	1	1.88	2.65	4.53
Total Operating Costs				157.76
Interest on variable costs and purchases (12% for 6 months)				9.54
Total establishment purchase, operating & interest costs				196.50
Total cost including annualized establishment cost		(24.45+29.20+157.76 +9.54		230.95

Break-even price for established crop (per pound cleaned)

\$0.63

Break-even price per pound, pure live seed standard

0.83

APPENDIX 2

IS GROWING CERTIFIED FORB OR SHRUB SEED RIGHT FOR ME?

(Courtesy Ron Stevenson, Stevenson Intermountain Seed, Ephraim, Utah)

(Questions to Evaluate)

1. Am I dissatisfied with the profit my present crops are making?
2. How much profit per acre can I expect to make growing forb or shrub seed?
3. Will any extra profit over what I am presently making be worth the extra work and risk?
4. Can I get the equipment I need to plant, grow and harvest the crop?
5. Can I wait one or two years or more while the crop establishes before I see any returns on my investment?
6. Can I tolerate a potential crop failure?
7. Can I tolerate variation in monetary returns?
8. Do I have the ability to store seed for a year or two to wait for more favorable prices?
9. Do I have the time and will I make the commitment to do “all that it takes” to do it right?

WHAT DO I NEED TO KNOW TO SUCCESSFULLY GROW CERTIFIED FORB OR SHRUB SEED AND MAKE A REASONABLE PROFIT?

(Questions to Answer)

1. Which species do I have the capability of successfully growing in relation to my soils, climate, water equipment, etc.?
2. Which of these species or varieties have acceptable profit potential? (May vary with market conditions.)
3. What price can I expect to sell my seed for?
4. What are my estimated establishment, production, harvesting, and seed cleaning costs?
5. Should I plant just one species or two or more?

6. How many acres should I plant?
7. How do I prepare my seed bed?
8. How do I plant the seed? (Seeding rate, how deep, row spacing, what time of year?)
9. Where do I get the stock seed to plant?
10. How do I manage my crop? How much water and when? What kind and how much fertilizer?
11. What requirements do I need to follow to grow certified seed?
12. What equipment do I need for planting, weed control and harvesting?
13. What weeds will I have to control? Can I use selective herbicides? Which ones and when? Will I have to use hand labor for weed control? Do I have any noxious weeds? What weed seeds can the seed conditioner remove from my seed? Can I sell my seed with some weed seeds in it?
14. When and how do I harvest my seed?
15. Who will I get to clean my seed?
16. Who can I sell my seed to? Do I want a long term agreement with one buyer?
17. How many years will my crop keep producing before I need to replant it?

APPENDIX 3

SEED VENDORS¹

Boyd Goble & Sons
260 North 100 West
Gunnison UT 84635
Ph: (801) 528-3234

Charles Inouye
240 West 300 North
Gunnison UT 84636
Ph: (801) 528-7863

Globe Feed & Seed Co.
Twin Falls ID 83303
Ph: (208) 733-2222

Gooding Seed Company
P.O. Box 57
Gooding ID 83330
Ph: (208) 934-8441

Granite Seed
1697 West 2100 North
Lehi UT 84043
Ph: (801) 531-1456

Intermountain Seed Co.
P.O. Box 62
Ephraim UT 84627
Ph: (801) 283-4383

L & H Seed Co.
4756 West Highway 260
Connell WA 99326
Ph: (509) 234-4433

Jacklin Seed Company
West 5300 Jacklin Avenue
Post Falls ID 83850

Maple Leaf Industries
P.O. Box 496
Ephraim UT 84627
Ph: (801) 283-4701

Palouse Seed Company
P.O. Box 291
Fairfield WA 99012

Plummer Seed Company
228 East 200 North
Ephraim UT 84627
Ph: (801) 283-4844

Poulson Seed Company
2849 Pleasant Valley Road
American Falls ID 83211
Ph: (208) 226-2072

Sharp Bros. Seed Company
Healy KS 67850

Steve Regan Company
4215 South 500 West
Murray UT 84107

Wheatland Seed Inc.
1780 North Hwy 69
Brigham City UT 84302
Ph: (801) 734-2371

Stevenson Intermtn. Seed
488 South 100 East
Ephraim UT 84627
Ph: (801) 283-6639

Wind River Seed
Rt. 1, Box 97
Manderson WY 82432
Ph: (307) 568-3361

Arkansas Valley Seed
4625 Colorado Blvd.
Denver CO 80202
Ph: (393) 320-7500

Curtis & Curtis
Star Route 8-A
Clovis NM 88101

Big Sky Wholesale
Shelby MT 59474
Ph: (406) 434-5011

Southwest Seed, Inc.
13260 Cty Rd 29
Delores CO 81323
Ph: (970) 565-8722

Grassland West
Clarkston WA 99403
Ph: (509) 758-9100

Mt. Valley Seed
1800 South West Temple
Salt Lake City UT 84115
Ph: (801) 486-0480

¹Additional vendors may be available. These vendors are not recommended or endorsed by Utah Division of Wildlife Resources, Utah State University, or USDA Forest Service.

