

TECHNICAL NOTE

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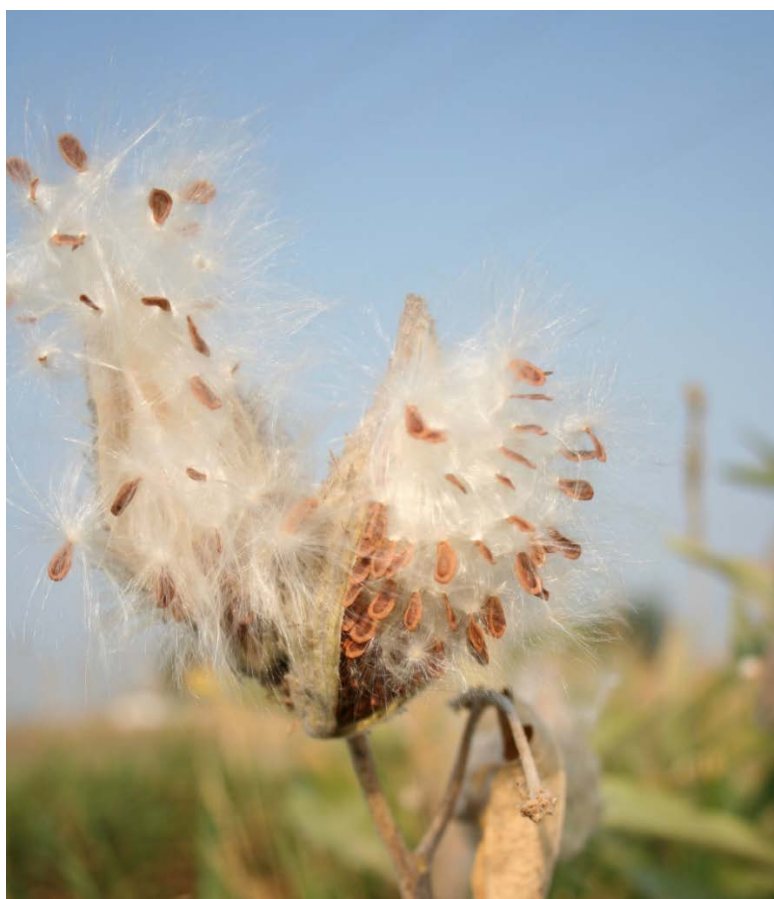
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HOW TO COLLECT AND PROCESS WILDLAND SHOWY MILKWEED SEED

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This Technical Note provides guidance on hand-collecting and processing showy milkweed seed from native stands for conservation plantings in the Intermountain West.

Introduction

Native forb seed is in high demand from a growing interest in supporting native wildlife habitat (Plant Conservation Alliance 2015). As insects are an integral part of the food web in terrestrial ecosystems and comprise a significant part of the diet of most birds and many mammals, certain forb species pose an even greater conservation significance due to their close association with wildlife species of concern (Dumroese et al., 2016). Milkweed species, while once widely considered a nuisance to agriculture and livestock production (Whitson et al., 1996), are more recently experiencing increased demand for seed and plant production as a result of the recognition of its value for native pollinators and its critical importance as the host plant for the declining Monarch butterfly (*Danaus plexippus*) (Borders and Lee-Mäder 2014; Landis and Dumroese 2015; Lee-Mäder et al., 2014; Tilley et al., 2018; Waterbury and Potter 2018; Xerces 2018). Milkweeds are also host plants for a number of other butterfly and moth species (Borders and Lee-Mäder 2014). Likewise, milkweeds are visited by a wide range of other insects, including honey bees, native bees, and agriculturally beneficial insects.

Milkweed species are crucial to the survival of monarch butterflies, whose western population has experienced an estimated 74% population decline since the mid 1990's (Schultz et al., 2017) (Figure 1). More recent studies indicate that the decline may be closer to 95% (Vaughan, 2018). Research clearly shows that declines in milkweed populations are linked to recent reductions in monarchs (Pleasants and Oberhauser 2013; Waterbury and Potter 2018). Adult monarchs will only lay eggs on milkweed plants, which comprise the sole food source for the developing larva



Figure 1. Milkweed (*Asclepias* sp.) are the sole host plant for monarch butterflies and an important food source for a variety of insects. Photo by John Anderson. Hedgerow Farms.

(caterpillar). Cardenolides, a natural chemical complex found in milkweed, are palatable to monarch caterpillars and other lepidoptera larva that feed on this plant. As the developing caterpillars feed on milkweed, the cardenolides are sequestered and accumulate in their bodies, protecting the caterpillars by making them less palatable to birds and other predators (Borders and Lee-Mäder 2014).

