HARVESTING, CLEANING & STORING SEED OF WESTERN SHRUBS 1/

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Acquisition of supplies of good seeds from a variety of adapted shrubs is a necessity for many rehabilitation programs, especially in the western states where different shrubs control and characterize the landscape. Because of their ability to grow much better than herbs or trees on many sterile and low precipitation areas, the planting of shrubs is a requirement for developing forage and cover for wildlife and domestic animals on extensive deteriorated, arid ranges. This is just as true for the adequate stabilization of large and small disturbed areas such as deep cuts in the land, old and new mine spoils, gravel pits, and a multitude of roadcuts and fills.

Enough has been learned over the past two decades that seeds of several native western shrubs as well as some adapted outsiders are available for collectors in fairly large quantities. Among these, at least in favorable years, are fourwing saltbush (Atriplex canescens), winterfat (Ceratoides lanata), big sagebrush (Artemisia tridentata), rubber rabbitbrush (Chrysothamnus nauseosus), antelope bitterbrush (Purshia tridentata), Stansbury cliffrose (Cowania mexicana stansburiana), mountain snowberry (Symphoricarpos oreophilus), curlleaf mountain mahogany (Cercocarpus ledifolius), true mountain mahogany (C. montanus), and blueberry elder (Sambucus cerulea). Hopefully, one recent introduction, prostrate kochia (Kochia prostrata), will be available from established seed production areas. However, there is a short supply of seeds, especially of a number of desired subspecies and ecotypes for special areas. Consequently, to get seeds of adapted specific ecotypes for particular areas, it is often necessary for the agency or company to harvest them or do without. Although private collectors are becoming more numerous, often the do it yourself approach is the only sire way for getting the kind of seeds best suited to the site. However, arrangements can be made, in some instances, to have private seed men harvest the seed from specified places.

It is the purpose of this review to briefly relate what is presently being done to harvest and clean shrub seeds to make them available for wild land areas, and to point out some of the future needs for this class of plants. Cleaning and storing are important parts of handling the seeds and making them available. Compared with harvesting and cleaning and getting seeds ready to plant, storage is less demanding but is still a pertinent aspect and must be done properly to keep good seeds available.

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Seeds of shrubs for the most part are largely obtained through hand harvesting from wild land stands. Attempts to establish seed orchards for production of seed have so far been minor. However, some of this has been done and more is being planned. Seed orchards are the procedure we must take for the production of certain exotics such as prostrate kochia. But harvesting seed from wild land stands must continue to be the major way of getting needed seeds for at least a few years. Considerable effort has been given to collecting seed from selected stands of particularly suited ecotypes for specific areas. Hopefully this will be encouraged and extended. Also some progress is being made in developing equipment for more efficient harvest. The status of this is briefly outlined.

Harvesting by Hand

Picking or stripping seeds by hand from the shrubs is the most widely used procedure. Seeds are stripped or flailed directly into canvas hoppers of various designs or into tubs, baskets, or boxes (fig. 1). These may be attached to the individual harvester by shoulder straps, but in some instances, appropriate receptacles may be set under the bushes and the seeds stripped into them. Some plumed seeds are shook onto canvas, heavy cloth, or plastic spread under the bushes. This is a favorite technique for plumed seeds such as curlleaf mahogany, Apache plume (Fallugia paradoxa), and Stansbury cliffrose. Also, this procedure has been employed to good advantage in obtaining the fruits of Utah serviceberry (Amelanchier utahensis) and tatarian honeysuckle (Lonicera tatarica), as well as pods of Siberian peashrub (Caragana arborescens), and common bladdersenna (Colutea arborescens). In some instances where the fruits have recently fallen, as may be found for curlleaf mahogany and Stansbury cliffrose, they can be picked directly off the ground. An ordinary sweep rake has been used in raking them into piles from which they are forked into sacks. It is important that this be done soon after they fall or the fruits are lost to field mice, chipmunks, birds, and other small animals.

Using ladders to prune off the high branches bearing heavy crops of fruits, then stripping the fruits off the branches has proved fairly efficient in getting fruits of such higher-growing shrubs. This has worked well for black chokecherry (Prunus virginiana melanocarpa), blueberry elder, and salt-tree (Halimodendron halodendron).

Of course, a resourceful and good collector innovates ways of getting fruits and seeds from shrubs. A dandelion rake, expertly used has been a method of getting seeds off a shrub intc various kinds of spreads laid under the bushes.

Mechanized Harvest

with increasing demands for snrub seeds, more intensive attention is being given to harvesting seeds from shrubs by machines. Some good progress has been made and continues to made, but use of machine-type harvesters would probably still

Fig. 1.--Two types of shoulder hoppers used for collecting a variety of wild land shrub seeds such as antelope bitterbrush, Stansbury cliffrose, and mountain mahogany.