Samples of Seed Tags

FOUNDATION SEED	
	RIND GEISTED STRIKERS VARIETY DOUGLAS CERT. NO. G-1295, LOT 005A WARNING! FVP LICENSED VARIETY
MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES	

TESTED CLASS SEED		
	Species Name	<i>Panicum Tridactylon</i>
	Common Name	<i>Andropogon Desmanthus</i>
	County/State/Elevation	Santa Fe/Utah/5800-6000 ft.
	Geophytes/Herb/Tree	Perennial, Grass/CO
	Cor. # WC-414	Lot # P7013
	Shoot Month, S-31 deg.	Salt, Chemically Free/Free
The seed in this container, with label properly affixed thereto, was produced in accordance with the Seed Certification Regulations and Standards established by the Utah Seed Improvement Association for the TESTED CLASS of purified seed. Complete test data was reported and is incorporated hereon and is available for inspection and seed count analysis only. The tag must be accompanied by a seed analysis and is complete with state and federal seed laws.		
Member of Association of Official Seed Certifying Agencies		

REGISTERED SEED	
	KIND _____ VARIETY _____ CERT. NO. _____ LOT _____ UTAH REGISTERED SEED The seed of this seedling, with few possible official exceptions, was produced in compliance with the Seed Certification Act and the Seed and Variety Act of 1931. This approval is applicable to the Registered class of certified seed. Compliance with law may be obtained by making a label which, when the seedling of parent seed, can be made in compliance with applicable laws. (Utah Seed Act, 1931.) SEEDLING NAME AND USE FOR PROOF OF SEED OFFICE UTAH CHIEF BREWERY, 1000 N. 1000 E., SALT LAKE CITY, UTAH 84103
UNITED STATES ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES	

SELECTED CLASS SEED		
	Species Name	<i>Artemisia tridentata</i> wyomingensis
	Common Name	Wyoming Mtn. Big Sagebrush
	County/State/Elevation	San Luis/Utah/10,000 ft.
	Gen./Placer. ID/Gen.	Gardner Creek/Ut. "Natural"
	Orig. # & DTH	Lot # OC-315
	Shapes, Tr., & S. desc.	Balls; loosely coated
The seed in this container, while not necessarily well tested, was produced in compliance with the Good Certification Practices, rules and standards established by the United States Department of Agriculture for the Official Seed Class of certified seed. Compliance may eventually be required, if based on seed limited representation. Field inspection and seed sample analysis. This may occur by correspondence by a seed and you label in compliance with state and federal seed laws.		
Member of Association of Official Seed Certifying Agencies		

CERTIFIED SEED	
	KIND DRAIN WILDRYE
	VARIETY PACNAR
	CERT. NO. 5-161, 1ST PKG 75-1
UTAH CERTIFIED SEED	
The seed in this container, with label properly placed thereon, has been produced in compliance with the Seed Certification Regulations and standards established by the Utah State Government Association for the Certified class of excellent seed, and is hereby guaranteed to be pure and to contain the minimum number of seeds per pound as required by the Utah Seed Law. This guarantee is made available by a seed breeder or processor in conformity with state and federal seed laws. Utah State Seed Association, 1000 North 1000, Salt Lake City, Utah 84143	
MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES	

SOURCE IDENTIFIED SEED		
	Species Name	<i>Artemisia tridentata</i> ssp./var.
	Common Name	Wt. Sagebrush
	County/State/Elevation	Quinta/Wyoming/6500-7000 ft.
	Geophytum (HAYCO)	---RGR
	Cont. # WC-124	Lot # 961
	Stage: fourth, JM	Soil: Wenchuan (Sandy Loam)
INTERAGENCY: GREEN WYOMING		
The seed in this container, with label properly filled down, was produced in cooperation with the Seed Certification Program and the Bureau of Plant and Soil Conservation, Department of Agriculture, State of Wyoming. It is a source of seed for the seed industry. Compliance by any buyer is required as indicated in label and label to be printed on field receipts and seed sale tags. These tags must be accompanied by a seed analysis form to comply with rules and label regulations.		
Member of Association of Official Seed Certifying Agencies		