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Rancho Santa Ana Botanic Garden

PROCESSING SEEDS

of California Native Plants for Conservation, Storage, and Restoration

WALL

MACDONALD

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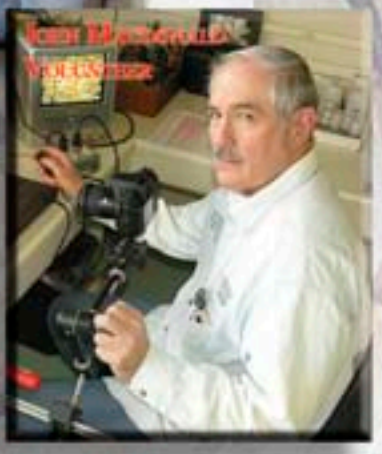
To see things in the seed, that is genius

Lao Tzu

Rancho Santa Ana Botanic Garden



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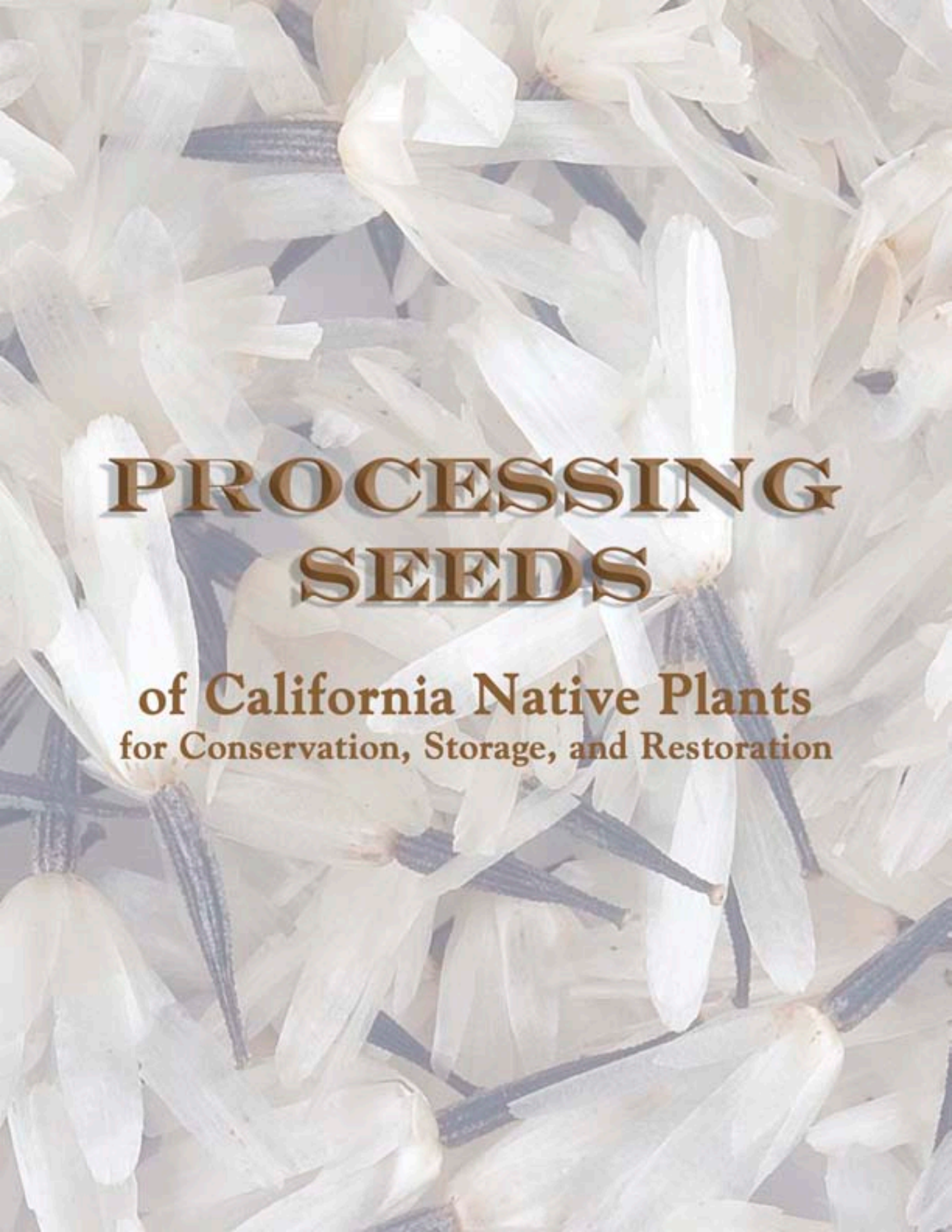

PROCESSING SEEDS

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We have made every effort to make the information in the manual as accurate as possible. However, the seed collection, storage conditions, and the equipment used may differ from that at RSABG and therefore your results may differ. RSABG cannot be responsible for any injuries, damage to seeds, or other losses due to using the information contained in the manual.

If you have comments or questions about this manual, or suggestions for improving or adding to the processing procedures, please contact Curator / Seed Conservation Program Manager by telephone or email.

Front outer cover photograph: *Cymopterus gilmannii* (Gilman's cymopterus)
Inner cover photograph: *Nicolletia occidentalis* (Mojave hole-in-the-sand plant)
Previous page cover photograph: *Achyrachaena mollis* (blow wives)

Table of Contents

Preface

In *Seeds, The Yearbook of Agriculture* (1961), published by the United States Department of Agriculture, Victor R. Boswell eloquently writes in the chapter What Seeds Are and Do: An Introduction...

> Seeds are many things.
>
> Above all else, they are a way of survival of their species. They are a way by which embryonic life can be almost suspended and then revived to new development, even years after the parents are dead and gone.
>
> Seeds protect and sustain life. They are highly organized fortresses, well stocked with special supplies of food against long siege.
>
> Seeds are vehicles for the spread of new life from place to place by the elements and by animals and people.
>
> Seeds are food for man and animals and other living things.
>
> Seeds are raw material for the fashioning of myriad products by people.
>
> Seeds are wealth. They are beauty. They are a symbol—a symbol of beginnings. They are carriers of aid, of friendship, of good will.
>
> Seeds are a source of wonder. They are objects of earnest inquiry in man's ceaseless search of understanding of living things.
>
> Seeds of unwanted kinds are as enemies; they are a source of trouble.
>
> Seeds are many things, but everything about seeds—their numbers and forms and structures—has a bearing on their main purpose, to insure continuing life. Seeds are containers of embryonic plants, the embryos of a new generation.

Acknowledgments

This manual is the result of the efforts of many persons, including those who contributed seed to the extensive wild-origin collections at the Rancho Santa Ana Botanic Garden. It also would not have been developed without the Seed Conservation Program volunteers and paid staff, all who have assisted in the development and refinement of many of the seed processing methods and provided helpful comments and suggestions along the way. In particular, we would like to thank Vanessa Ashworth, Linda Worlow, Jerry Baskin, Genevieve Arnold, and Norma Standard for the many hours they invested in the editing and data entry for this manual, and writing of the glossary. We are also appreciative of the support this program receives from both the current and past administrations and from the Rancho Santa Ana Botanic Garden Board of Trustees. Finally, we offer our gratitude to the RSABG Volunteer Organization and Volunteer Emerita Fay McGartland for their enthusiastic support of this project, and the funding they have provided for the first printing of this manual.

Michael Wall, Curator / Seed Conservation Program Manager
John Macdonald, Photographer / Garden Volunteer

Introduction

This Seed Processing Manual has been developed from the methods documented and the seed images recorded over a ten-year period by the Rancho Santa Ana Botanic Garden Seed Conservation Program. Information on seeds and the processing techniques described in this manual are limited to plant species native to California and northern Baja California, Mexico, but the general techniques will be applicable to other physiologically or taxonomically related species.

The species included in this manual were initially selected based on what species were processed and on what information we had accumulated over the first ten years since the project was initiated. Later we added species that we felt were particularly challenging to process and clean, those whose seed or fruits were difficult to identify, and those species that would add to the diversity of seed and fruit types represented in this manual.

Today there is a growing number of governmental agencies, small commercial businesses, and not-for-profit resource, environmental, and community service organizations that have the need to collect, clean, and process relatively small seed collections from local native plant populations. High quality, local-source germplasm collections are a valuable resource for restoration, conservation, and stewardship of our natural biological communities.

Using this manual

Most of the techniques described in the manual are merely descriptions of the first attempt to process or clean a seed lot. Users of this manual will likely improve upon these techniques through their own trials and experimentation. It is for this reason that a DVD is included with this manual. On the DVD you will find this entire manual as a PDF file. In addition, the "Seed Processing Procedures" section of this manual is available in Filemaker Pro® format that the user may use to update or add to the seed processing procedures. Refer to the "Seed Processing Procedures" section for details.

Improving this manual

If you have improved upon the seed processing procedures discussed in this manual, or have developed procedures that are not included in it, you may use the "Seed Processing Procedures" file (Filemaker Pro® format) on the DVD to update and print out pages for your manual. If you would like to share your techniques and methods for possible inclusion in future editions of this manual, they may be submitted to:

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Introduction

Having clean, healthy, sound seed allows for greater longevity in storage, more predictable propagation results, and more reliable data from germination trials. Hollow, broken, parasitized, or underdeveloped, inferior seeds are generally removed in the cleaning process. Separating seed from floral chaff and any surrounding fruit pulp aids in the drying process and helps control storage molds and fungal pathogens. Clean seed lots allow for better inventory control and management of the collections.

Seed cleaning is basically a three-step process:

(1) threshing (separating seed from their respective fruits)
(2) winnowing (separating seed from floral chaff)
(3) viability or quality assessment (determining the percentage of sound seed in the collection)

The "best" method to clean seeds of any given species is only limited by one's experience, imagination, and access to basic equipment. The only correct way to clean a given seed lot is that which does not damage the seed. With the exception of the seed blower, most tools and equipment recommended in this manual are found in the average kitchen, can be easily made from materials available at most hardware stores, or are relatively inexpensive to purchase from seed processing equipment suppliers.

Seeds are separated from chaff by methods that take advantage of differences between chaff and seed size, weight, shape, and texture. In some cases the seed and chaff are so similar in these characteristics that obtaining high percentage purity in the seed lot is not possible. In these situations, if human resources are available, the seed can be hand-separated from the chaff.

Fruit types

The most commonly encountered fruit types and their basic cleaning methods are described below.

Dry dehiscent fruits
Many plant species produce seeds in capsules that split and discharge the seeds as they dry. Cleaning is always easier if one allows the fruits to naturally shed their seed into bags or onto sheeting directly from the plant. Generally though, with most dehiscent fruits, some seed remains and it can be separated from the fruits in the threshing and winnowing process.

Composites
Seed lots from composite species–members of the Daisy or Sunflower family (Asteraceae)–are often difficult to process. Composite seeds (actually a type of fruit called an *achene*), are often light in weight, have a broad surface area, and large quantities of floral chaff.

Processing Seeds
Seed Processing Techniques

Once mixed with the seed, the chaff can be difficult to separate from the achenes. Additionally, pappus hairs, typical for this plant group, make separation by screens and blowers challenging. One solution, when processing fruits of composite species, is to manually select only fully ripe achenes that are easily plucked from the floral receptacle. In general, fertile achenes have a fluffier pappus and will easily detach from the floral receptacle. Fertile, ripe seed and fruits easily detach from the parent plant while parasitized, immature, and infertile fruits frequently remain firmly attached and do not normally disperse. Selecting only the material that separates easily from the fruits or floral receptacles simplifies the cleaning process. For many composite species, the pappus is easily detached from the achenes by gently rubbing them with a wooden block over a flat rubber car floor mat. This process also helps to break up the chaff into smaller particles that can then be more easily separated using screens or blowers. The rubber mat method works equally well in removing the awns from grasses, making handling, counting, and packaging easier and more space efficient.

Fleshy fruits
Moist fleshy fruits are most easily cleaned by maceration soon after collection. Dry fleshy fruits should be soaked in water for a period of time, just long enough to soften the fleshy portion. This can usually be accomplished in one to a few hours. The macerated pulp and seeds are then spread out on a screen in a warm environment to dry. Once the pulp has dried, the seeds are separated from the pulp by rubbing the material on a screen or rubber mat with a padded wooden block. Thorough and immediate drying is critical to prevent the seeds from molding. The dried pulp is then blown off or sieved out. Some species produce dry and mealy fleshy fruits. This outer pulp can be removed by macerating or threshing the fruits in their dry state.

Seed cones
Many seed cones of conifers, if mature when collected, will open naturally as they dry. Harvested seed cones are typically spread out on matting or in an open box in a warm dry site. Once the cones have fully opened seed can be shaken or gently pried out. Some pines and cypresses have closed cones that require heat to open. Cones of this type can be placed in an oven at 180° F (85° C) until cone scales open, which will occur in 20 minutes or less. Exposure to this temperature should not be applied for longer periods or the seed could be damaged. Cones of species that do not naturally open, and do not respond to dry heat can be immersed in boiling water for 30 seconds to one minute. The cones are then placed in a warm environment to dry, split, and release the seed.

Nutlets
Plants in the Mint family (Lamiaceae) typically produce four nutlets per flower that are tightly or loosely enclosed within the floral calyx. The harvested floral whorls need to be broken up or threshed to remove all of the seed. The threshed material is then screened and blown to separate out the seed from the floral chaff. Most plants in the Borage family (Boraginaceae), however, will release their nutlets into the collecting bag as they dry, and any remaining seeds are easily shaken or rubbed out of the floral structures.

Static electricity when processing seed collections

When relative humidity is extremely low, static electricity presents many challenges during the blowing and hand-sorting stages. Static electricity is particularly problematic using plastic or metal tools and equipment. Static electricity is most easily minimized through the use of a humidifier in the workroom or placed near the workstation. Anti-static dryer sheets as well as anti-static cleaners that are used on electrical components also help to reduce the electrical charge that can build up under dry conditions. These techniques are illustrated on page T-9.

Viability assessment process

Ripe, fully developed, sound seed will be filled from edge to edge with healthy, firm, generally moist tissue. Most typically, mature healthy seed have seed coats that have hardened and darkened in color from white to green in the immature stage to tan, brown, or black when they have matured. Ripe seed also have usually disconnected from the fruit or ovary wall. At the Seed Bank, seeds are assessed for quality and viability using the following method that separates immature, hollow, or parasitized seed from sound seed by weight. First the seed blower is used to separate out a light-weight fraction from the cleaned seed. From this sample, between 5–10 seeds are dissected under magnification to determine if they are filled with healthy tissue. If the quality of the seed is below standard, additional seed is blown out and checked. This process is repeated until a sample is achieved in which all dissected seeds are filled and sound. It has not been unusual to have collections of seeds in which 90 percent, or even 100 percent, of apparently perfectly sound seeds are hollow or parasitized. While not as thorough or as informative as visually inspecting the seeds under magnification, the viability assessment process can be speeded up when inspecting small seeds by utilizing a "squash test." Hollow dry seeds will crack or pop when pressed with the blunt end of the wooden handle of a dissecting needle. A ring of moisture will appear on the blotter paper when healthy seeds are squashed. This test can also be used for assessing the viability of a seed crop in the field.

For some programs, it may be impractical or unnecessary to achieve such a high standard of viability. It is, however, important to determine the percentage of the seed in a collection that has the capability to germinate and produce seedlings. If one does not have access to a seed blower to remove unsound seeds from the collection, seed viability can be assessed by dissecting and examining a random sample of between 50–100 seeds. If 25 percent of the dissected seeds are viable and the germination is 50 percent, then it would require a minimum of 800 seeds to produce 100 seedlings, i.e., 800 x .25 x .50 = 100.

Finally, the cleaned seed lot is closely inspected under magnification for the presence of seeds of other plant species. To prevent the spread of undesired plant species, these contaminant seeds are removed from the collection during the cleaning process.

Illustrated seed processing techniques

The following pages illustrate seed cleaning and processing techniques, and some of the various tools used.

The creation of a thousand forests is in one acorn

Ralph Waldo Emerson

Processing Seeds

Seed Processing Techniques

THRESHING

Seeds are allowed to fully ripen and dehisce onto paper, matting, or into the collection bag.

Heat can be used to open many cones.

Seeds are separated from their fruits by threshing the floral material over screens and sieves.