Fig. 2.--One model of vacuum seed harvester being used to pick fourwing saltbush fruits off the ground.

Fig. 3. Experimental model of a back-pack seed harvester used in obtaining seed from a variety of shrubs. This equipment is most effective for plumed seeds.

considered in the trial stage. However, conventional approaches work well where the land is sufficiently level that a machine can be pulled by a tractor or 4-wheel drive vehicle. Actually, a small combine has been found effective in harvesting seeds of some low stature shrubs. Prostrate kochia, planted in 3-foot wide rows on level land, has been handily combined. The technique could be used to advantage on level wild land stands or orchards of winterfat, black sagebrush, (Artemisia nova), and various subspecies of low rabbitbrush (Chrysothamnus viscidiflorus). A low-growing form of fourwing saltbush (Stroh and Thornburg 1969) was successfully harvested in Bridger, Montana with a tractor-drawn combine. Where the shrubs are of uniform height, like some ecotypes of vasey big sagebrush (Artemisia tridentata vaseyana), they could likely be combined. Bluegrass seed strippers drawn by 4-wheel drive vehicles are successfully used in harvesting winterfat, various subspecies of low rabbitbrush, and black sagebrush. A reel-type harvester mounted on a jeep has proven successful in harvesting big sagebrush and rubber rabbitbrush.

Various kinds of vacuum-type seed harvesters have been used and are being developed for harvesting seeds of shrubs of wild land stands. These are coming into wider use, especially for small plumed seeds. A weakness of these is that the seeds must go through the impellor which may damage many. However, small seeds and those having indurated coverings such as utricles of several of the saltbushes are usually not damaged. A successful large custom-made seed harvester developed by the Forest Service, San Dimas Equipment Center (fig. 2) in which the seed circumvents the impellor has been successfully and widely used by Region 3 of the Forest Service in harvesting seed in large amounts of fourwing saltbush, cliffrose, and true mountain mahogany. Custom-made backpack vacuum seed harvesters are also being developed at the San Dimas Center for harvesting seed by one man walking over rough terrain (fig. 3). The special-made vacuum seed harvesters, noted above, have overcome the problem of seed damage. Even so, a number of commercial vacuum seed harvesters where seeds go through the impellor mechanism have been successfully used for harvesting seeds of several species, especially those having small seeds such as black sagebrush and low rabbitbrush. However, it has been found that oven any slight damage usually has deleterious effects on the viability of the seed.

Processing

The techniques for processing shrub seeds to make them available and useable vary widely. The best equipment we have found for separating seeds from fleshy fruits such as berries and pomes as well as some dry fruits such as achenes has been the Dybvig separator (fig. 4). It is now widely used. It pulps the flesh off the seeds, after which they are dried, then later cleaned up well by a fanning mill. The machine consists of a plate spinning at the bottom of a seed hopper. The adjustable, flanged plate is set to leave an opening just smaller than the size of the seed to

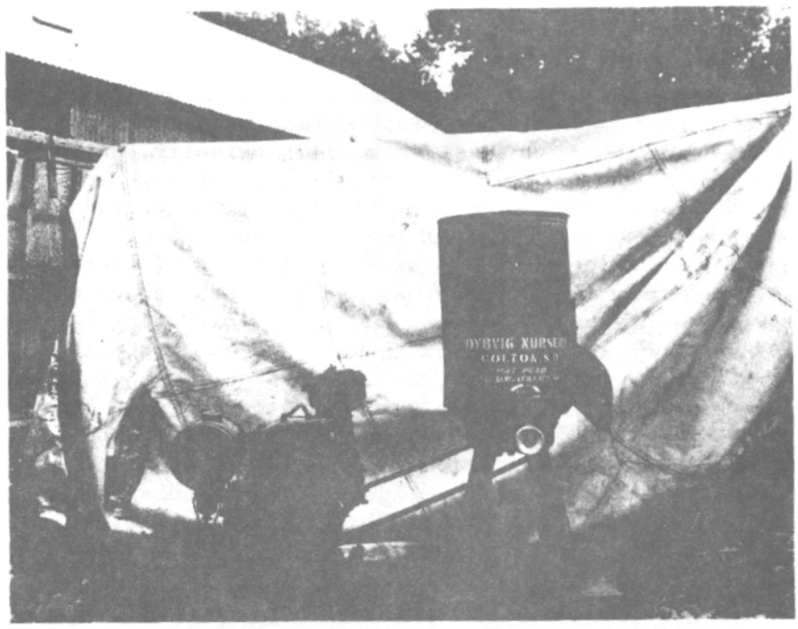

Fig. 4. The Dybvig seed cleaner is efficient for removing pulp from fleshy fruit. Seeds from pulp are prepared for better germination and mechanical seeding.