In addition to serving as the host plant for monarch caterpillars, milkweeds provide a critical nectar source for migrating adult monarchs (Alonso-Mejia et al., 1997). These migrations span hundreds of miles from over-

wintering sites in Mexico or the California coast to Idaho, Oregon and Washington, and take multiple generations to complete. (Borders and Lee-Mäder 2014; Morris et al., 2015). Milkweed patches in the landscape provide critical breeding and nectaring sites throughout this long migration without which, monarchs would not survive.

Besides being of critical importance to monarchs and other Lepidoptera species, milkweed has great value to native bee populations. Unpublished data of pollinator visitation to milkweeds throughout the west indicated 134 different native bee species representing 30 genera nectaring on milkweed (Ikerd 2018). Milkweed may also be of special importance to specific populations of native bees. Records further show frequent milkweed visitation by bumble bees, including four species identified as of special concern; *Bombus affinis*, *B. occidentalis*, *B. pensylvanicus* and *B. terricola*. (Borders and Lee-Mäder 2014).

Milkweed also appears to be very attractive to honey bees (*Apis mellifera*), and numerous sources have recorded frequent use of this plant by honey bees in a variety of geographic areas across many different landscapes (Krochmal 2016) (Figure 2). Bee keepers generally consider milkweed an excellent ‘honey plant’, and it is estimated that a single honey bee colony can collect up to 17 lbs of nectar from milkweed in a single day (Borders and Lee-Mäder 2014). Abundant nectar translates to abundant honey, and beekeepers have reported honey production averaging 50 lbs per colony when honey bees are foraging on milkweed (Border and Lee-Mäder 2014).



Figure 2. Showy milkweed is a valuable resource for European honey bees as well as native bee species. Photo by Derek Tilley.

A less well-known fact about milkweed is its value as a ‘conservation biocontrol’ (CBC) plant (Fiedler et al., 2008; Border and Lee-Mäder 2014).

Conservation biocontrol is a practice whereby insects that are natural enemies of crop pests (aka ‘beneficial insects’) are attracted into an area through the creation of appropriate habitat, such as preferred nectar plants. Many common beneficial insects rely on nectar to supplement their diets, or as an exclusive source of food during specific periods of their life-cycles. Milkweed visitation records and observations include a wide array of beneficial insects such as lady beetles (Coccinellidae), predatory bugs (many families), lacewings (Neuroptera), predatory thrips (multiple families), minute pirate bugs (*Orius* spp.), hover flies (Syrphidae), parasitic wasps (multiple spp / families) and tachinid flies (Tachinidae) (James et al 2016). Unpublished data from the Utah State University Bee lab recorded at least six species of predatory wasp visiting milkweed (Ikerd 2018), and another study linked the presence of milkweed to increased parasitism rate of leaf-footed plant bugs in cotton (Tillman and Carpenter 2014). Finally, in a study evaluating and comparing various CBC plants in a Washington state vineyard, showy milkweed attracted more beneficial insects than any other plant in the study area (James et al., 2016).

In some key portions of the monarch’s western migration, notably the Snake River Plains in Idaho, showy milkweed is the most abundant milkweed species, especially in riparian corridors frequented by monarchs, and therefore critical to the perpetuation of the monarch life cycle in the

west (Dumroese et al., 2016; USDA NRCS 2018). Showy milkweed is a native herbaceous perennial that spreads from seed and rhizomes, producing stems that grow to 1.5 to 5 ft tall. The gray-green leaves are opposite, 4 to 8 in long, oval, and covered in velvety hairs. The stems and leaves exude a milky latex sap when cut. Flowers are in loose clusters at the top of the stems and are whitish to pinkish in color. Individual flowers look like crowns, with the corolla (petals) reflexed, and hoods above the corolla. Plants flower from May to September. Thick seed pods averaging 3 to 5 in long split down one side in the fall to release reddish-brown, flat seeds. Attached to each seed is a tuft of white, silky hairs, botanically known as coma, but more commonly referred to as floss, that allows them to be dispersed by wind (Welsh et al., 2003).

Showy milkweed is adapted throughout the west in a broad range of moisture conditions (Figure 3). In semi-arid parts of the Intermountain West it is very commonly found along canal banks and riparian sites and in sub-irrigated or occasionally flooded wetlands with sedges and rushes (Welsh et al., 2003). Populations can also be found however in very dry sites receiving less than 9 in of annual precipitation (personal obs.), though these populations are likely to be located in depressions where water accumulates. In areas that receive more precipitation, it tends to be a species of open fields, meadows and forest clearings. In the arid Southwest it is more commonly found at higher elevations in openings in coniferous forests (Kearny and Peebles 1951).