Threshing grass florets

Using rubberized gloves to remove awns from florets makes it easier to separate fertile from sterile florets in the blower/winnowing process. (left)

After threshing, awns are scalped off and florets are dislodged by rubbing the bottom side of the screen with a comb or brush. (right)

Processing Seeds

Seed Processing Techniques

Here knob-cone pine seeds are de-winged by vigorous agitation using round palm seeds to gently knock wings from the seeds.

To facilitate the winnowing process, pappus, hairs, and awns can be removed from the seed by gently rubbing on a rubber mat.

For some plants, it is best to avoid threshing, which creates extra chaff that will be difficult to remove. Here, a brush is used to separate ripe achenes from floral receptacles.

String trimmers can be used to thresh large quantities of dry material.

Processing Seeds

Seed Processing Techniques

Threshing moist fruits is done using a food mill or mesh screens to macerate the fruits.

Blenders can work well to macerate fruits to release the seeds inside or to strip off the outer pulp layers. Modified blender showing taped blades and nylon line.

WINNOWING

Sorting seed from the lighter weight chaff is easy with a blower. If a blower is not available the seed sample can be agitated in a shallow pan or a bowl. This allows the seed to settle and the lighter chaff to rise to the surface. The chaff can then be blown off using a gentle stream of air.

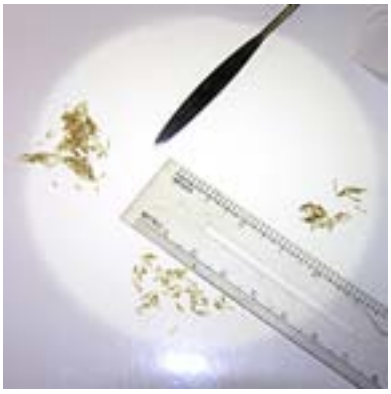
Separating chaff from seeds by floatation. This is a useful technique for large seeds. Filled, sound seed will sink, while the chaff will float and can be screened off the surface.

Processing Seeds

Seed Processing Techniques

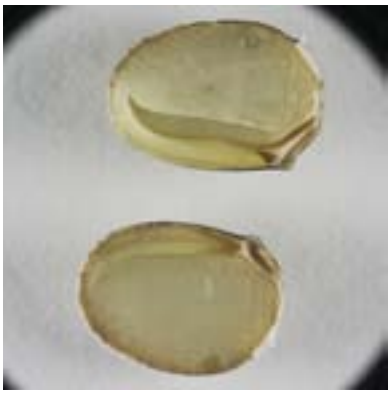
Sorting chaff from seed by surface texture by shaking material on rough-textured paper, a velvet cloth, or a velvet-lined box.

Hand sorting using a fine brush, tweezers, or a light table to manually sort healthy sound seed from chaff.



QUALITY ASSESSMENT

Healthy, sound seeds are generally plump in shape, with an intact, undamaged seed coat, and are filled inside from edge to edge. This dissection exam of a seed sample is generally done under magnification.



Healthy sound seeds are generally moist but sometimes have a dryish embryo and endosperm. One quick way to determine viability, especially on very small seeds, is to squash the seed on a piece of blotter paper and see if it leaves a spot of moisture.

Processing Seeds

Seed Processing Techniques

Immature, hollow, or parasitized seed can often be separated out from the seed lot using a seed blower.

Sound seeds of larger-seeded species will sink in water and will thus be separated from the inferior portion of the collection that floats.

STATIC ELECTRICITY

Dry air may cause static electricity to form on the blower or other equipment.

This may cause chaff to adhere to the equipment.

Running a humidifier before using the blower may help prevent this.

Also, wiping equipment with anti-static laundry dryer sheets or spraying with an electronic component anti-static spray may help reduce the effects of static electricity on the seeds and equipment.

Processing Seeds

Seed Processing Techniques

BULK CLEANING

Bulk collections are cleaned outside while wearing respiratory protection (dust mask).

Material is placed on a grate and rubbed with a wire faced wooden paddle.

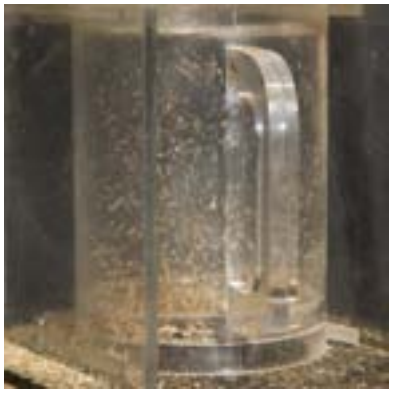
The material that passes through the grate is then placed on a smaller size screen and rubbed again.

The material that passes through the screen is placed in the blower.

The chaff blows directly into a bucket via a 4-inch duct.

The material remaining in the blower cup is then run through a smaller screen into a wooden box.

This material is then cleaned using a sieve and blower to remove any remaining chaff and unsound seed.



Introduction

On the DVD included with this manual is information in a form that can be easily edited. This file will allow the user the opportunity to revise, reprint, and update the appropriate pages in their own manual based on their needs and on the equipment they have on hand. Editing the "Seed Cleaning Procedures" files requires Filemaker Pro® 7.0, or later, data management software. Filemaker Pro® is a data management software program that is readily available and easy to learn. The file is a cross-platform database so it may be accessed and used on either a Macintosh® or a PC. While the procedures are sorted by species in this manual, having the database allows the user to sort the procedures by family if desired.

In using this section the reader should be aware that the goal of the Seed Bank at Rancho Santa Ana Botanic Garden is to clean seed collections to as close as possible to 100 percent pure live seed. The cleaning procedures provided in this manual generally reflect this standard. This processing and cleaning standard may not be necessary and even impractical for others needs.

Blower speeds

The blower speeds noted in the manual were determined using two different Oregon Seed Blower units. The figures in the procedures are thus for reference only, and the appropriate blower speeds and adjustments need to be determined for each seed lot depending on the blower model in use.

Sieves

The sieve sizes noted in the methods are U.S. Standard Sieve Series.

Screens

The large, medium, and small screens refer to wood-framed screens made from 1/4-inch, 1/8-inch, and 1/16-inch standard welded metal hardware cloth that is available at most hardware stores.

Seed variation

Seed size and weight can vary considerably from one seed lot to the next, and thus the various sieve sizes and blower speeds should be considered as guidelines or starting points.

Difficulty levels

We have rated the various species in the manual using a difficulty scale of 1 to 5, with 1 being easy and 5 being the most difficult. The difficulty levels were assigned depending upon how much time it took to process a collection to an estimated 95 percent viability level or as close to this target as possible. The 95% viability ranking is used due to sampling margins of error making 100% viability unlikely to be achieved.

Difficulty level 1—A collection producing many thousand seeds that can be processed in an hour or so is generally rated easy. These are typically species producing dry dehiscent fruits with small, smooth, round seeds.

Difficulty level 2—A collection that is more difficult to process than *Difficulty level 1* but less difficult that *Difficulty level 3*.

Difficulty level 3—A collection with a 3 ranking may generally take 3 to 5 hours to process. Level 3 species might be collections from plants producing moist fruits, seed from composite species, collections that have a high percentage of hollow fruits, and those that require some hand cleaning.

Difficulty level 4—A collection that is more difficult to process than *Difficulty level 3* but less difficult that *Difficulty level 5*.

Difficulty level 5—These are collections that may take from 6 to 10 or more hours to process. Collections that are slow to process are maternal line collections, where each parent's seed is handled separately, and collections that require a great deal of hand sorting.

Glossary notation

In the following procedures section the words in green type are those included in the glossary in the back of this manual.

NYCTAGINACEAE

Abronia maritima

Fruit: Achene, 8.0–11.0 mm, winged
Seed: 3.0–4.0 mm enclosed within the hard indehiscent fruit

Rub fruits over medium screen. Blower speed: 2.0 to remove chaff. Higher blower speeds required to sort out lighter sterile fruits. Some hand sorting to remove pedicels.

Difficulty Level 3

NYCTAGINACEAE

Abronia villosa

Fruit: Achene, 9.0–12.0 mm, winged
Seed: enclosed within the hard indehiscent fruit

Rub fruits over medium screen. Blower speed: 2.0 to remove chaff. Higher blower speeds required to sort out lighter sterile fruits. Some hand sorting to remove pedicels.

Difficulty Level 3

ASTERACEAE

Acamptopappus shockleyi

Fruit: Achene, 3.5–5.0 mm, ovate cylindical tapering at one end, densely white hairy
Seed: enclosed within fruit

Sort floral material through #14 sieve to remove some chaff. Blower speed: 1.15 then to 2.5 to sort out peduncles and involucres (or hand sort). High percent of fruits are sterile. Higher blower speed and dissection examination required to sort out hollow fruits.

Difficulty Level 3

ASTERACEAE

Acamptopappus sphaerocephalus

Fruit: Achene, 3.0–4.5 mm, ovate-cylindrical, densely covered with short, white hairs
Seed: enclosed within fruit

Sort floral material over medium screen to remove large chaff and twigs. Working with small lots, slowly increase speed of blower to 1.25 to remove sterile fruits (80–90% of this seed lot). Seed remaining at 1.35 blower speed 90% filled (9 of 10 seeds).

Difficulty Level 3

LAMIACEAE

Acanthomintha lanceolata

Fruit: Nutlet, deeply set in a persistent calyx; 1.7–2.0 mm long, narrow eliptical, light to medium brown, with dark mottling, smooth
Seed: enclosed within fruit

Most seed will dehisce and be released into collection bag, lightly rub dried inflorescences over a small screen, sort floral material through #18 and #35 sieves. Blower speed: 1.5 to remove chaff then to 1.75 to sort out the small percentage of hollow seeds.

Difficulty Level 1

ACERACEAE

Acer glabrum

Fruit: Achene samara, 12.0 mm, oblong, light brown, deeply wrinkled to folded, smooth
Seed: enclosed within fruit

Rub fruits over medium screen to detach wings. Blower speed 1.5–2.0 to remove wing chaff, to 3.0 or higher to remove hollow sterile fruits. 65% in this seed lot were hollow.

Difficulty Level 2

ASTERACEAE

Achillea millefolium

Fruit: Achene, 2.0 mm, elongate, ovate, compressed, gray with thick white margins, glabrous
Seed: enclosed within fruit

Rub floral heads over medium screen then sort through #16 sieve, rub this material through #25 sieve. Blower speed: 1.0.

Difficulty Level 2

POACEAE

Achnatherum coronatum

Fruit: Caryopsis, enclosed within the lemma and palea of the floret (8.0 mm)
Seed: enclosed within fruit

Rub floral stems on rubber mat to remove florets from spikelets and separate awns. Blower speed: 1.5. Repeat process as necessary until chaff and awns are removed.

Difficulty Level 2

POACEAE

Achnatherum hymenoides

Fruit: Caryopsis, enclosed within the lemma and palea of the floret (3.0 mm)
Seed: enclosed within fruit

Rub material over medium screen to separate florets from spikelets, rub over #10 sieve to break up chaff and remove bulky cottony chaff. Blower speed: 1.25+ then to 2.0 to remove poor quality and hollow fruits.

Difficulty Level 3

POACEAE

Achnatherum speciosum

Fruit: Caryopsis, enclosed within the lemma and palea of the floret (9.0 mm)
Seed: enclosed within fruit

Most seed will be released from flowering spikes in the drying bag. Rub florets gently over rubber mat to remove the long awns. Blower speed: 1.25 to separate fruits from floral chaff. Repeat rubbing and blowing as necessary. Increase blower speed to separate sterile florets from heavier fertile ones. Some hand sorting required.

Difficulty Level 3

ASTERACEAE

Achyrachaena mollis

Fruit: Achene, 3.0 mm, awl shaped, black, ridged, pappus of long white chaffy scales
Seed: enclosed within fruit

Easiest to clean if achenes are removed from flower receptacle with pappus intact. Use air sorter to blow seeds up leaving heavier chaff below. Other option is to rub seed and chaff over rubber mat to remove pappus and break down chaff. Blower speed: 1.5. Some hand cleaning.

Difficulty Level 3

ASTERACEAE

Acourtia microcephala

Fruit: Achene, 4.5–6.0 mm, linear, greenish brown, ridged, pappus bristles longer than fruit
Seed: enclosed within fruit

Hand pluck fruits from involucres or allow material to naturally release into collection bag, rub floral material on rubber mat with padded wood block to separate cottony pappus from fruits, shake material through #16 sieve. Blower speed: 1.15 to sort out chaff, pappus, and sterile fruits.

Difficulty Level 4

ROSACEAE

Adenostoma fasciculatum

Fruit: Achene, enclosed within a floral cup (hypanthium) 2.0–3.0 mm, obovate, reddish, ribbed
Seed: enclosed within fruit

Rub floral material and fruits over medium screen, rub and sort through #10 and #18 sieves to separate floral parts from the fruits and to break up chaff. Blower speed: 1.8 to separate chaff from fruits. Collections likely to have a high percent of sterile seed. Use higher blower speed to sort out filled fruits from the sterile fruits.

Difficulty Level 3

ROSACEAE

Adenostoma sparsifolium

Fruit: Achene, enclosed within a floral cup (hypanthium) 1.0–2.0 mm, obovate, reddish to dark brown, ribbed, smooth to hairy
Seed: enclosed within fruit

Sort and lightly rub floral material and fruits over medium screen, rub over #30 sieve to break up chaff. Blower speed: 1.0 to separate chaff from fruits. Re-rub fruits on #30 sieve to remove corolla parts attached to the hypanthium. Blower speed from 1.4 to 1.75 to sort filled fruits from the sterile fruits.

Difficulty Level 2

ASTERACEAE

Ageratina occidentalis

Fruit: Achene, 2.0–3.0 mm, linear, dark brown to black, ridged, glandular, pappus bristles 3.0–4.0 mm
Seed: enclosed within fruit

Pluck achenes from ripe floral involucres, rub with rubber padded block or with light finger pressure on rubber mat to remove pappus from fruits. Blower speed: 1.0. Repeat rubbing and blowing as necessary.

CAUTION! seeds can be easily damaged during threshing and cleaning process. Resieve through #18 or #20 to remove larger chaff.

Difficulty Level 3

ASTERACEAE

Agoseris grandiflora

Fruit: Achene, 4.5–6.5 mm, linear, grayish brown, longitudinally deeply grooved, long cottony pappus
Seed: enclosed within fruit

Rub plucked floral material on rubber mat to separate cottony pappus from achenes. Very messy, thus use of a dust mask is recommended. Use blower to separate cottony pappus from fruits.

Difficulty Level 2

ASTERACEAE

Agoseris retrorsa

Fruit: Achene, 4.0–7.0 mm, long hairy pappus
Seed: enclosed within fruit

Rub floral material on a rubber mat with a padded wood block to remove cottony pappus bristles. Shake material through #6 and #30 sieves to remove large and dusty cottony chaff. Blower speed: 1.25. Rub achenes between hands or on mat, repeat blower.

Difficulty Level 2

LILIACEAE

Allium fimbriatum

Fruit: Capsule, dehiscent, 3.0–4.0 mm
Seed: 1.5–2.0 mm, ovoid, black, net-ridged

Rub floral material over medium screen to break open capsules, sort through #12 and #20 sieves. Blower speed: 1.75 to 2.0.

Difficulty Level 1

LILIACEAE

Allium parryi

Fruit: Capsule, dehiscent
Seed: 1.5–2.5 mm, ovoid, black, irregularly ridged, shiny

Avoid threshing capsules as it is difficult to separate seed from heavy capsule chaff. Better to allow seeds to naturally dehisce from fruits as the capsules ripen. Blower speed 1.0+.