Here seeds are stacked in piles.

be cleaned. It can be rotated at various speeds. It is the fruit rubbing against the plate that removes the flesh from the seed. The actual seed of fleshy fruit is worked out of the machine through the clearance around the plate by a stream of water. Treatment will also break the seeds out of a number of the dry fruits and they are expelled in the same manner but without water.

There are a number of other types of macerators (U.S.D.A. Agric. Handb. No. 506) but we have not found one that excels this equipment, especially for fleshy fruit. For very small lots, a home blender has been used to some advantage. To reduce possible damage to the seed, the steel blades can be replaced by heavy rubber ones.

Seeds of most fleshy fruits are separated effectively by flotation in water. Empty seeds and debris either float or sink more slowly than full seeds. Macerated material left with seeds are placed in a garbage can or washtub and the pulp and unfilled seeds are floated off over the edge of the tipped receptacle. A stream of water from a hose directed from an angle is necessary to create a rotary swirling and lifting effect. Slight stirring of the material in the bottom of the receptacle helps.

Wet seeds are surface-dried on canvas, plastic, or concrete. Final cleaning with an ordinary separator blows away remaining foreign materials and empty seeds.

Storage

Seed of shrubs have stored well in an open metal warehouse in Ephraim, Utah. They have been kept in various types of containers including cloth and paper sacks, garbage cans, metal files, and wooden boxes (fig. 5). Many of the experimental accessions have been merely in manila packets and placed in the metal file cases in the warehouse.

The highest summer temperature of the warehouse has been 90° F (32°C) and the lowest temperature has been about 0° F (-18°C). The average overall year-long temperature has been about 50° F (10° C). During the months of December, January and part of February, the day-long temperature remains below freezing. After this there is a general warming till July and then a general cooling to the coldest month, January.

We have found the most important element in good keeping quality of seed in a warehouse is to make sure the seeds are well dried before they are put away and then kept dry. Here in the arid climate of central Utah, no special techniques have been necessary other than subjecting thin layers of seed to the direct rays of the sun. Some daily moving of seed about and keeping them thinly spread on canvas, cement or plastic speeds up the drying process. In more moist or humid climates, some means of artificial drying may be a necessity (U.S.D.A. Handb. No. 450 1974, U.S.D.A. Handb. No. 506 1978). Waiting until the seed is well mature and

ready to harvest speeds up drying time of seeds from dry fruits and is a helpful aid to better longevity of the seed from fleshy fruits as well. Of course, fleshy fruits that must have the seeds extracted from pulp in water, such as in a Dybvig cleaner, have a relatively longer drying period. However, we have generally found that waiting to harvest the seeds until the pulp around the seed is mature is usually wise. Although seeds may germinate, lack of good maturity significantly reduces longevity of seeds, regardless of the species.

Shrubs have varied widely with respect to the longevity of their seed in our warehouse storage. Two factors most important in this appear to be the hardness or thickness of the wall over the embryo and occurrence of some dormancy.

Two shrub species in the chenopod family (winterfat and fourwing saltbush) illustrate what the difference in hardness and thickness of the seed coat means to longevity. The fruit of both species is a utricle. The wall surrounding the embryo of winterfat is thin and fragile, whereas, the wall surrounding the embryo of fourwing saltbush is tough and fairly thick. Winterfat has a longevity from two to three years compared to fourwing saltbush which has a longevity from six to 10 years plus. In the case of fourwing saltbush, we do find considerable variation in longevity of germination of seeds from different sources. This, as well, appears to be associated with the thickness of the wall surrounding the embryo.

Following is a list of species classified into two categories: those that hold up in longevity over five years (Table 1) and those that have shorter periods of longevity, usually less than three years (Table 2).

In making this classification, we have used a standard of no less than 70 percent of the first year's germination. Because of the large subject and involvement of factors associated with germination of western shrubs, we have left this problem as a paper for another occasion such as this.

Table 1. List of shrubs having a longevity of seeds of usually more than 5 years.