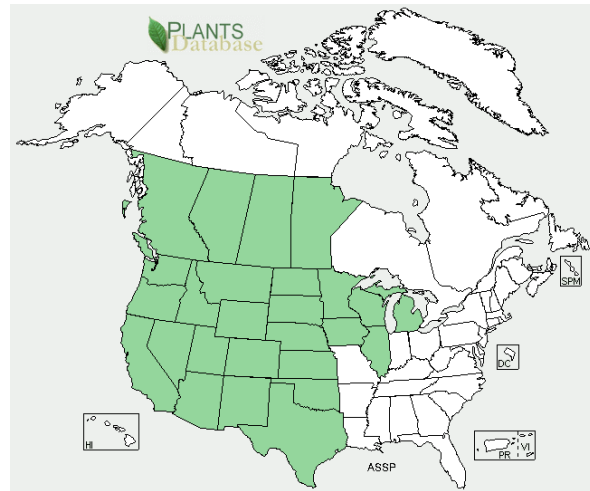


Figure 3. North American distribution map of showy milkweed. USDA The PLANTS Database.

Showy milkweed has been produced in limited quantities in agricultural settings for hypoallergenic fillers in pillows and comforters (Knudsen and Zeller 1993) and is more recently being explored for seed oil for use in soaps and personal care products (Evangelista 2007). Knudsen and Zeller (1993) report using a “modified ear corn picker” for harvesting milkweed seed pods for floss; however, they do not report on seed retention or the seed’s viability following processing. Seed gained as a byproduct of floss production should not be used for conservation use as it has not been matched to local ecotypes (Landis and Dumroese 2015; MonarchWatch 2018) and would likely not contain sufficient genetic diversity for native site restoration. Ecoregions of the United States (Bailey 1994) are currently being used as guidelines for seed transfer zones of milkweed species for use in conservation and restoration plantings (Landis and Dumroese 2015; MonarchWatch 2018).



Figure 4. Variations of the milkweed pod surface can be indicative of different clones. This information is useful in assuring that seed is collected from a sufficient number of individuals for a broad genetic base. Photos by Derek Tilley.

Capturing a broad genetic diversity in milkweed seed is an important consideration for wildlife habitat plantings. Genetic diversity can provide insurance against unforeseen ecological changes such as drought or pathogens. Showy milkweed can produce large clonal stands spreading as much as 30 to 60 ft in the right soil conditions. Often different clones can be separated visually by looking at morphological cues such as leaf size or shape, flower color and number of flowers per head. During seed collection, the surface of the seed pods can be a very indicative feature of distinct clonal stands. Some patches will have very smooth pod surfaces with relatively few bumps or prickles, while others will bear pods with numerous soft prickles making them appear rather spiny (Figure 4). Seed collectors should collect from numerous clones within an area to capture the full genetic diversity of a site and not create any unnecessary genetic restrictions in restoration plantings.

Seed Collection

Moderate-intensity collection of showy milkweed seed should not significantly affect the longevity or natural recruitment of native sites due to the rhizomatous, perennial nature of the species (Meissen et al., 2015; Meissen et al., 2017). That said, an individual area should not be stripped entirely of milkweed seed during the collection process, particularly in regions where milkweed is less common. This will help facilitate the natural spread of the plant. Likewise, seed harvest typically occurs late enough in the summer that it is unlikely to affect monarch butterfly or caterpillar foraging (Figure 5).



Figure 5. Hand collecting of showy milkweed with woven sacks occurs after seed has ripened and insects are no longer foraging for pollen or nectar. Photo by Derek Tilley.

Judging the most efficient time for seed harvest can be difficult; however, a quick look at the seed can help in decision making. Milkweed seed goes through a sequence of color transitions as it ripens in the pod (Figure 6). It starts as a creamy whitish green color, then pink and finally a dark brown. Unfortunately, the pods ripen on the plant indeterminately, that is, the pods on one plant won't all be fully ripe at the same time, and it is very difficult to determine seed maturation without opening the pod. When fully ripe, the pods will begin to split open, the coma will dry and the seed will shatter and disperse. However, targeting seed collection of strictly

fully ripe pods would necessarily require numerous visits to a site to collect all the available seed. Luckily, we have found that the seed undergoes a significant amount of after-ripening in the pod following harvest, so one or two visits to a site is usually sufficient. After-ripening is so pronounced, in fact, that it may be worth investigating just how early showy milkweed can be harvested without significant declines in viability. It may be possible to mechanically harvest seed prior to pod break with a single pass of a corn picker and still maintain high levels of seed germination.