Difficulty Level 1

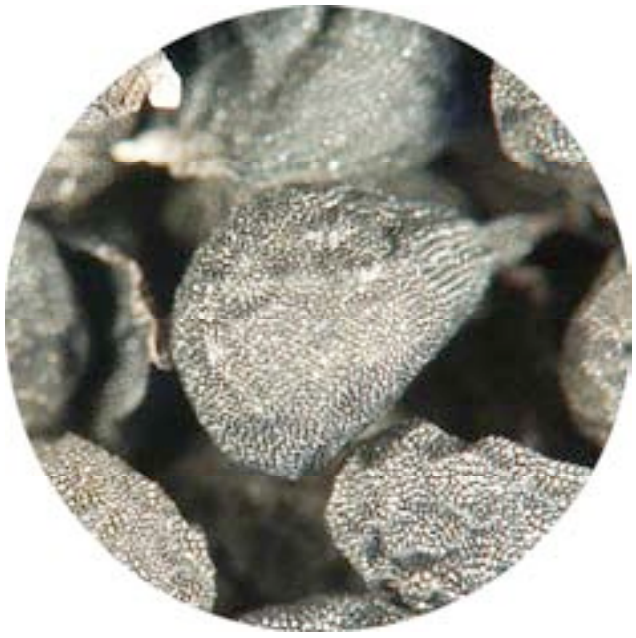
LILIACEAE

Allium praecox

Fruit: Capsule, dehiscent
Seed: 2.0 mm, ovoid, shiny black, pitted surface, wrinkled

Rub floral material over a #25 sieve to break up capsules and release seed, some of which cling tightly to base of capsule. Sort through #12 and #18 sieves to separate seed and bulky chaff. Blower speed: 1.75. Repeat sieves and blower as necessary.

Difficulty Level 2



AMARANTHACEAE

Amaranthus fimbriatus

Fruit: Capsule, dehiscent
Seed: 0.4–0.9 mm, lenticular, dark reddish brown to black, shiny smooth

Rub floral material over #18 and #35 sieves to release seed still in capsules. Blower speed: 1.5 to remove chaff, to 1.75 to remove sterile seed.

Difficulty Level 1

ASTERACEAE

Amblyopappus pusillus

Fruit: Achene, 1.5–2.5 mm, obconic, 3–4 angled, black with short hairs, pappus a crown of 7–12 scales
Seed: enclosed within fruit

Rub plucked floral material over medium screen, then rub and sort through #18 sieve. Blower speed: 1.25+. Resieve several times through #12 sieve to catch some remaining chaff.

Difficulty Level 3

ASTERACEAE

Ambrosia chamissonis var. *bipinnatifida*

Fruit: Achene, bur, 6.0–9.0 mm, long spiny
Seed: enclosed within the hard woolly bur, medium to dark brown. High percentage of sterile empty fruits.

Rub material over #12 sieve. Blower speed: 2.0. Increase blower speed and repeat dissection examinations to separate sterile aborted fruits.

Difficulty Level 3

ASTERACEAE

Ambrosia chenopodifolia

Fruit: Achene, bur, 5.0–9.0 mm, spiny, densely woolly
Seed: enclosed within the hard woolly bur, medium to dark brown. High percentage of sterile empty fruits

Rub burs with wood block over small screen to remove spines and break up floral chaff. Blower speed: 1.25. Increase blower speed and repeat dissection examinations on lighter seeds as necessary to sort out sterile aborted fruits.

Difficulty Level 3

ASTERACEAE

Ambrosia dumosa

Fruit: Achene, bur 4.0–6.0 mm, short spiny, yellow brown with a high percentage of sterile fruits
Seed: enclosed within the spiny bur

Rub burs and floral material over large screen, then through a #16 sieve to break up male flower heads and chaff. Very difficult to separate male flowers from fruits. Blower speed: 1.5–1.75. Gradually increase blower speed and repeat dissection examinations as necessary to sort out sterile fruits.

Difficulty Level 4

BORAGINACEAE

Amsinckia vernicosa var. *furcata*

Fruit: Nutlet, 3.0 mm, ovate, light brown to gray with black mottling, smooth and shiny, sharply angled above, groove on back forked at base
Seed: enclosed within fruit

Rub floral material over #12 and #25 sieves to separate seed from inflorescences. Blower speed: 1.75+.

Difficulty Level 1

SAURURACEAE

Anemopsis californica

Fruit: Capsule, dehiscent at tip opening
Seed: 0.8–1.2 mm, spherical to ovate, reddish brown, pitted and slightly glandular-sticky

Rub inflorescences over small screen to break up fruits and release seeds. Rub and shake material through #20 and #45 sieves, Blower speed to 1.75.

Difficulty Level 1

ASTERACEAE

Anisocoma acaulis

Fruit: Achene, 4.0–5.0 mm, linear, tan, appressed, densely white hairy, pappus of long plumose bristles
Seed: enclosed within fruit

Gently rub flower heads over medium screen to separate achenes from receptacle and detach pappus. Sort through #8 sieve. Blower speed: 1.25 to remove chaff. Sort material over #14 sieve to remove any sand and small chaff.

Difficulty Level 3

SCROPHULARIACEAE

Antirrhinum coulterianum

Fruit: Capsule, dehiscent, upper chamber indehiscent
Seed: 0.5–1.0 mm, dark brown to black, ovate-triangular to rectangular, deeply pitted

Rub floral stems over small screen, then through #25 and #40 sieves. Blower speed: 1.15.

Difficulty Level 1

BRASSICACEAE

Arabis hoffmanii

Fruit: Silique, long and flat, tardily dehiscent
Seed: 1.5–2.0 mm, reddish brown, oval, compressed with marginal wings

Most seeds released into storage bag, rub dried floral material over small screen to release seed from fruits, sort through #18 and #40 sieves. Blower speed: 0.75.

Difficulty Level 1

ERICACEAE

Arbutus menziesii

Fruit: Berry, few to several seeds, less than 12.0 mm wide
Seed: 2.0–2.5 mm, ovate, angled, brown, longitudinally ridged to net-veined

Macerate fruits over #25 sieve under stream of water (avoid overwashing or overly vigorous rubbing). Let seeds thoroughly dry, then gently rub them over a #25 sieve to break down dried pulp. Blower speed: 1.75.

Difficulty Level 3

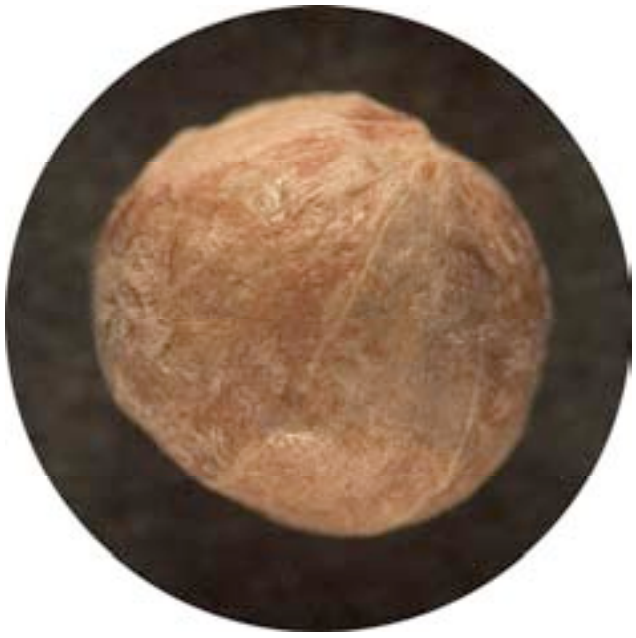
ERICACEAE

Arctostaphylos australis

Fruit: Drupe, pulp mealy when mature, 4.0–6.5 mm, ovoid to spherical, light brown, smooth to net-ridged. Fruit segments tightly fused
Seed: enclosed within fruit

Use blender with taped blades, and nylon trimmer line attached, short bursts at low speed to strip pericarp from seed. Blower speed: 4.75 to remove fruit chaff. Moderate quantity of sterile seed (27%) in this seed lot.

Difficulty Level 2



ERICACEAE

Arctostaphylos catalinae

Fruit: Drupe, 5.0–15.0 mm, made up of 5 to 9 wedge-shaped dark brown segments
Seed: 2.0–4.0 mm. Fruit segments tightly fused

Soak fruits minimum of 1–2 hours. Place fruits in blender 2/3 full of water, run 15–30 seconds, repeat for floating pulpy fruits. Rub and wash over small screen or #12 sieve. Drain, put wet material in warm place to thoroughly dry. Use blower to separate powdery dried pulp.

Difficulty Level 3

ERICACEAE

Arctostaphylos gabrielensis

Fruit: Drupe, ovoid, brown, 5.0–10.0 mm, heavily ridged, fruit segments tightly fused
Seed: enclosed within fruit

Easier to remove fruit pulp if fruits are presoaked 1–2 hours. Then rub and rinse over medium screen or use blender and water to strip pulp. After drying, rub again and use blower to separate powdery dried pulp.

Difficulty Level 3

ERICACEAE

Arctostaphylos glandulosa

Fruit: Drupe, ovoid, 3.5–6.0 mm, fruit segments tightly fused or splitting into wedge-shaped segments
Seed: enclosed within fruit segments

Soak drupes for two hours. Wash and macerate fruits over medium screen repeatedly until most seed is clean of fruit pulp, dry thoroughly, rub over small screen to strip remaining pulp, Blower speed: 3.0.

Difficulty Level 3

ERICACEAE

Arctostaphylos glauca

Fruit: Drupe, sticky, pulp moist, tightly adhering to stone, ovoid to spherical, medium brown, 12.0–15.0 mm, smooth to net-ridged. Each fruit contains 5 to 7 fertile or sterile fused segments
Seed: enclosed within fruit

Soak fruits for 2–3 hours. Macerate small batches of fruits covered with water in blender equipped with nylon string-trimmer line for 30–40 seconds. Drain over medium screen, quickly dry in direct sun for several hours, then slowly and thoroughly dry in warm shade. Use blower to separate dried pulp from seeds. Cleaning time: 5.5 hours to process 8 quarts of cleaned seed for this large seed lot.

Difficulty Level 2

ERICACEAE

Arctostaphylos pungens

Fruit: Drupe, pulp dry, not adhering to stone, spherical, dark brown, 6.0–8.5 mm, rough, prominently ridged, 5 to 7 mostly fused segments with some sections separating during processing
Seed: enclosed within fruit segments

Macerate small batches of mature dried fruits covered in water in blender equipped with nylon string-trimmer line for 30–40 seconds. Use blower to separate pulverized pulp from seeds. Cleaning time: 2.5 hours to process 5 cups of cleaned seed for this seed lot.

Difficulty Level 2

CARYOPHYLLACEAE

Arenaria macradenia var. *arcuifolia*

Fruit: Capsule, dehiscent
Seed: 2.0–3.5 mm, oval, compressed, dark gray brown, notched at end, low tubercled ridges

Rub floral stems over medium screen to open fruits and separate any seed remaining in capsules, sort through #12 and #18 sieves. Blower speed: 1.5. Resieve through #10 sieve several times to remove twigs or large chaff.

Difficulty Level 1

POACEAE

Aristida purpurea

Fruit: Caryopsis, cleaned to floret only, floret: lemma linear, tan to purple, 9.0–12.0 mm long, smooth, awns 10.5–12.0 mm long
Seed: enclosed within fruit

Rub floral material over a small screen. Florets will get stuck and be held in the screen. Place screen over a clean sheet of paper and rub the bottom of the screen with a comb or brush to dislodge the florets. A high percentage of these in this seed lot were filled and viable.

Difficulty Level 1

ARISTOLOCHIACEAE

Aristolochia californica

Fruit: Capsule: dehiscent, 40.0–50.0 mm, ovoid, prominently ridged, seeds ripe when fruit is greenish yellow
Seed: 4.0–5.5 mm, ovate to cordate, medium brown, smooth; broadly convex on one side, deeply concave on the other with a yellow hilum

Fruits have a very high moisture content if harvested while slightly green. Dry capsules in a warm environment, stir and check regularly so they do not mold. Thresh dried capsules over a large screen to separate seeds, blower to 45 to remove chaff and some aborted seed.

Difficulty Level 1

PLUMBAGINACEAE

Armeria maritima

Fruit: Achene, enclosed within a persistent and indehiscent calyx
Seed: 2.0–2.5 mm, ovate, light to dark gray-green, smooth

Gently rub dried flower heads over a medium screen to separate flowers from stems. Blower speed: 1.1 to sort out floral bracts, blower to 1.5 to separate filled and empty floral calyces; 8 of 10 calyces in this seed lot filled at this blower speed. Seeds can also be extracted from the surrounding calyx by rubbing them over a #18 sieve, but some seeds are damaged in the process.

Difficulty Level 2

ASTERACEAE

Arnica chamissonis subsp. *foliosa*

Fruit: Achene, 4.5–5.0 mm, linear dark gray, long creamy-white pappus hairs
Seed: enclosed within fruit

Rub thoroughly dried seed on rubber mat with light finger pressure to remove pappus. Run through blower to separate pappus. Increase blower speed and conduct dissection examination as required to sort out hollow sterile fruits. Approximately 50% of the fruits in this seed lot were sterile.

Difficulty Level 3

ASTERACEAE

Artemisia californica

Fruit: Achene: 1.2 mm, obovate, yellowish brown with a thin, white, membranous fruit coat
Seed: enclosed within fruit

Sort dehisced loose floral material from the bottom of the collection bag through a #25 sieve to remove bulk of the chaff; gently rub this material over a #45 sieve or a rubber mat to separate the achenes from the flowers then resort material through the 25 sieve. Blower speed: 19 then resieve material several times through the #25 sieve to catch remaining small twigs and chaff. Threshing flowering stems to obtain more seed was not that productive as most had dehisced naturally from the inflorescences.

Difficulty Level 1

ASTERACEAE

Artemisia douglasiana

Fruit: Achene, 1.5 mm, cylindrical, amber colored within surrounded by a thin, white, papery husk
Seed: enclosed within fruit

Rub floral material on a #25 sieve. Blower speed: 1.1 will remove most of the chaff.

Difficulty Level 3

ASTERACEAE

Artemisia dracunculus

Fruit: Achene: 1.0 mm, obovate, reddish brown, smooth
Seed: enclosed within fruit

Thresh floral material over a small screen then rub and sift gently through #18 and #40 sieves. Blower to 20 then resieve over a #30 sieve to remove larger chaff. Reblow to 22+ and repeat sieving and blowing as necessary.

Difficulty Level 2

ASTERACEAE

Artemisia ludoviciana

Fruit: Achene, short-cylindrical, blunt on both ends,1.0 mm, reddish brown, smooth but with shallow longitudinal surface ridges under magnification
Seed: enclosed within fruit

Rub floral stems over medium screen, sort through #18 sieve. Blower speed: 1.25 to remove high quantity of sterile flowers and chaff. Very low seed set in this seed lot with only 189 seeds recovered from a collection of ca. 15 inflorecence branches, each with many hundreds of flower heads containing 1,000+ flowers.

Difficulty Level 2

ASTERACEAE

Artemisia tridentata

Fruit: Achene: 1.5–1.8 mm, ovate-acute, greenish brown to tan, shallowly ridged within a winged membranous fruit coat
Seed: enclosed within fruit

Rub inflorescence over a small screen then through #16 and then #35 sieves to separate large and fine chaff. Blower to 24. Resieve over a #18 sieve then reblow to 25. Some hand sorting to get perfectly clean. Relatively low seed production with 0.521 gm or 4,322 seeds extracted from ca. 40 flowering stems containing many thousands of flowers.

CAUTION: Seed is very soft and easily damaged.

Difficulty Level 2

ASCLEPIADACEAE

Asclepias albicans

Fruit: Follicle, dehiscent
Seed: 5.0–7.0 mm obovate, flattened, medium reddish brown with long silky hairs

Gently rub mature seed on rubber mat, or vigorously shake seeds in a paper bag to separate hairs from fruit. Sort material through screens or sieves or use blower to remove cottony pappus. Very messy, use dust mask.

Difficulty Level 2

ASCLEPIADACEAE

Asclepias californica

Fruit: Follicle, dehiscent
Seed: 10.0–12.0 mm, obovate, flattened, medium reddish brown with long silky hairs

Gently rub mature seed on rubber mat, or vigorously shake seeds in a paper bag to separate hairs from fruit. Sort material through screens or sieves or use blower to remove cottony pappus. Very messy, use dust mask.

Difficulty Level 2

ASCLEPIADACEAE

Asclepias erosa

Fruit: Follicle, dehiscent
Seed: 10.0–15.0 mm, obovate, flattened, medium reddish brown with long silky hairs

Gently rub mature seed on rubber mat, or vigorously shake seeds in a paper bag to separate hairs from fruit. Sort material through screens or sieves or use blower to remove cottony pappus. Very messy, use dust mask.