Scientific Name	Common Name
Amelanchier alnifolia alnifolia	Saskatoon serviceberry
Amelanchier utahensis utahensis	Utah serviceberry
Arctostaphylos patula	Greenleaf manzanita
Atriplex canescens	Fourwing saltbush
Atriplex confertifolia	Shadscale saltbush
Berberis repens	Creeping barberry
Caragana arborescens	Siberian peashrub
Ceanothus cuneatus	Wedgeleaf ceanothus
Ceanothus martinii	Martin ceanothus
Ceanothus prostratus	Squawcarpet ceanothus
Ceanothus sanguinius	Redstem ceanothus
Ceanothus velutinus	Snowbrush ceanothus
Cercocarpus ledifolius	Curlleaf mountain mahogany
Cercocarpus montanus	True mountain mahogany
Colutea arborescens	Common bladdersenna
Cornus stolonifera	Redosier dogwood
Cotoneaster acutifolia	Peking cotoneaster
Cowania mexicana stansburiana	Stansbury cliffrose
Ephedra nevadensis	Nevada ephedra

Table 1. Continued

Scientific Name	Common Name
Ephedra viridis	Green ephedra
Eriogonum heracleoides	Wyeth eriogonum
Forestiera neomexicana	New Mexican forestiera
Halimodendron halodendron	Siberian salt-tree
Lonicera tatarica	Tatarian honeysuckle
Peraphyllum ramosissimum	Squawapple
Prunus virginia melanocarpa	Black common chokecherry
Purshia glandulosa	Desert bitterbrush
Purshia tridentata	Antelope bitterbrush
Rhus trilobata trilobata	Skunkbush sumac
Ribes aureum	Golden currant
Rosa woodsii ultramontana	Woods rose
Salvia dorrii carnosa	Purple sage
Sambucus cerulea	Blueberry elder
Sambucus racemosa pubens microbotrys	Red elder
Shepherdia rotundifolia	Roundleaf buffaloberry
Sorbus scopulina scopulina	Greenes mountain ash
Symphoricarpos oreophilus oreophilus	Mountain snowberry

Table 2. List of shrubs having a longevity of seed of usually less than five years.

Scientific Name	Common Name
Acer glabrum	Rocky Mountain maple
Acer grandidentatum	Bigtooth maple
Artemisia nova	Black sagebrush
Artemisia tridentata tridentata	Basin big sagebrush
Artemisia tridentata vaseyana	Mountain big sagebrush
Ceratoides lanata lanata	Winterfat
Chrysothamnus nauseosus albicaulis	White rubber rabbitbrush
Chrysothamnus nauseosus consimilis	Threadleaf rubber rabbitbrush
Chrysothamnus viscidiflorus lanceolatus	Mountain low rabbitbrush
Fallugia paradoxa	Apache plume
Fraxinum anomala	Singleleaf ash
Grayia brandegei	Spineless hopsage
Grayia spinosa	Spiny hopsage
Kochia prostrata	Prostrate kochia
Sarcobatus vermiculatus	Black greasewood
Syringa vulgaris	Common lilac

geneticists and support personnel or contract the work out. Many prefer to contract the work out. Some northwestern contractors provide a full range of tree improvement services. These include, tree selection, cone and scion collection, cone and seed processing, test site preparation and planting, progeny test measurements, controlled pollinations and other activities common to tree improvement programs. The following lists the northwestern firms and range of services offered.

* Full range of services covers tree selection, cone and Scion collecting, cone and seed processing, test site preparation and planting, progeny-test measurements controlled pollinations, and other activities common to tree improvement programs. (Courtesy of Joe Wheat - The Industrial Forestry Association

Contractor	Tree Improvement Services offered
Barnes Tree Improvement Co. P.O. Box 666 Cottage Grove, OR 97424 Ph.: (503) 942-4066 Jerry Barnes	Full range*
Brown Seed Co. 12101 N.E. 28th St. Vancouver, WA 98660 Ph.: (206) 892-4111 Charley Brown	Cone & seed processing, seed storage
GeneTechs 870 N.W. 110th Portland, OR 97229 Ph.: (503) 641-3243 Dick Corter	Full range*
Bob Graton 120 Pharr Lane Ph.: (707) 458-3284 Cresent City, CA 95531	Tree selection, Cone & scion collecting, Progeny-test establishment
Reese Bros. P.O. Box 630 Kelso, WA 98626 Ph.: (206) 636-4090	Full range* except for cone & seed processing
Silvaseed P.O. Box 118 Roy, WA 98580 Ph.: (206) 843-2246 Bent Gerdes	Cone collecting, cone & seed processing, seed storage
Simpson Timber Co. P.O. Box 308 Albany, OR 97321 Ph.: (503) 926-6055 Lee Pugsley	Cone & seed processing, seed storage

The above, then, describes the commercial services offered in the Northwest and nationally of interest to those working with forest tree seed. Contact with one frequently leads to a chain of sources. If this doesn't provide the specific information needed, you can always check with Forest Service, State and Private Specialists located in their Regional Offices in Portland, San Francisco, Missoula, Denver, Ogden and Albuquerque. Like Frank, they may not be seed specialists but they may well be able to put you in touch with folks who are.