Figure 6. Seed ripeness and optimum harvest time can be judged by opening a few pods in each stand and examining the seed color. Seed is a dark brown when fully mature, but the seed can be harvested just prior to maturity and allowed to after-ripen while drying. Photo by Derek Tilley.

Once a few pods start to split, the rest of the stand is close enough to harvest everything. Open a few randomly selected pods from each clone to check the seed maturity. If there are some brown seeds present, the rest of the stand should be ready to harvest. We hand-pick pods and place them into large sacks to transport to a drying area. The pods are stored and dried in loosely woven

burlap sacks, which are placed in a sunny area to dry or placed in an open room with fans to assist drying (Figure 7). The burlap bags are shaken and flipped daily to allow maximum air-flow and to expedite drying. This also prevents pods from molding which can be a problem if the bags are left on one side for too long. The drying process takes two to four weeks depending on conditions. Drying is complete when the pods are crunchy and opened. There are approximately 240 seeds per pod and 70,000 to 80,000 seeds per lb; therefore approximately 300 pods are needed to produce 1 lb of clean seed.



Figure 7. Seed pods are dried in loosely woven burlap sacks for several weeks before processing. The bags are turned periodically to assure even drying and prevent fungal infection. Photo by Derek Tilley.

The exact timing of seed maturation varies by region and by year. In the Upper Snake River Plains of Southeast Idaho seed harvest occurred as early as August 25 in 2016, while in the same location seed wasn't ready to harvest until September 20 in 2017. Likewise, in 2018 harvesting occurred on August 20 in the Boise area of southwestern Idaho, August 25 in southeastern Idaho, and September 10 in the Bighorn Basin of Wyoming.

Seed Processing

Once the seed is dry, we empty the contents of 1 or 2 burlap sacks onto an 8 x 4 ft wooden cleaning frame lined with 0.5 in screen (Figure 8). The frame is placed over a clean shop floor or a large tarp. The seed and pods in the frame are raked and lightly beaten repeatedly using hay forks or rakes to help break the seed from the coma and release the seed from the pods. The seed and a small amount of inert matter (pod pieces, etc) falls through the screen and onto the tarp, while larger pieces and the fluffy coma remain above. The coma can be discarded, burned, or retained for use in hypoallergenic pillow stuffing or crafting. The Xerces Society and Monarch Watch have constructed powered milkweed seed and floss separators (Borders and Lee Mäder 2014; MonarchWatch 2018), but we have not compared the time or labor inputs of the two systems.



Figure 8. Dried seed and pods are raked over a wire mesh screen to separate vegetative material and floss from the seed. Photo by Derek Tilley.

For smaller lots of seed, we have also used a shop-vac to separate the seed from the coma (Figure 9). This technique is quite handy if the material is loose and not matted. When sucked into a shop-vac, the seed and coma separate with the coma clumped in the upper part of the tank around the filter, while the seed and heavier inert matter fall to the bottom. This method is suitable for very small batches, but if too much material is fed into the vacuum, there won't be enough free space for seed to move in, and it will remain hung up in the floss. We also find that the vacuum tank needs to be emptied and floss removed from the filter periodically to prevent build-up.



Figure 9. Small collections can be quickly cleaned using a shop vac. Photos by Derek Tilley.

Staff at the Corvallis Plant Materials Center use a small plot combine to perform the rough seed and floss separation (Figure 10). Dried material is carefully fed by hand into the combine header, and the seed falls through the sieves while the coma is expelled out the back. This process, while messy, is the quickest means for a quick cleaning; however, a final cleaning is required to produce a high-quality seed lot.



Figure 10. A quick, rough screening of seed from other material can be accomplished using a stationary combine. Photo by Amy Bartow.

After the initial separation, either from the screen or vacuum or combine, the seed can be cleaned to high levels of purity using an air-screen cleaner with 5.50 mm top screen and 3.15mm bottom screen and light air. This will remove any leftover bits of pod, leaves or weed seed and allow for smooth flow through seeding equipment. Following these techniques, we typically see Tetrazolium test results of over 95 percent and purities between 95 and 99 percent.

Summary

Increased concern for monarch butterfly and other beneficial pollinator habitat has created a demand for high-quality wildland collected milkweed seed. Native wildland populations of showy milkweed are abundant enough in many locations to provide large quantities of region-specific seed if fully utilized. Hand harvesting and simple tools for seed processing can be employed by low-tech seed collectors to produce moderate volumes of seed with the potential to restore or create many acres of monarch and pollinator habitat. Harvesting limitations due to indeterminant pod and seed maturation may be overcome by early harvesting and allowing seed to after-ripen prior to processing. Additionally, the techniques and equipment described here would likely work on other milkweed species with similar characteristics.

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