Difficulty Level 2

ASCLEPIADACEAE

Asclepias fascicularis

Fruit: Follicle, dehiscent
Seed: 6.0 mm, obovate, flattened, medium reddish brown with long silky hairs

Gently rub mature seed on rubber mat, or vigorously shake seeds in a paper bag to separate hairs from fruit. Sort material through screens or sieves or use blower to remove cottony pappus. Very messy, use dust mask.

Difficulty Level 2

ASTERACEAE

Aster foliaceus

Fruit: Achene, 2.0 mm, ovate, yellowish to brown, sparsely hairy with 4.0–5.0 mm long pappus bristles
Seed: enclosed within fruit

Clean by hand using a small camel's hair brush to separate achenes from floral receptacles. Blower speed: 1.0 to separate achenes from chaff and clumped, parasitized fruits; rub seed on rubber mat to remove pappus from fruits, sort through #20 sieve. Blower speed: 1.35 to remove inferior and sterile achenes and chaff.

Difficulty Level 2

FABACEAE

Astragalus agnicidus

Fruit: Legume, indehiscent. Seeds contained behind papery inner chamber wall
Seed: 1.0–2.0 mm, reniform, compressed laterally, dull dark brown to black, smooth

Seeds easily removed by hand from papery pods.

Difficulty Level 4

FABACEAE

Astragalus brauntonii

Fruit: Legume, tardily dehiscent
Seed: 1.5–1.75 mm, reniform, compressed, dark brown, wrinkled texture

Rub fruits on medium screen, #14 and #20 sieves, or on flat rubber mat to release seed from fruit. Blower speed: 1.5 to 2.0, with higher blower speeds required to sort out aborted or parasitized seeds. Sterile or parasitized seeds varied from 18% to 48% in one collection from 7 individuals that were sampled. Sterile seed can be lighter in color.

Difficulty Level 1

FABACEAE

Astragalus lentiginosus var. *coachellae*

Fruit: Legume, inflated, indehiscent
Seed: 2.0–3.0 mm, reniform, compressed, dark brown to black, rough texture. Parasitized seed medium to light brown in color, not compressed

Use string trimmer or blender to shatter inflated pods and release seed or open by hand for small lots. Blower speed: 3.25 to 4.25 required to sort out parasitized seed.

Difficulty Level 2

FABACEAE

Astragalus nevinii

Fruit: Legume, indehiscent inflated pod, stiffly papery, difficult to open
Seed: 1.5–2.0 mm, black to reddish, irregularly shaped, deeply notched

Rub fruits over medium screen to open pods and release seeds, then resieve through #10 and #25 sieves to sort out chaff. Blower speed: 2.25+, then resieve through #12 sieve to remove remaining large chaff.

Difficulty Level 2

FABACEAE

Astragalus pycnostachyus var. *lanosissimus*

Fruit: Legume, small tardily dehiscent pods, 1–7 seeds per fruit
Seed: 1.1–1.7 mm, reniform, light to dark brown, smooth

Rub dried mature fruits over #12 or #14 sieves to remove seeds. Blower speed: 2.5 to 3.5 to remove chaff and hollow, parasitized, or aborted seeds that can make up a high percentage of the collection.

Difficulty Level 1

CHENOPODIACEAE

Atriplex hymenelytra

Fruit: Utricle
Seed: 1.2 mm, round to reniform, flat, reddish brown, encased within the winged utricle

Rub fruits over medium screen with screened paddle, then through #14 and #20 sieves using wood block. Blower speed: 1.75 to 2.0. Repeat as necessary to release seed from fruit. Difficult to separate seed from fruit.

Difficulty Level 4

CHENOPODIACEAE

Atriplex leucophylla

Fruit: Utricle, spongy tubercled bracts 3.6 mm surrounding achene
Seed: 4.5–7.0 mm, circular, flat, reddish brown within winged utricle

Cleaned only to separate fruits. Shake floral material over large screen, then a #10 sieve to remove small chaff and dirt. Blower speed: 1.75. Hand-pick remaining large chaff. Experiment with different blower speeds to determine best method to extract and verify presence of viable seed. Otherwise estimate percent filled fruits from a sample of 100 fruits.

Difficulty Level 4

ASTERACEAE

Baccharis salicifolia

Fruit: Achene, 1.0–1.2 mm, linear, some curved, yellow, smooth with white ridges and copious white fluffy pappus
Seed: enclosed within fruit

Gently sort floral material over large screen to separate fruits from floral receptacles. Blower speed: 15 to separate floral material from floral bracts and chaff. Rub floral material gently but thoroughly over a #35 sieve to remove pappus from achenes. Blower speed: 17 to separate achenes from fluffy chaff. Sort material several times through a #35 sieve and then through a #40 sieve to remove some of the remaining chaff. Hand-sort remainder for a clean collection.

Difficulty Level 4

ASTERACEAE

Baileya multiradiata

Fruit: Achene, 2.5–4.0 mm, cylindrical, pale green, ribbed
Seed: enclosed within fruit

Gently rub floral material over medium screen. Rub and sort through #14 and #25 sieves to remove fine chaff. Blower speed: 1.5, then increase blower speed as necessary to separate heavier fertile achenes from lighter sterile fruits.

Difficulty Level 2

ASTERACEAE

Baileya pauciradiata

Fruit: Achene, 3.0–5.0 mm, linear to club-shaped, light tan to gray, ribbed
Seed: enclosed within fruit

Gently rub floral material over medium screen, rub and sort through #14 and #25 sieves to remove fine chaff. Blower speed: 1.5 then increase blower speed as necessary to separate the heavier fertile achenes from the lighter sterile fruits.

Difficulty Level 3

BERBERIDACEAE

Berberis nevinii

Fruit: Berry, (fleshy) containing ca. 4 seeds per fruit
Seed: 3.5–4.0 mm, narrow-ovoid, reddish-tan, smooth

Macerate fruits in blender or food mill with fruits covered with 2 inches of water. Strain pulp and seeds over small screen, place outdoors in warm environment, stirring occasionally until dry. Rub dried material over medium screen or #12 sieve, blow to separate dried pulp. Re-rub fruits over small screen and blow as necessary to clean remaining pulp from seeds.

Difficulty Level 3

ASTERACEAE

Blennosperma bakeri

Fruit: Achene, dehiscing very early from receptacle, 3.0–4.0 mm, narrow-ovoid, reddish-brown, 4–5 angled/ridged, with dense white tubercles
Seed: enclosed within fruit

Sort floral material through medium screen to remove twigs and large chaff. Rub material through #8 and #18 sieves. Blower speed: 1.9 to separate hollow fruits and chaff.

Difficulty Level 1

ASTERACEAE

Blepharizonia plumosa

Fruit: Achene, ray achenes held within involucral bracts, ray achenes slightly wider at top end; both ray and disk achenes 2.0–3.5 mm, narrow-ovate, acute, dark brown to black, (densely short hairy) and prominently ribbed
Seed: enclosed within fruit

Gently rub floral heads over a #16 sieve to release achenes and break up involucres and large chaff. Blow material, slowly increasing speed to 1.25 to remove some of the light chaff and the hollow sterile disk achenes. Gently rub remaining material over rubber mat or #25 sieve to break up chaff and separate ray achenes from involucre bracts. Blower speed: 1.45. Considerable hand cleaning required to get the collection really clean.

Difficulty Level 4

NYCTAGINACEAE

Boerhavia coccinea

Fruit: Nut: 3.0 mm, narrlowly obovate or club shaped, brown, sticky exudate on surface
Seed: Enclosed within the fruit

Rub thoroughly dry floral material over a medium screen to separate fruits from the stems. Repeat rubbing over a #12 sieve then sort over the same sieve to remove most of the stem chaff. First blow to 24 to remove chaff. The sticky fruits tend to clump together and may clean up better if washed in a warm soapy solution first then re-dried. Final blowing to 36 to separate the high percentage (70%) of aborted fruits.

Difficulty Level 4

POACEAE

Bouteloua gracilis

Fruit: Caryopsis, cleaned to florets. Florets 5.0 mm, white with prominent tufts of hairs at base of floret; fertile florets darker in color with brown mottling on lemma and palea. Caryopsis 2.0–2.5 mm long, linear, amber colored, smooth, dry
Seed: enclosed within fruit

Gently rub inflorescences with a small rubber covered wood block over rubber mat or small sieve to separate florets from inflorescence branches. Gently rub the florets to break up empty sterile florets. This releases caryopses from some of the florets. Blower to 1.25. Re-rub chaff and re-blow to check for remaining fertile florets.

Difficulty Level 4

SAXIFRAGACEAE

Boykinia rotundifolia

Fruit: Capsule, dehiscent
Seed: 0.5–0.7 mm, black

Rub capsules over #40 sieve. Blower speed: 1.0.

Difficulty Level 1

CUCURBITACEAE

Brandegea bigelovii

Fruit: Dry 1-seeded fruits, body 5.0–6.0 mm, laterally compressed, medium brown
Seed: enclosed within fruit

Hand clean, seeds easily damaged, high percentage of hollow fruits, blow at 1.5 to sort out empty fruits.

Difficulty Level 2

ASTERACEAE

Brickellia arguta

Fruit: Achene, 3.5 - 5.0mm, linear, ribbed, dark brown
Seed: enclosed within fruit

Hand sort, plucking ripe achenes from floral receptacle. Pappus is strongly attached to the achene. Blower speed: 1.0 working with small quantities of fruits; 7 of 10 of the heaviest fruits were filled and moist with 3 of 10 hollow. To remove remaining chaff place material in a bowl and shake, fruits will rise to the top and the chaff will settle at the bottom of the bowl. The fruits can then be "scraped off".

Difficulty Level 5

ASTERACEAE

Brickellia californica

Fruit: Achene, 2.5–3.0 mm, linear-cylindric
Seed: enclosed within fruit

To reduce chaff and make separation easier, try to remove achenes from flower heads prior to threshing. Rub fruits on rubber mat to remove pappus and break up chaff. Blower speed: 1.25, repeat rubber mat and blower. Some lighter achenes lost in process.

CAUTION! Threshing can easily damage these delicate fruits.

Difficulty Level 4

ASTERACEAE

Brickellia incana

Fruit: Achene, 7.0–11.0 mm, linear, light brown to tan with dense white hairs and abundant, 10 mm-long plumose pappus bristles. Hollow, sterile achenes are typically lighter in color
Seed: enclosed within fruit

If fruit pappus is not easily detached by rubbing, hand sort by pulling ripe achenes from receptacles. Working with small batches of material, begin by blowing seeds at 1.25, rotating blower baffle and/or stopping unit and shaking blower cup to reduce clumping of material. Slowly increase blower speed to 1.5 repeating the preceeding process. Hand sort dark, good fruits from hollow, light-colored ones.

Difficulty Level 5

LILIACEAE

Brodiaea kinkiensis

Fruit: Capsule, dehiscent
Seed: 3.0–5.0 mm, black, sharply angled, shallowly pitted

Rub dry floral material and capsules over large screen, then over #6 sieve to release seed from capsule. Blower speed: 1.75.

Difficulty Level 1

POACEAE

Bromus carinatus

Fruit: Caryopsis: (9.0–12.0 mm), enclosed within lemma and palea, of the floret (12.0–14.0 mm), narrowly ovate, tan, smooth with awns 0.3 times the body length

Seed: enclosed within fruit

Wearing respiratory protection and sturdy gloves, repeatedly rub floral material between your palms to remove awns. Fill blower cup to no more than 1/4 capacity. Pulse and blow 35 blower speed. After blowing the heavier seed is 100% filled and the lighter material is 90% good seed, and 10% chaff and sterile florets. To recover additional filled seed reblow the lighter blown out material at 37.

Difficulty Level 1

BUDDLEJACEAE

Buddleja utahensis

Fruit: Capsule, tardily dehiscent
Seed: 0.2–0.5 mm and smaller, elliptical, reddish, smooth and sticky

Because of the small seed size and weight it is very difficult to clean after capsules and other floral chaff is crushed and mixed in with the collection. Better to allow capsules to dehisce naturally and shake seeds through #35 or #40 sieves.

Difficulty Level 3

PORTULACACEAE

Calandrinia ciliata

Fruit: Capsule, dehiscent
Seed: 1.0–2.5 mm, disk shaped, shiny black, smooth

Rub dried inflorescences over small screen, sort floral material through #16 and #30 sieves. Blower speed: 1.25 to 2.0. Higher blower speed may be required to sort out an often high percentage of hollow seed.

Difficulty Level 2

CUPRESSACEAE

Calocedrus decurrens

Fruit: Cone
Seed: 25 mm, ovoid, reddish in color with broad wings strongly attached to the seed.

Avoid threshing to remove wings as seeds are soft and easily damaged. Incense cedar seeds contain a thin liquid amber-colored turpentine-like substance that is emitted when the thin seed coats are penetrated. Best to separate any hollow inferior seeds by weight using the blower.

Difficulty Level 3

LILIACEAE

Calochortus catalinae

Fruit: Capsule, tardily dehiscent
Seed: 5.0 mm, flat, round to ovoid disks, stacked within three chambered capsules, yellowish-white

Most seed will dehisce into collection bag, open dried capsules by hand. Avoid threshing fruits which creates capsule chaff that will be difficult to separate from the light buoyant seeds. Blower speed: 1.25 for a long period removes a lot of broken capsule pieces. Higher blower speed at 1.75+ to separate seed from dirt and heavy chaff.

Difficulty Level 3

LILIACEAE

Calochortus palmeri subsp. *munzii*

Fruit: Capsule, tardily dehiscent
Seed: 3.5–5.0 mm, oval to angular, flat, whitish to yellow gray

Rub capsules over large screen, then through #6 sieve to release seed from fruit and separate large chaff. Blower speed: 1.25 to 1.5.

Difficulty Level 1

LILIACEAE

Calochortus weedii var. *weedii*

Fruit: Capsule, tardily dehiscent
Seed: 3.0–5.0 mm, round to ovoid, compressed yellowish to white

Hand clean—most seeds fall out of dried fruit into collection bag, use blower or hand pick capsule particles left in seed lot. Blower speed: 1.25 to remove chaff and poor quality seeds.

Difficulty Level 2

PORTULACACEAE

Calyptridium monandrum

Fruit: Capsule, dehiscent
Seed: 0.5–0.8 mm, elliptic, flat, shiny black, shallowly pitted with circular collar around edge

Rub floral material over medium screen, sort through #26 and #45 sieves to remove large and fine chaff. Blower speed: 0.75, then again at 2.5 to separate seed from heavy chaff and sand. Resieve through #20 to remove any remaining large chaff.

Difficulty Level 1

ONAGRACEAE

Camissonia boothii

Fruit: Capsule, dehiscent
Seed: 0.8–1.5 mm, seeds both large (dark) and small (pale) filled and fertile

Rub floral material with heavy block on medium screen to open capsules and release seed, then through #25 and #40 sieves. Blower speed: 1.5.

Difficulty Level 2

ONAGRACEAE

Camissonia brevipes

Fruit: Capsule, dehiscent
Seed: 0.8–1.5 mm, ovate-elliptic, tan

Rub floral material over small screen to break up fruits and release seed, then through #18 and #30 sieves, Blower speed: 1.0 to 1.25.

Difficulty Level 2

ONAGRACEAE

Camissonia californica

Fruit: Capsule, dehiscent
Seed: 1.0–1.5 mm, ovate to wedge shaped, yellow to reddish brown with red spots under magnification, smooth, shiny

Rub floral material over small screen, then through #18 and #35 sieves. Resieve through #16 sieve to sort out larger chaff. Blower speed: 1.5. May be best to allow fruits to ripen and dehisce into the collection bag. Higher blower speeds may be required to separate out sterile seed and chaff.

Difficulty Level 1

ONAGRACEAE

Camissonia claviformis subsp. *claviformis*

Fruit: Capsule, dehiscent, 15.0–25.0 mm
Seed: 0.8–1.5 mm, narrowly ovate-acuminate, tan, smooth

Rub floral material over small screen to break up capsules and release seed. Rub and sort through #18 and #40 sieves. Blower speed: 1.0.

Difficulty Level 2

ONAGRACEAE

Camissonia guadalupensis subsp. *clementina*

Fruit: Capsule, dehiscent
Seed: 0.7–1.0 mm, ovoid-elliptic, black to reddish-black

Rub floral material over medium screen to open capsules and release seed. Rub and sort through #25 and #45 sieves. Blower speed: 1.25. Resieve several times with #30 sieve to catch additional chaff.

Difficulty Level 2

CAMPANULACEAE

Campanula exigua

Fruit: Capsule, dehiscent
Seed: 0.4–0.6 mm, very small, oval, red-orange, smooth, shiny

Gently rub and sort floral material through #45 and #60 sieves.

CAUTION! Smaller seed can fall through blower screen. Blow only material that does not pass through a #45 sieve.

Difficulty Level 2

PAPAVERACEAE

Canbya candida

Fruit: Capsule, dehiscent
Seed: 0.6 mm, elliptical-elongated to reniform, brown, smooth, shiny

Rub floral material on #45 and #60 sieves, Blower speed: 1.1 to remove chaff. Blower speed: to 1.5 to blow seeds up to separate rocks from seeds.

Difficulty Level 2

CYPERACEAE

Carex alma

Fruit: Achene, within a perigynium: 3.5–4.5 mm, ovate, sharply acuminate, brown
Seed: enclosed within fruit

Rub floral material over a #12 sieve to release fruits from floral spikes. Blower speed: to 1.25.

Difficulty Level 2

CYPERACEAE

Carex aquatilis var. *aquatilis*

Fruit: Achene, within a perigynium: 2.5–4.0 mm, widely ovate, acute, light brown
Seed: enclosed within fruit

Rub floral material over #18 sieve to release fruits from floral spikes, sift through #12 sieve.

Difficulty Level 2

PHILADELPHACEAE

Carpenteria californica

Fruit: Capsule, tardily dehiscent
Seed: 1.2 mm, fusiform, reddish-brown, prominently longitudinally ridged

Rub fruits over #18, #35, and #45 sieves, seeds will collect on the #45 sieve. Blower speed: to just under 1.0 to separate bulk of chaff. Shake material on rough textured paper plates to separate remaining small particles of capsule chaff from the seeds.

Difficulty Level 1

SIMAROUBACEAE

Castela emoryi

Fruit: Drupe, indehiscent, woody, 6.0–9.0 mm long, ovate, reddish brown, smooth to rough
Seed: enclosed within fruit

Rub floral material over large screen to separate fruits from stems, sort through and gently rub over #8 sieve. Blower speed: to 9.0. 90% (9 of 10) seeds filled at 9.0 blower speed.

Difficulty Level 2

SCROPHULARIACEAE

Castilleja foliolosa

Fruit: Capsule, dehiscent
Seed: 1.5–2.0 mm, triangular, net-like seed coat, jade green

Rub floral material over small screen to break up capsules and sort out large chaff, then through #30, #18 and #12 sieves. Blower speed: less than 1.0, rescreen through #18 sieve to remove larger chaff.

Difficulty Level 1

BRASSICACEAE

Caulanthus heterophyllus

Fruit: Silique, dehiscent
Seed: 1.0–2.0 mm, elliptical, compressed, reddish-brown, smooth

Rub dry fruits with fingers or padded wood block on rubber mat or small sieve. Blower speed: 1.25, higher blower speed may be required to separate out poor quality, non-viable seed.

Difficulty Level 1

BRASSICACEAE

Caulanthus inflatus

Fruit: Silique, dehiscent, seeds per fruit varied from a few to more than 25
Seed: 2.2 mm, oval, reddish brown to olive-green, smooth with an indentation at point of attachment to the septum

Rub floral material over #14 sieve to open fruits and release seed. Alternative: rub capsules with fingers or with padded wood block on rubber mat. Sort through #14 sieve. Blower speed: 1.5 or higher.

NOTE: Self-incompatibility? No seed was produced from open-pollinated nursery-generated plants.

Difficulty Level 1

RHAMNACEAE

Ceanothus leucodermis

Fruit: Capsule, dehiscent (explosively when ripe)
Seed: 2.0–3.0 mm, ovoid, convex one side, dark brown, smooth, shiny

Rub floral material over medium screen to release seed from capsules, then through #08 and #18 sieves to sort out large and small chaff. Blower speed: 2.5 to 3.5. Higher blower speeds required to sort out the often high percentage of hollow seeds. Hollow seed can also be floated to separate them from filled seeds.

Difficulty Level 2

RHAMNACEAE

Ceanothus megacarpus var. *insularis*

Fruit: Capsule, dehiscent (explosively when ripe)
Seed: 4.0–5.0 mm, ovoid to round, slightly 4-angled, greenish to dark brown, very hard, glabrous, shiny

Fruits harvested at an immature stage are hard and require pounding and macerating over medium screen to release seeds. Repeated threshing and blowing at 4.0 to separate seed from inner fruit casing. Velvet cloth separator can also be used to "catch" the casing and twigs as round seeds roll down the cloth mat. Use a blower or float seeds in water to sort out hollow seeds.

Difficulty Level 4

RHAMNACEAE

Ceanothus oliganthus

Fruit: Capsule, dehiscent (explosively when ripe)
Seed: 2.5–3.0 mm, ovoid, shiny black to reddish brown

Rub fruits over #10 and #18 sieves to break up capsules, Blower speed: 2.0. Use higher blower speed, or float seeds in water to sort out hollow seeds.

Difficulty Level 1

GENTIANACEAE

Centaurium venustum

Fruit: Capsule, dehiscent
Seed: 0.2–0.4 mm, round, shiny black to reddish black, wrinkled texture under magnification

Rub floral material over small screen to break capsules and release seed. Use progressively smaller sieves to # 60 to remove chaff. Blower speed: 0.75.

CAUTION! Some seed can fall through blower screen. Only use air sorter on seed that did not pass through #45 sieve.

Difficulty Level 2

ASTERACEAE

Centromadia pungens subsp. *laevis*

Fruit: Achene, ray achenes 1.5–2.0 mm, elliptic, acute, dark brown to gray, very tardily dehiscent from receptacle, disk achenes sterile
Seed: enclosed within fruit

Rub floral material over small screen then through #16 and #25 sieves. Blower speed: 1.75 or #18 and #30 sieves and blower speed at 1.25. Procedure may vary with each seed lot.
Higher blower speed required to sort out hollow, aborted fruits.

Difficulty Level 2

POLYGONACEAE

Centrostegia thurberi

Fruit: Achene: within a spiny 3.5–5.0 mm, indehiscent, reddish brown to yellowish tan involucre; achene is 1.5–2.0 mm, ovate and sharp tipped, dark gray with a white membranous outer fruit coating
Seed: enclosed within fruit

Rub dried plants over a medium screen to separate involucres from the stems. Re-sort material several times through a large screen to remove as much stem chaff as possible. Blower to 20 to remove chaff and empty involucres. Remove remaining twig chaff by repeated shaking over a textured paper plate or velvet cloth. Easy to clean if you don't care about the twiggy chaff. Difficult and requiring hand cleaning to get the collection really clean.

Difficulty Level 1

ROSACEAE

Cercocarpus betuloides

Fruit: Achene, 9.0–12.0 mm, linear, light to reddish-brown, mostly prominently ridged

Rub dried fruits (achenes) on rubber mat or small screen to remove feathery style tails and break up chaff. Blower speed: 2.0. Repeat as necessary to remove tails using increasing blower speeds with dissection examination to sort out hollow fruits that can make up a high percentage of the collection.

CAUTION!! Hairs from seed can be very irritating! Use face mask, long-sleeved shirt and goggles.

Difficulty Level 1

ROSACEAE

Cercocarpus ledifolius

Fruit: Achene, 7.0–8.0 mm, linear, reddish brown, hairy
Seed: enclosed within fruit

Rub dried fruits on rubber mat or small screen to remove feathery tails and to break up floral chaff. Blower speed: 2.25. Repeat as necessary to remove tails and increase blower speeds with regular dissection examinations to sort out hollow fruits that can be a high percentage of the collection.

CAUTION!! Hairs from seed can be very irritating! Use face mask, long-sleeved shirt and goggles.

Difficulty Level 1

ASTERACEAE

Chaenactis glabriuscula

Fruit: Achene, with fertile ray and disk achenes, both with pappus of scales. Disk achene: 3.0–4.5 mm, linear acute, black; ray achene: 5.0 mm, cylindric, light tan to gray
Seed: enclosed within fruit

Ray achenes firmly attached to receptacle beneath bracts. Gently rub floral material on rubber mat to break up chaff and release fruits from involucres. Repeat sieving, and use blower to sort material. Hand sort larger remaining chaff as required.

Difficulty Level 3

EUPHORBIACEAE

Chamaesyce platysperma

Fruit: Capsule, 3.0mm, round, 3 ovary chambers
Seed: 2.0 mm, ovoid, concave on back, ribbed on front, gray

Rub fruits over medium screen, then through #14 sieve. Blower speed: 1.0 to 1.25.

Difficulty Level 2

EUPHORBIACEAE

Chamaesyce setiloba

Fruit: Capsule: dehiscent
Seed: 1.0 mm, 3-sided, gray, faintly ribbed

Shake over a #35 sieve to separate dehisced seed from floral material. Separately rub unopened fruits over the #35 sieve to extract seeds from the fruits. Blower to 18 to remove chaff. If necessary blow again at 22 to blow seed up separating it from sand in the collection.

Difficulty Level 1

POLYGONACEAE

Chorizanthe brevicornu

Fruit: Achene, within a reddish brown, spiny involucre, 5.0–6.0 mm, firmly attached to stems
Seed: enclosed within fruit

Use string trimmer in bucket or rub floral stems over large screen to release fruits from stems. Clean only to involucres. Rub involucres over medium screen then #10 sieve to knock off spines. Blower speed: 1.75. Difficult to separate hollow and filled fruits.

Difficulty Level 5

POLYGONACEAE

Chorizanthe fimbriata var. *fimbriata*

Fruit: Achene, 3.5–4.0 mm, linear-acute brown sheath over blackish seeds, enclosed with the pink involucre.
Seed: enclosed within fruit

Clean only to involucres using medium screen plus rubber mat to separate fruits from twiggy pedicel. Sort involucres through #6 and #18 sieves. Blower speed: 1.25. Repeat sieving–much hand sorting.

CAUTION: Over rubbing on rubber mat can release seeds from involucre and also damage seed.

Difficulty Level 4

POLYGONACEAE

Chorizanthe parryi var. *fernandina*

Fruit: Achene, 1.8–2.0 mm, ovate-acute outer sheath medium gray to tan in color, tan to black with outer fruit sheath removed; loosely enclosed within a persistant indehiscent reddish straight-spined involucre, 2.2–2.5 mm long.
Seed: enclosed within fruit

Hand sort out large debris and exotic seeds. Rub inflorescences gently over #16 sieve with rubber covered wooden block, frequently shaking sieve so achenes will fall through. Gently rub sieved material on rubber mat, regularly sieving material through #20 sieve to separate seeds from involucres and chaff. Repeat as necessary until all involucres are empty. Blower speed: 1.5 to 1.7 to separate seeds from chaff. Resieve through #20 sieve several passes to remove twigs and large chaff.

Difficulty Level 4

POLYGONACEAE

Chorizanthe parryi var. *fernandina*

Fruit: Achene, 1.8–2.0 mm, ovate-acute outer sheath medium gray to tan in color, tan to black with outer fruit sheath removed; loosely enclosed within a persistant indehiscent reddish straight-spined involucre, 2.2–2.5 mm long
Seed: enclosed within fruit

Option 2 for large quantities: Thresh floral material with string trimmer in bucket for about 20 seconds, sort material through medium screen and then through a #18 sieve to separate seeds from involucres and chaff. Repeat threshing-screen-sieve process a minimum of 5 times to remove ca. 80–85% of seeds from involucres. Blow sieved seeds and chaff to 1.75. Sort material several passes through #20 sieve to remove remaining twiggy chaff.

Difficulty Level 3

POLYGONACEAE

Chorizanthe polygonoides

Fruit: Achene, 2.5–3.5 mm, ovoid-acute, yellowish to dark gray, within a 3-winged, dark red spine-tipped, indehiscent involucre
Seed: enclosed within fruit

Rub floral material over a medium screen or a #10 sieve to remove involucres from stems. Blower speed: 1.6 to separate hollow involucres from filled fruits, some hand sorting required.

Difficulty Level 3

POLYGONACEAE

Chorizanthe rigida

Fruit: Achene, 1.5 mm, ovate-acute, tightly enclosed within the spiny involucre, 3.0–6.0 mm
Seed: enclosed within fruit

Clean only to separate involucres from plants. Rub floral stems over large screen to separate spiny fruits. Sort over #12 sieve to remove small chaff. Blower speed: 1.25 to separate lighter empty involucres and chaff. Hand sort out twigs.

Difficulty Level 4

POLYGONACEAE

Chorizanthe valida

Fruit: Achene, 2.5–3.5 mm, narrow-ovate, 3-angled, acute at one end enclosed within a reddish brown, strongly pleated, involucre
Seed: enclosed within fruit

Rub inflorescences gently over smooth rubber mat with a padded wooden block. Shake material thorugh #16 and #18 sieves to sort out cleaned fruits from floral chaff. Avoid vigorous threshing that can damage the achenes. Blower speed: 1.5.

Difficulty Level 3

ASTERACEAE

Chrysothamnus nauseosus

Fruit: Achene, 5.0 mm, linear, tan to light brown, smooth, copious pappus of long feathery bristles
Seed: enclosed within fruit

Gently rub floral material on rubber mat to separate pappus from achenes. Blower speed: 1.5 to blow out cottony pappus and sterile fruits. Messy!! Use protective dust mask during cleaning.

Alternate method: vigorously shake small quantities of mature achenes in a paper bag then sort through screens or use blower to separate pappus hair from achenes.

Difficulty Level 3

ASTERACEAE

Cirsium neomexicanum

Fruit: Achene, 5.0–6.0 mm, plump, bluntly ovate, dark, shiny brown
Seed: enclosed within fruit

Rub flower heads over large screen to break up heads and release fruits. Most viable achenes are deeply set in the outer (ray) involucres. It helps to conduct the initial threshing outdoors as the pappus is very messy. Rub and sift material through a large screen to remove bracts and remaining "fluffy" chaff from fruits. Sift twice again over #6 and #14 sieves. Blower speed: 2.0 and again to 2.25 to separate broken and hollow achenes.

Difficulty Level 2

ONAGRACEAE

Clarkia amoena

Fruit: Capsule, dehiscent, 4-grooved, wider at base, woody
Seed: 1.0–1.5 mm, ovoid-elliptic, dark brown, shallowly papillate

For larger quantities, thresh floral material with string trimmer or over medium screen to open capsules and release seed, sort through #14 and #25 sieves. Blower speed: 1.25 to 1.75. Chaff from thick capsule chaff is the same size and weight as seed and difficult to separate. Resieve through #12 sieve or use velvet cloth to remove chaff particles. Best not to collect floral stems until the capsules have begun to split open. Place these upside down in the collection bag in a warm environment.

Difficulty Level 2

ONAGRACEAE

Clarkia bottae

Fruit: Capsule, dehiscent
Seed: 0.6–1.2 mm, ovoid, sharply angled, brown

Thresh floral material with a string trimmer unit, on a #16 sieve, or over a medium screen to break up capsules and release seed. Sort threshed floral material through small screen, then through a #16, or #18 and #40 sieves. Blower speed: 1.35. Rescreen through #16 sieve to remove seed capsule chaff.

Difficulty Level 1

ONAGRACEAE

Clarkia epilobioides

Fruit: Capsule, dehiscent
Seed: 0.5–0.8 mm, irregularly angled, dark to reddish brown, dull, pitted

Rub floral material over small screen to break capsules and release seed. Blower speed: 0.75 to remove light chaff, sort through #25 sieve to remove larger chaff, reblow at higher speed. Some hand cleaning required.

Difficulty Level 2

ONAGRACEAE

Clarkia gracilis subsp. *sonomensis*

Fruit: Capsule, dehiscent, long and narrow
Seed: 1.0–2.0 mm, ovoid to rectangular, sharpley angled, brown to grayish with dark spots, hairy under magnification

Thresh floral material over medium screen, or use string trimmer to open capsules and release seed. Rub and sort floral material through #16 and #30 sieves. Seeds are soft and easily damaged. While threshing, shake sieves periodically to allow seeds to fall through #16 sieve into a #30 sieve. Blower speed: 1.25 to 1.5. Repeated resieving through #14 sieve and some hand cleaning required to remove the heavy capsule chaff.

Difficulty Level 2

ONAGRACEAE

Clarkia purpurea

Fruit: Capsule, dehiscent
Seed: 1.0 mm, sharply angled, dark brown to black

Lightly rub and sort floral material through #16 and #20 sieves. Blower speed: 1.75. Resieve material through #14 sieve to catch seed capsule chaff.

Difficulty Level 1

ONAGRACEAE

Clarkia rubicunda

Fruit: Capsule, dehiscent, cylindric with 4 grooves
Seed: 1.0–1.5 mm, ovoid, angled, tip acute, reddish brown

Rub fruits over medium screen or use string trimmer to break up fruits, then rub and sort through small screen or #18 and #40 sieves. Blower speed: 1.25 to 1.5. Some, mostly sterile, seed is removed at higher blower speeds. Resieve through #16 sieve several times to catch seed capsule chaff.

Difficulty Level 1

ONAGRACEAE

Clarkia unguiculata

Fruit: Capsule, dehiscent
Seed: 0.8–1.0 mm, ovate, medium to reddish brown, prominently papillate or with glandular surfaces

Rub fruits over small screen, then through #18 and #40 sieves. Blower speed: 1.15. Resieve several times through #14 or #16 sieve to catch seed capsule chaff.

Difficulty Level 1

ONAGRACEAE

Clarkia virgata

Fruit: Capsule, dehiscent
Seed: 1.5–2.0 mm, sharply angled, dark dull brown, papillate

Rub fruits over medium screen to break up capsules, then sort through #14 and #25 sieves Blower speed: 1.5. Resieve through #12 sieve as necessary to remove seed capsule chaff.

Difficulty Level 1

ONAGRACEAE

Clarkia williamsonii

Fruit: Capsule, dehiscent, long and narrow
Seed: 1.0–1.5 mm, sharply angled, dark brown

Rub floral material through #16 and #40 or #14 and #35 sieves. Blower speed: 0.75. Difficult to separate chaff due to light seed weight. Best not to collect floral stems until capsules have begun to split open. Place these upside down in collection bag in a warm environment.

Difficulty Level 2

PORTULACACEAE

Claytonia perfoliata

Fruit: Capsule, dehiscent
Seed: 1.0–1.5 mm, elliptic, flat, shiny black, smooth

Rub floral material over small screen to open capsules and separate material from stems. Sort through #18 and #35 sieves to remove large and fine chaff. Blower speed: 1.5.

Difficulty Level 1

RANUNCULACEAE

Clematis lasiantha

Fruit: Achene, 5.0–6.0 mm, ovate, 4-angled, light brown, densely hairy with 20.0–40.0 mm plumose styles
Seed: enclosed within fruit

Rub floral material over a #6 sieve or large screen to remove bulk of styles. Lightly rub fruits on rubber mat or small screen, re-sieve through #6 and #16 sieves. Blower speed: 1.75. Remove damaged and parasitized seed at higher speeds.

Difficulty Level 2

SCROPHULARIACEAE

Collinsia concolor

Fruit: Capsule, dehiscent
Seed: 1.2 mm, ovoid to reniform, dark brown to black

Rub floral stems over small screen to open capsules, sort through #12 and #30 sieves. Blower speed: 1.5 to 2.0. Rescreen through #14 sieve as necessary.

Difficulty Level 1

SCROPHULARIACEAE

Collinsia heterophylla

Fruit: Capsule, dehiscent
Seed: 2.0–2.2 mm, ovoid, deeply concave on one side, surface with prominent net-veined reticulations

Rub floral stems over medium screen, and then through #12 and 25 sieves. Blower speed: 1.5.

Difficulty Level 1

SCROPHULARIACEAE

Collinsia parviflora

Fruit: Capsule, dehiscent
Seed: 0.8–1.5 mm, medium to dark brown, shallow net-veining on seed coat

Rub floral material over #16 and #35 sieves. Blower speed: 1.25 to 1.5.

Difficulty Level 1

SCROPHULARIACEAE

Cordylanthus maritimus subsp. *maritimus*

Fruit: Capsule, tardily dehiscent
Seed: 1.5 mm, reniform to elliptical, tan, net-ridged

Rub thoroughly dried floral material over a medium screen to open capsules and release seed, then sort through #12 sieve several times to remove large chaff. Blower speed: 1.25 to remove chaff and any inferior or sterile seed. Some hand cleaning required.

Difficulty Level 3

SCROPHULARIACEAE

Cordylanthus palmatus

Fruit: Capsule, tardily dehiscent
Seed: 1.0–3.0 mm, ovoid to kidney shaped, mostly dark brown with deeply corrugated seed coat, some seed yellow brown with little surface texture

Rub floral material over #14 and #30 sieves. Blower speed: 1.4 to separate chaff and hollow seed. Resieve through #20 sieve to remove small rock grains.

Difficulty Level 2

SCROPHULARIACEAE

Cordylanthus rigidus subsp. *setigerus*

Fruit: Capsule, tardily dehiscent
Seed: 1.0–1.8 mm, ovate, acute at one end, dark brown or black, rough corrugated surface

Rub floral material over #14 and #30 sieves. Blower speed: 1.5. Resieve over #16 sieve, blow again at 1.25–1.5.

Average number seeds per fruit 27; number fruits examined 10; total seeds 274—range 4 to 76 seeds per fruit

Difficulty Level 2

SCROPHULARIACEAE

Cordylanthus tenuis subsp. *capillaris*

Fruit: Capsule, tardily dehiscent
Seed: 1.2–2.0 mm, ovate, sharply angled, grayish brown, surface wavy-ridged

Rub floral material over #16 sieve to break up capsules and release seed. Blower speed: 1.25. Hand sort or screen out small quantity of large chaff.

Difficulty Level 2

ASTERACEAE

Coreopsis bigelovii

Fruit: Achenes, both ray and disk fertile
Seed: ray: reddish brown, elliptic slightly recurved, 6.0 mm, pitted; disk: linear, flattened, gray to black 6.0–8.0 mm, short appressed hairy

By hand or using a large screen, sort out stems and involucres after all fruits have dehisced from receptacles into collection bag. Shaking collection bag facilitates the release of achenes from flower heads. Material must be thoroughly dried or ray achenes may still be attached to inside of involucre bracts. Sort achenes and floral chaff through a large screen or a #6 sieve. Blower speed: 0.9.

Difficulty Level 3

CORNACEAE

Cornus nuttallii

Fruit: Drupe, 8.0–10.0 mm long, elongated-obovoid, bright red fleshy outer exocarp, single stone within.
Seed: 7.0–9.0 mm long, elongate-obovoid, thick woody tan to straw-colored endocarp

Soak fruits in water for several hours, then to remove outer fruit pulp macerate in a blender with nylon string line attached to taped blades; or macerate by hand with a wood block on a screen under running water. Let macerated fruits dry, then rub again on a screen to remove some of the dried fruit pulp. All fruits in this seed lot were filled and sound, even those that floated in water.

Difficulty Level 2

CROSSOSOMATACEAE

Crossosoma californicum

Fruit: Capsule, dehiscent
Seed: 2.5–3.0 mm, round or slightly compressed, shiny smooth black to brown, with dense fibrous "aril" appendage from point of seed attachment

Rub fruits over #16 sieve to break open follicles, separate fruits, and break up chaff. Blower speed: 1.75.

Difficulty Level 3

EUPHORBIACEAE

Croton californicus

Fruit: Capsule, tardily dehiscent, one seed per fruit
Seed: 3.0–5.0 mm, spherical, gray with black mottling, smooth

Rub floral material with wood block on rubber mat or small screen to separate outer fruit wall. Blower speed: 4.25 to separate out lighter aborted seeds (50% in this seed lot).

NOTE: Smaller light brown seeds produced are commonly sterile.

Difficulty Level 1

BORAGINACEAE

Cryptantha circumcissa

Fruit: Nutlet, indehiscent, four per flower, 1.0–1.2 mm, ovate-acute, light gray, shiny, shallowly tuberculed
Seed: enclosed within fruit

Rub floral material over #14 sieve to remove fruits from stems, then rub floral material over #20 sieve to separate nutlets from floral calyces. Blower speed: 1.25. Resieve several passes through #20 sieve, reblow to remove remaining chaff.

CAUTION!! Very irritating hairs and dust. Wear protective clothing, gloves, and dust mask.

Difficulty Level 2

BORAGINACEAE

Cryptantha flavoculata

Fruit: Nutlet, indehiscent, 2.5–3.0 mm, ovate, light brown to tan, rough, deeply pitted surface
Seed: enclosed within fruit

Rub floral stems over large screen, then through #12 and #18 sieves. Blower speed: 1.5. Resieve or hand sort out heavy twiggy chaff.

CAUTION!! Very irritating hairs and dust. Wear protective clothing, gloves, and dust mask.

Difficulty Level 2

BORAGINACEAE

Cryptantha intermedia

Fruit: Nutlet, indehiscent, four per flower, 1.5–2.0 mm, ovate-acute, light gray, prominently tuberculed
Seed: enclosed within fruit

Rub floral material over #14 sieve to remove fruits from stems, rub over #20 sieve to separate nutlets from floral calyces. Blower speed: 1.3. Resieve several passes through #20 sieve, reblow or hand sort to remove remaining chaff.

CAUTION!! Very irritating hairs and dust. Wear protective clothing, gloves, and dust mask.

Difficulty Level 2

BORAGINACEAE

Cryptantha micrantha

Fruit: Nutlet, indehiscent, 0.6–1.5 mm, broadly lanceolate acute, gray, smooth, shiny
Seed: enclosed within fruit

Rub floral material over #25 and #45 sieves. Blower speed: 1.25.

CAUTION!! Very irritating hairs and dust. Wear protective clothing, gloves, and dust mask.

Difficulty Level 1

BORAGINACEAE

Cryptantha muricata

Fruit: Nutlet, indehiscent, 1.0–2.0 mm, ovate acute, medium to dark gray, prominently tuberculed
Seed: enclosed within fruit

Rub floral stems over small screen or use string trimmer to break up material and release seed, rub and sift through #18 and #30 sieves. Blower speed: 1.5. Resieve through #16 sieve to remove twigs.

CAUTION!! Very irritating hairs and dust. Wear protective clothing, gloves, and dust mask.

Difficulty Level 2

BORAGINACEAE

Cryptantha traskiae

Fruit: Nutlet, indehiscent, 1.0–1.5 mm, brown, ovate acute, compressed, shallowly tuberculed
Seed: enclosed within fruit

Rub floral material over medium screen, then through #20 and #40 sieves. Blower speed: 1.5.

CAUTION!! Very irritating hairs and dust. Wear protective clothing, gloves, and dust mask.

Difficulty Level 2

BORAGINACEAE

Cryptantha virginensis

Fruit: Nutlet, indehiscent, 2.5–4.5 mm, ovate, gray, rough pitted surface
Seed: enclosed within fruit

Rub floral material over medium screen, then through #12 and #16 sieves to separate nutlets from floral involucres and to break up chaff. Blower speed: 2.0. Repeat rubbing and blowing as necessary.

CAUTION!! Very irritating hairs and dust. Wear protective clothing, gloves, and dust mask.

Difficulty Level 2

CUCURBITACEAE

Cucurbita foetidissima

Fruit: Berry: 70.0–80.0 mm, spherical, bright yellow
Seed: 8.0–11.0 mm, broadly obovate, light tan, smooth

Section fruits then soak in warm soapy water for 2–3 hours. Scoop out pulp and seeds into the water then agitate to separate pulp from seeds. Rinse seeds with forceful spray then let dry. Gently rub seeds on small screen to break up dried pulp and clean seeds. Blower to 65 to separate seeds from pulp and any hollow seeds.

Difficulty Level 3

CUPRESSACEAE

Cupressus forbesii

Fruit: Cone, dehiscent to indehiscent
Seed: 3.5–5.0 mm, oval-angular, dark reddish brown, smooth

To hasten opening of cones soak in boiled water for 15 seconds and leave to dry in oven at 90°F. Some cones may open on their own if placed in a warm place such as on a high shelf near the ceiling. Vigorously shake opened cones, or use rock tumbler or dryer to dislodge seeds from cones. High percentage of sterile seeds (up to 90%). Viable seeds will have clean, moist, firm, white endosperm tissue that will be obvious when dissected. Separate aborted seeds using blower speed between 2.0 and 3.0.

Difficulty Level 4

ASTERACEAE

Deinandra clementina

Fruit: Achene, ray achenes 1.5–3.0 mm, dull black, rough wrinkled texture
Seed: enclosed within fruit

Rub floral material over small screen, then sort through #12 sieve to seperate achenes and coarse chaff, then rub over rubber mat or sieve to break up chaff. Blower speed: 1.0 to 1.25. Repeat screening through #18 sieve to remove any remaining large chaff.

(formerly *Hemizonia clementina*)

Difficulty Level 4

ASTERACEAE

Deinandra conjugens

Fruit: Achene, ray achene 2.0–2.5 mm, ovate, convex on one side, black, tuberculed to corky texture; disk achene 2.0 mm, mostly straight and tapered, medium brown, with several short papery pappus bracts
Seed: enclosed within fruit

Rub and sort material through #14 and #35 sieves to separate achenes and chaff. Gently rub material again over #35 sieve with wooden block to separate ray achenes from involucres and to break up large floral chaff. Blower speed: 1.5 to separate the frequently high percentage of sterile or parasitized fruits.

NOTE: 98% of the ray and only 2% of the disk achenes were fertile in this seed lot. Ray achenes enclosed within involucral bracts. (formerly *Hemizonia conjugens*)

Difficulty Level 4

ASTERACEAE

Deinandra kelloggi

Fruit: Achene, ray achene 2.0–2.5 mm., broadly ovate, curved, light brown to black, wrinkled texture; disk achene 1.5–2.0 mm, linear, light brown, smooth, appear sterile
Seed: enclosed within fruit

Rub and sort material through #14 and #35 sieves to separate achenes and chaff, then gently rub material again over a #35 sieve with a wooden block to separate ray achenes from involucres and to break up large floral chaff. Blower speed: 1.5 to separate the frequently high percentage of sterile fruits.

NOTE: 75% of the achenes in this seed lot were sterile and were removed at higher blower speeds.

(formerly *Hemizonia kelloggi*)

Difficulty Level 3

ASTERACEAE

Deinandra mohavensis

Fruit: Achene, ray achene 2.0 mm, dark brown to black, curved; disk achene 2.0 mm, light brown, straight, 4-angled
Seed: enclosed within fruit

Rub floral material over medium screen, then through #12 or 14 and #25 sieves. Blower speed: 1.25. Shake achenes on rough textured paper plates or velvet cloth to separate remaining chaff from fruits. Seed lots mostly 80–90% ray achenes.

(formerly *Hemizonia mohavensis*)

Difficulty Level 3

ASTERACEAE

Deinandra palmeri

Fruit: Achene, ray achenes 2.0 mm, dark brown to black, curved, wrinkled texture; disk achenes 1.5 mm, linear, light brown, smooth, appear sterile
Seed: enclosed within fruit

Rub floral material over small screen to break up chaff and separate achenes from floral receptacles, then through #16, #30, and then through #10 sieves. Blower speed: 1.5. Dissect sample and check for filled fruits.

NOTE: Garden seed collection from 5 clones all producing large quantities of fruits. All fruits were sterile. Plant is likely self-incompatible.

(formerly *Hemizonia palmeri*)

Difficulty Level 3

RANUNCULACEAE

Delphinium californicum

Fruit: Follicle, dehiscent, 11.0–16.0 mm
Seed: 2.0–3.0 mm, 3–4 angled, dark brown, rough wrinkled seed coat

Rub fruits over medium screen, rescreen several times to remove larger stems and chaff. Blower speed 1.0.

Difficulty Level 1

RANUNCULACEAE

Delphinium cardinale

Fruit: Follicle, dehiscent
Seed: 2.0–3.0 mm, irregularly angled, dark brown, wrinkled, or rough in texture

Rub capsules and stems over #12 and #20 sieves. Blower speed: 1.25.

Difficulty Level 1

PAPAVERACEAE

Dendromecon rigida

Fruit: Capsule, dehiscent, linear 5.0–10.0 cm
Seed: 3.0–4.0 mm, spherical, brown to olive, finely reticulate with a prominent fleshy aril

Let fruits dry and dehisce in paper collection bag. Seed is then easily separated through a #10 sieve or blower unit.

Difficulty Level 1

POACEAE

Deschampsia danthonioides

Fruit: Caryopsis, enclosed within the lemma and palea of the floret; floret: lemma and palea ovate, 1.0–2.0 mm long, covered with dense white hairs, single bent awn
Seed: enclosed within fruit

Rub floral material gently on rubber mat to dislodge florets from inflorescence, sort through #18 sieve. Blower speed: 1.25.

Difficulty Level 3

POLYGONACEAE

Dodecahema leptoceras

Fruit: Achene, 1.5–2.0 mm, ovate, tan membraneous sheath; two achenes per involucre
Seed: enclosed within fruit

Hand sort out large debris and chaff. Rub floral material over #16 sieve to separate achenes from involucres. Blower speed: 1.25. Repeat rubbing and blowing until all achenes are extracted and involucres are well macerated. Blower speed: 1.5 to sort out poor quality sterile seed and stem chaff.

Difficulty Level 2

PRIMULACEAE

Dodecatheon clevelandii

Fruit: Capsule, dehiscent
Seed: 1.5–1.8 mm, ovoid to sharply irregularly angled, pinkish brown

Rub floral material over #12 and #20 sieves. Blower speed: 1.25 to 2.1 to sort out hollow, poor quality seed.

Difficulty Level 1

PRIMULACEAE

Dodecatheon redolens

Fruit: Capsule, dehiscent
Seed: 1.5–2.0 mm, ovoid to sharply irregularly angular, brown

Rub floral material over #12 and #20 sieves. Blower speed: 1.0.

Difficulty Level 1

BRASSICACEAE

Draba corrugata

Fruit: Silicle, elliptic, tardily dehiscent, 5.0–20.0 mm, 2.0–3.0 mm wide
Seed: 0.5–1.2 mm, elliptical, flat, yellow to reddish brown, surface shallowly pitted

Rub floral stems and fruits over #25 sieve to open and release seed from silicle. Blower speed: 1.0. Resieve with #25 sieve to remove any remaining heavier chaff.

Difficulty Level 1

BRASSICACEAE

Draba cuneifolia

Fruit: Silicle, eliptical, 8.0–10.0 mm
Seed: 0.5–0.7 mm, elliptical, reddish yellow

Rub floral material over #12 sieve to separate fruits from stems. Rub fruits over #30 and #60 sieves with padded wood block. Resieve several times through #30 sieve, Blower speed: 1.0.

Difficulty Level 2

CRASSULACEAE

Dudleya caespitosa

Fruit: Follicle, tardily dehiscent
Seed: 1.0 mm, narrow ovoid to fusiform, reddish brown

Rub floral stems and fruits over small screen, then through #30 sieve. Blower speed: <1.0.

Difficulty Level 2

CRASSULACEAE

Dudleya cymosa

Fruit: Follicle, tardily dehiscent
Seed: 0.5–1.0 mm, narrow ovoid, acute to fusiform, reddish brown

Rub fruits over #30 sieve to release seed from follicles. Blower speed: at 0.75 to 1.0. Resieve with #25 sieve several times to remove remaining chaff.

Difficulty Level 2

CRASSULACEAE

Dudleya densiflora

Fruit: Follicle, tardily dehiscent
Seed: 0.7–1.2 mm, narrow ovoid, acute to fusiform, reddish brown

Rub fruits and floral material over #45 sieve. Blower speed: 0.75.

Difficulty Level 2

CRASSULACEAE

Dudleya pulverulenta

Fruit: Follicle, tardily dehiscent
Seed: 0.2–0.5 mm, narrow ovoid, acute to fusiform, reddish brown

Rub floral stems over small screen to open capsules and to remove stems and coarse chaff, then through #35 and #45 sieves. Blower speed: 0.75. Resieve several times, then through #35 sieve to remove fine chaff, (seeds will go through sieve).

Difficulty Level 1

CRASSULACEAE

Dudleya setchellii

Fruit: Follicle, tardily dehiscent
Seed: 0.4–0.8 mm, narrow ovoid, acute to fusiform, reddish brown

Rub fruits over #45 sieve. Blower speed: 1.0. A moderate quantity of underdeveloped/unfilled seeds were removed at this blower speed. 100 % of remaining seeds filled and moist.

Difficulty Level 1

CRASSULACEAE

Dudleya variegata

Fruit: Follicle, tardily dehiscent
Seed: 0.7–1.0 mm, narrow ovoid, acute to fusiform, reddish brown

Rub fruits and floral material over #45 sieve. Blower speed: 1.25.

Difficulty Level 2

CACTACEAE

Echinocereus engelmannii

Fruit: Fleshy, berry-like, 20–30 mm, spheric, red, spiny
Seed: 1.0–1.5 mm, kidney shaped, brownish black, pitted

Place moist fruits in blender and cover them with twice as much water as fruits, whir at low speed, using short pulses until all fruits are broken up. Drain fruits and wash material over a #25 sieve, place outdoors in a warm sunny location or indoors in an oven set at the lowest setting to thoroughly dry. Rub seeds and dried pulp over sieve. Blower speed: 2.25 to remove chaff and hollow seeds. Thoroughly dry fruits can also be rubbed over screens to break up fruits and release seed that can then be blown.

Difficulty Level 2

CACTACEAE

Echinocereus maritimus

Fruit: Fleshy, berry-like in form, thin skinned, spiny
Seed: 1.0 mm, kidney shaped, dark brown to black, pitted

Run moist fruits through food mill to macerate fruits, wash pulp and seeds over #30 sieve. Place outdoors in a sunny warm place or indoors in an oven set at less than 100°F. Seeds are fragile and seed coats are easily damaged during cleaning. Using a stiff brush, rub the thoroughly dried material on a #35 sieve to break up dried pulp. Blower speed: 1.8 to 2.0 to remove chaff and hollow seeds.

Difficulty Level 2

POACEAE

Elymus glaucus

Fruit: Caryopsis (7.0–10.0 mm), tightly enclosed within the lemma and palea of the floret (9.0–12.0 mm), narrowly ovate, tan, smooth with awns 2–2.5 times the body length

Seed: Enclosed within fruit

Wearing respiratory protection and sturdy gloves, repeatedly rub floral material between your palms to remove awns. Blower at 1.5 removes chaff, sterile seed and some fertile seed. After blowing the heavier seed is 100% filled and the lighter material is 50% good seed, and 50% chaff and sterile florets. To recover additional filled seed reblow at 1.5. The recovered seed will have about 70–75% filled seed.

Difficulty Level 1

HYDROPHYLLACEAE

Emmenanthe penduliflora

Fruit: Capsule, dehiscent, 7.0–10.0 mm
Seed: 1.5–2.0 mm, oval, flat, gray-brown, surface broadly pitted

Rub floral material over medium screen, then through #14 and #25 sieves. Blower speed: 1.0. Then, 2 to 3 rescreenings through a #12 sieve to separate seeds from the remaining larger chaff.

Difficulty Level 2

ASTERACEAE

Encelia californica

Fruit: Achene, 4.5–7.0 mm, obovate, flat, dark gray, short, dense white fringe hairs
Seed: enclosed within fruit

Material needs to be very dry. By hand, gently pluck achenes and chaff from receptacles. Blow fruits and receptacle chaff scales at 1.0. Blow good material up at 1.5 blower speed to separate them from the parasitized clumps of achenes. Blow floral material to 1.15 to separate hollow fruits and some chaff. Gently rub remaining achenes, scales, and petals over #20 sieve or rubber mat with wooden block to break up chaff. Blow at slowly increasing speeds to 1.2, repeat as necessary to increase percentage of filled achenes.

Difficulty Level 4

ASTERACEAE

Encelia farinosa

Fruit: Achene, 4.0 mm, obovate, flat, dark gray with a dense fringe of white hairs along the edge
Seed: enclosed within fruit

Material needs to be very dry. By hand, gently pluck achenes and chaff from receptacles. Blow achenes and receptacle chaff scales at 1.0. Blow good material up at 1.5+ blower speed to separate them from the parasitized clumps of achenes. Blow floral material to 1.15 to separate hollow fruits and some chaff. Gently rub remaining achenes, scales, and petals over #20 sieve or rubber mat with wooden block to break up chaff. Blow at slowly increasing speeds to 1.2, repeat as necessary to increase percentage of filled achenes.

Difficulty Level 4

EPHEDRACEAE

Ephedra californica

Fruit: Cone
Seed: 8.0 mm, ovate, dark brown, smooth, 1 seed per fruit

Rub cones over medium screen to remove cone scales. Blower speed: 3.0–4.0 to sort out chaff. Repeat rubbing and blowing as necessary. Final blowing to 9.0 to sort out broken and parasitized seed.

NOTE: Use velvet cloth-lined box, shaking material from side to side, to separate cones or seeds from stem branches in collection.

Difficulty Level 2

ONAGRACEAE

Epilobium sp.

Fruit: Capsule, dehiscent, straight
Seed: 0.5–1.0 mm narrowly elliptic, reddish brown, longitudinally ridged

Rub material over medium screen to release seed from fruits, then through #25 sieve. Blower speed: 1.0. Resieve through a #25 sieve as necessary to remove remaining larger capsule chaff.

Difficulty Level 1

MALVACEAE

Eremalche rotundifolia

Fruit: Capsule, tardily dehiscent, 10.0 mm
Seed: 3.0–4.0 mm, compressed wedge-shaped disks, black

Rub fruits over #6 and #12 sieves to open capsules and release seeds. Blower speed: 1.0. Hand clean remaining heavy capsule chaff.

Difficulty Level 3

POLEMONIACEAE

Eriastrum densifolium subsp. *elongatum*

Fruit: Capsule, tardily dehiscent, average of four seeds per fruit
Seed: 1.5–2.5 mm, narrow elliptic, tan, smooth

Rub flower heads over medium screen to release capsules and seed from flower heads, rub screened floral material through #16 and #35 sieves to release seed from remaining capsules. Blower speed: 1.5. Resieve through #16 sieve several passes to remove twigs and large chaff, some hand cleaning required.

Difficulty Level 2

POLEMONIACEAE

Eriastrum densifolium subsp. *sanctorum*

Fruit: Capsule, tardily dehiscent, average of four seeds per fruit
Seed: 2.5–3.5 mm, narrow elliptic, tan, smooth

Rub flower heads over medium screen to release capsules and seed from flower heads, rub screened floral material through #16 and #35 sieves to release seed from remaining capsules. Blower speed: 1.5. Resieve through #16 sieve several passes to remove twigs and large chaff, some hand cleaning required.

Difficulty Level 2

POLEMONIACEAE

Eriastrum sapphirinum

Fruit: Capsule, tardily dehiscent, 3–4 seeds per fruit
Seed: 1.0–2.0 mm, narrow elliptic, greenish tan, smooth

Rub flower heads over small screen to separate fruits. Blower speed: 1.5 to separate capsules from chaff. Rub capsules over rubber mat with padded wood block to release seeds, then through #25 and #40 sieves. Reblow at 1.25, resieve several passes through #18 or #20 sieves to catch remaining larger chaff.

Difficulty Level 3

ASTERACEAE

Ericameria cooperi

Fruit: Achene, ray achenes 2.5 mm, ovate-cylindric tapering, ridged, densely short, silky-white hairy; disk achenes appear sterile
Seed: enclosed within fruit

Gently rub material through #14 and #20 sieves. Blower speed: 1.25 to remove the frequently high percentage of sterile fruits and chaff. Floral material can be shaken on a paper plate to further separate the semi-sticky seeds from peduncles and sterile disk flowers.

Alternate method: Gently rub floral material on a rubber mat to remove pappus from the achenes and to break up chaff. Use blower to clean and sort out the high percentage of hollow, sterile achenes.

Difficulty Level 4

ASTERACEAE

Ericameria linearifolia

Fruit: Achene, 4.0–5.0 mm, lanceolate, densely silky, hairy; ray achenes fertile, disk achenes sterile
Seed: enclosed within fruit

Rub floral material over rubber mat to remove pappus from achenes, then sift through #12 sieve to remove cottony chaff. Blower speed: at 1.5. Sterile disk achenes will be blown off with the chaff.

Alternate method: Rub floral material over #14 sieve or medium screen. Blower speed: 1.6 to sort out sterile fruits.

Difficulty Level 2

ASTERACEAE

Erigeron breweri

Fruit: Achene, 1.6–2.0 mm, yellowish to medium brown, smooth with 2.0–3.0 mm long pappus bristles
Seed: enclosed within fruit

Clean by hand using a camel-hair brush to separate achenes from floral receptacles, then rub material on rubber mat to remove pappus from achenes. Sort through a #25 sieve, repeat rubbing and sorting if necessary to remove pappus. Blower speed: 1.0 to separate chaff and sterile inferior fruits. Some hand cleaning required.

Difficulty Level 3

ASTERACEAE

Erigeron foliosus

Fruit: Achene, 1.8–2.2 mm, narrow-elliptic, light brown
Seed: enclosed within fruit

Gently rub floral material on rubber mat to remove pappus from achenes. Blower speed: 1.0 for > 1 minute, will lose some achenes in chaff. Repeat rubbing and blowing as necessary.

Difficulty Level 3

ASTERACEAE

Erigeron glaucus

Fruit: Achene, 1.5–2.0 mm, oblong, tan to reddish, smooth
Seed: enclosed within fruit

Clean by hand using a camel-hair brush to separate achenes from floral receptacles. Shake achenes and floral material over #12 and #20 sieves to remove pappus from the fruits. Blower speed: 1.0. Rub remaining material over a #40 sieve to knock off remaining pappus and break down chaff. Reblow as necessary to remove remaining chaff and pappus hairs.

Difficulty Level 3

HYDROPHYLLACEAE

Eriodictyon crassifolium

Fruit: Capsule, dehiscent
Seed: 0.8–1.2 mm, elliptic, dark brown, shallowly ridged

Rub floral material over small screen, then through #20 and #45 sieves. Blower speed: 1.25, resieve through #18 sieve several times.

Difficulty Level 1

POLYGONACEAE

Eriogonum cinereum

Fruit: Achene, 2.5–3.0 mm, ovate, acute, brown, smooth
Seed: enclosed within fruit

Rub material over #18 sieve to break up flowers and release seed. Blower speed: 2.0, repeat rubbing and blowing as necessary. Very low percentage of flowers actually set seed.

Difficulty Level 2

POLYGONACEAE

Eriogonum crocatum

Fruit: Achene, often tightly enclosed within floral involucre; 2.5–4.0 mm, ovate, acute at one end, light brown to pale gray, smooth
Seed: enclosed within fruit

Rub floral material over medium screen to separate flower heads and stems, then through #16 and #35 sieves. Blower speed: 1.25 to separate flowers and chaff. Repeat rubbing with padded wooden block on rubber mat or #25 sieve to further separate achenes from involucres. Blower speed: 1.75–2.0 to sort out sterile or parasitized fruits.

Difficulty Level 3

POLYGONACEAE

Eriogonum davidsonii

Fruit: Achene, 1.0–2.0 mm, ovate, acute at one end, black to reddish, smooth, shiny
Seed: enclosed within fruit

Rub floral material on rubber mat or small screen to separate flower and fruits from branches, then through #16 and #30 sieves. Continue rubbing on #30 sieve to separate achenes from floral calyces. Blower speed: 1.5.

Difficulty Level 2

POLYGONACEAE

Eriogonum fasciculatum var. *foliolosum*

Fruit: Achene, 1.8–2.5 mm, ovate-acute at one end, reddish brown, smooth
Seed: enclosed within fruit

Rub floral material over medium screen to break up heads and remove large chaff, then through #14 and #25 sieves, shaking periodically. Blower speed: 1.5. Gently rub fruits over #25 sieve to remove outer husk. Blower speed: 2.0 to sort out poor quality, empty, aborted seeds. Repeat rubbing and blowing as necessary. Sift seeds through #12 sieve to remove remaining twigs and large chaff. A low percentage of flowers actually set seed.

Difficulty Level 3

POLYGONACEAE

Eriogonum giganteum

Fruit: Achene, 0.8–1.3 mm, ovate, acute, reddish brown, smooth
Seed: enclosed within fruit

Rub floral material over small screen or #18 and #30 sieves. Blower speed: 1.5. A low percentage of flowers actually set seed.

Difficulty Level 2

POLYGONACEAE

Eriogonum gracile

Fruit: Achene, 1.2–2.0 mm, ovate-acute at one end, black to reddish, smooth, shiny
Seed: enclosed within fruit

Rub floral material over rubber mat or small screen to separate flower and fruits from branches, then through #16 and #30 sieves. Continue rubbing on #30 sieve to separate achenes from floral calyces. Blower speed: 1.5.

Difficulty Level 2

POLYGONACEAE

Eriogonum microthecum var. *johnstonii*

Fruit: Achene, 3.0 mm, ovate-acute, brown to wine red, smooth
Seed: enclosed within fruit

Lightly rub floral material over #30 sieve to separate fruits from persistant involucre and break up floral material. Use blower to separate chaff from fruits and to sort out sterile achenes. A low percentage of flowers actually set seed.

CAUTION! Delicate seed is easily damaged during the threshing process.

Difficulty Level 2

POLYGONACEAE

Eriogonum nudum

Fruit: Achene, 2.0–3.0 mm, ovate, 3-angled, sharply acute at one end, reddish brown, smooth
Seed: enclosed within fruit

Gently rub floral material over #14 and #30 sieves to release fruits from floral calyx, continue rubbing on #30 sieve to separate achene from persistant calyces. Blower speed: 1.25 to remove floral chaff and under developed or sterile seeds. Repeat rubbing and blowing as necessary.

Difficulty Level 3

POLYGONACEAE

Eriogonum ovalifolium subsp. *vineum*

Fruit: Achene, 3.5–4.0 mm, ovate, sharply narrowing and acute at one end, reddish to tan membraneous sheath covering the achene
Seed: enclosed within fruit

Rub floral material over medium screen. Blower speed: 1.25 to remove lighter floral chaff, then through #14 sieve. Blower speed: 1.5.

Difficulty Level 2

POLYGONACEAE

Eriogonum saxatile

Fruit: Achene, 3.5–5.0 mm, ovate-acute, light to medium brown, smooth
Seed: enclosed within fruit

Rub material and frequently shake through #14 and #25 sieves to separate seed from involucres and to break up chaff. Seed fragile and easily broken. Blower speed: 1.5 to separate parasitized and poor quality seed. A low percentage of flowers actually set seed.

Difficulty Level 3

POLYGONACEAE

Eriogonum thomasii

Fruit: Achene, 0.6–1.0 mm, ovate-acute, shiny black, smooth
Seed: enclosed within fruit

Rub material over medium screen, then through #14, #30, and #45 sieves, repeat through # 30. Blower speed: 1.25. A low percentage of flowers actually set seed.

Difficulty Level 2

POLYGONACEAE

Eriogonum trichopes var. *trichopes*

Fruit: Achene, 1.5–2.0 mm, ovate-acute, dark reddish brown, smooth
Seed: enclosed within fruit

Rub floral material over small screen, then through #20 and #40 sieves. Blower speed: 1.25. A low percentage of flowers actually set seed.

Difficulty Level 3

POLYGONACEAE

Eriogonum umbellatum subsp. *nevadense*

Fruit: Achene, 3.5 mm, ovate-acute, angular, tan, smooth
Seed: enclosed within fruit

Rub floral material over #14 and #25 sieves. Blower speed: 1.75. A low percentage of flowers actually set seed.

NOTE: Hand sorting required.

Difficulty Level 4

POLYGONACEAE

Eriogonum wrightii subsp. *subscaposum*

Fruit: Achene, 2.0–4.0 mm, ovate-acute, brown to grayish tan, smooth
Seed: enclosed within fruit

Rub floral material over medium screen, then through #12 and #20 sieves, then through #10 sieve to remove remaining coarse chaff. Blower speed: 1.5. A low percentage of flowers actually set seed.

NOTE: Good seed is large and plump. Use blower to sort out shriveled, shrunken seed.

Difficulty Level 2

ASTERACEAE

Eriophyllum confertiflorum

Fruit: Achene, 2.0–4.0 mm, narrow obconical, 4-angled, dark brown, pappus of short scales
Seed: enclosed within fruit

Gently rub thoroughly dried flower heads over medium-size screen followed by gentle rubbing and sifting through #18 and #25 sieves. Blower speed: 1.25. Higher blower speed may be needed to separate sterile fruits.

Difficulty Level 4

ASTERACEAE

Eriophyllum lanatum

Fruit: Achene, 3.5–5.0 mm, linear, gray to black, ridged, pappus of short scales. High percentage of sterile fruits
Seed: enclosed within fruit

Gently rub and sift material through #12 and #30 sieves. Blower speed: 1.1, then gently rub material on rubber mat to break up chaff and flowers. Blower speed: 1.25. Some hand sorting. 75% achenes sterile and blown out at 1.25.

Difficulty Level 3

ASTERACEAE

Eriophyllum nevinii

Fruit: Achene, 3.0 mm, linear, tapered, 4-angled, ribbed, dark gray. High percentage of sterile fruits
Seed: enclosed within fruit

It is very difficult to separate achenes from chaff, thus it is best to avoid threshing. If possible, collect very mature samples and allow fertile achenes to be shed from the receptacle during initial drying process. If this is not possible, rub very well-dried floral material on rubber mat with padded wood block to break up chaff, then sort through #12 and #30 sieves to separate large chaff and dust. Blower speed: 1.0, then repeat process as necessary. Blower speed: 1.1–1.25 to remove hollow sterile achenes.

Difficulty Level 5

ASTERACEAE

Eriophyllum wallacei

Fruit: Achene, 2.0–3.0 mm, linear, black, appressed silky hairy under magnification, pappus of short scales
Seed: enclosed within fruit

Rub stems and floral material with padded wood block over #14 and #30 sieves to remove achenes that are tightly enclosed within involucre bracts. Sort material through a #20 or #25 sieve, lightly rub on rubber mat to break up flower petal chaff. Blower speed: 0.8 to remove some chaff and sterile achenes. Repeat rubbing and blowing as necessary. Not possible to remove all flower petal chaff from fruits.

Difficulty Level 4

Fruits

APIACEAE

Eryngium aristulatum var. *hooveri*

Fruit: Schizocarp, 2.5–3.5 mm, densely covered with white scales splitting into 2 mericarps enclosed within and adherent to inferior ovary wall
Seed: enclosed within fruit

Rub floral material over medium screen to separate fruits from inflorescences and stems. Resieve several passes to remove stem material and floral peduncles, then sort through #18 sieve to remove fine chaff. Blower speed: 1.65 to remove chaff and a small quantity of sterile fruits.

Difficulty Level 3

PAPAVERACEAE

Eschscholzia caespitosa

Fruit: Capsule, dehiscent
Seed: 1.5–2.4 mm, sub-globose to somewhat elongated, gray-brown to black, with low to moderate reticulation or pitted

Let fruits dry and dehisce in paper collection bag, then sort floral material through #18 sieve several times to remove chaff. Blower speed: 1.5.

Difficulty Level 1

PAPAVERACEAE

Eschscholzia californica

Fruit: Capsule, dehiscent
Seed: 1.5–1.8 mm, oval to round, brown to greenish brown, surface prominently net-ridged

Let fruits dry and dehisce in paper collection bag, then sort floral material through #12 and #25 sieves. Blower speed: 1.25–1.5. Resieve through #12 sieve and reblow as necessary to remove remaining chaff.

Difficulty Level 1

PAPAVERACEAE

Eschscholzia lemmonii

Fruit: Capsule, dehiscent from base, 3.0–7.0 cm
Seed: 1.5 mm, elliptic, dark brown, surface net-ridged

Let fruits dry and dehisce in paper bag. Rub fruits over medium screen to remove any remaining seed from capsules, then sort floral material through #12 and #18 sieves. Blower speed: 1.75.

Difficulty Level 1

PAPAVERACEAE

Eschscholzia lobbii

Fruit: Capsule, dehiscent
Seed: 1.2 mm, spherical, medium brown, deeply pitted

Let fruits dry and dehisce into paper collection bag. Rub fruits over medium screen, then through #12 sieve. Blower speed: 1.5.

Difficulty Level 1

ROSACEAE

Fallugia paradoxa

Fruit: Achene, 3.0–4.0 mm long, narrowly ovate, light tan, surface hairy with long hairy style tails
Seed: enclosed within fruit

Achenes are fragile and easily broken during cleaning. Gently rub floral material over #30 sieve or small screen to break up chaff and remove tails and hairs. Blower speed: 1.25 to remove light chaff. Sort material through #18 sieve to remove any broken seed and small chaff. Reblow at 1.5 to remove chaff and empty hollow seed. Hand sort out remaining large chaff.

Difficulty Level 4

CACTACEAE

Ferocactus cylindraceus

Fruit: Fleshy, berry-like in form, 1–2 cm diameter, scaly; tardily dehiscent
Seed: 2.0–2.5 mm, spherical to reniform, black, smooth to shallowly pitted under magnification

Break open dried fruits with pliers to release seeds. Rub this material over #10 and #18 sieves. Blower speed: 1.75. Higher blower speed separates parasitized and poor quality seeds.

Difficulty Level 1

FOUQUIERIACEAE

Fouquiera splendens

Fruit: Capsule, dehiscent
Seed: 10.0–13.0 mm, elliptic, convex, white hairy with marginal wings

Gently rub capsules on rubber mat to dislodge seeds, then hand select seeds. Do not use screens or blocks to break up capsules as resulting pieces of the capsules are very difficult to separate from seed.

Difficulty Level 5

OLEACEAE

Fraxinus dipetala

Fruit: Samara, 18.0–25.0 mm, including attached wing, obovate, laterally compressed (flat), tan
Seed: seed within the fruit 10–12.0 mm

Hand sort out stem and chaff material. Blower speed: 1.5 to remove inferior hollow fruits and those containing dried up seed.

Difficulty Level 2

STERCULIACEAE

Fremontodendron californicum

Fruit: Capsule, tardily dehiscent, average 4–5 seeds per fruit
Seed: 4.0 mm, ovoid, dark brown, smooth

Very difficult to open capsules and remove seeds! Vigorously agitating and washing fruits in blender dislodges 75% of the seeds and helps to control hairs.

Try drying fruits at warm temperature (90°F) for extended period to encourage seeds to naturally fall out of fruits or bag fruits on the plant letting them dehisce naturally.

CAUTION!! Irritating stellate hairs on fruits and chaff. Use gloves and dust mask.

Difficulty Level 4

RUBIACEAE

Galium angustifolium

Fruit: Nutlet, 2.5–3.0 mm, reniform, reddish brown to black, long white silky hairs, tuberculed
Seed: enclosed within fruit

Rub thoroughly dried fruits over small screen or #25 sieve to remove hairs and separate fused nutlets. Blower speed: 2.25 to remove chaff, hairs, and hollow seed.

Difficulty Level 2

SCROPHULARIACEAE

Galvezia speciosa

Fruit: Capsule, dehiscent
Seed: 0.8–1.0 mm, ovoid, dark brown to black, irregularly ridged to pitted

Rub floral material over small screen to release seed. Rub and sift through #30 sieve. Blower speed: 1.0. Rescreen through #20 sieve to remove remaining large chaff.

Difficulty Level 1

GARRYACEAE

Garrya veitchii

Fruit: Berry, spherical to elliptic, brown to black when ripe
Seed: 3.0–4.5 mm, gelatinous coating and sticky when wet

Rub dried fruits over screen to remove fruit pulp, then float cleaned seeds to separate good (sinkers) from bad seed (floaters). Rub soaked seeds (sinkers) over sieve under running water if necessary to remove additional adherent fruit pulp. Examine sample for viable embryo tissue and dry thoroughly before storing.

Difficulty Level 3

ASTERACEAE

Geraea canescens

Fruit: Achene, 8.0–9.0 mm, obovate, dark gray with long white hairs, pappus bracts 2.0 mm long
Seed: enclosed within fruit

Shake floral material through large screen to remove involucres. Blower speed: 1.0. Difficult to remove flower petals from collection. Thoroughly dry floral material, then rub on rubber mat to break up petals and chaff. Blower speed: 1.1. Repeat rubbing and blowing as necessary. Higher blower speeds may be required to sort out sterile achenes.

Difficulty Level 4

GERANIACEAE

Geranium carolinianum

Fruit: Schizocarp
Seed: 1.7–2.2 mm, ovoid, brownish gray, pitted

Rub fruits over small screen, then sift through #6 sieve to remove large chaff. Blower speed: 1.5.

Difficulty Level 3

POLEMONIACEAE

Gilia capitata

Fruit: Capsule, dehiscent
Seed: 2.0 mm, ovoid, pinkish tan, smooth to shallowly pitted

Rub floral material over medium screen to release seed, rub and sift through #16 and #35 sieves. Blower speed: 2.0.

Difficulty Level 1

POLEMONIACEAE

Gilia latifolia

Fruit: Capsule, dehiscent
Seed: 0.5–1.0 mm, oval, yellow orange, shallowly pitted

Rub floral material over small screen to release seed, rub and sift through #16 and #35 sieves. Blower speed: 1.5

CAUTION: Most seed goes up with chaff if not blown carefully.

Resieve several times through #18 sieve to catch larger chaff.

Difficulty Level 2

POLEMONIACEAE

Gilia nevinii

Fruit: Capsule, dehiscent
Seed: 0.8–1.0 mm, ovoid, pinkish brown, shallowly pitted

Rub floral material over small screen to release seed from capsules, rub and sift through #18 and #25 sieves. Blower speed: 1.25.

Difficulty Level 1

POLEMONIACEAE

Gilia transmontana

Fruit: Capsule, dehiscent
Seed: 1.0–2.0 mm, ovate angled, reddish brown, winged margins

Rub floral material through small screen, then through #18 and #40 sieves. Blower speed: 1.5.

Difficulty Level 2

POLEMONIACEAE

Gilia tricolor

Fruit: Capsule, dehiscent
Seed: 1.2–1.5 mm, oblong to ovoid, pinkish tan, deeply pitted

Rub floral material over small screen, then through #18 and #30 sieves. Blower speed: 1.65.

For large quantities use string trimmer / weed wacker to thresh collection material and release seed then use screens, sieves, and blowing to remove chaff.

Difficulty Level 1

CAMPANULACEAE

Githopsis diffusa subsp. *diffusa*

Fruit: Capsule, dehiscent, ca. 8.0–9.0 mm long, obconic, ribbed
Seed: 0.5–0.7 mm, narrow-elliptic, shiny reddish brown, slightly sticky

Rub floral material over #35 and #60 sieves. Blower speed: 1.0. Resieve through #40 sieve to separate seeds from remaining chaff.

Difficulty Level 2

ASTERACEAE

Gnaphalium californicum

Fruit: Achene, 0.5–0.7 mm long, elliptic, brown
Seed: enclosed within fruit

Rub floral material over #30 and #60 sieves. Most fruits will pass through a #60 sieve.

CAUTION: Can not use blower since much of the fruits pass through blower cup screen.

Difficulty Level 2

ASTERACEAE

Gnaphalium canescens subsp. *thermale*

Fruit: Achene, 0.5–0.9 mm, elliptic, yellowish brown
Seed: enclosed within fruit

Rub floral material over small screen to break up flower heads and release fruits, then sift material through #25 and #60 sieves. Blower speed: 1.0, resieve several passes through #30 sieve.

Difficulty Level 3

BRASSICACEAE

Guillenia flavescens

Fruit: Silique, very tardily dehiscent
Seed: 1.2–1.8 mm, elliptical, brownish to orange

Rub floral material over small screen, then rub and sift through #18 and #30 sieves. Blower speed: 1.75.

Difficulty Level 2

BRASSICACEAE

Guillenia lemmonii

Fruit: Silique, very tardily dehiscent
Seed: 1.0–1.5 mm, elliptical, red brown

Siliques must be thoroughly dry. Rub over small screen to break open fruit, then rub and sift through #18 and #30 sieves. Blower speed: 0.75. Resieve material through #25 sieve to remove remaining chaff.

Difficulty Level 2

ASTERACEAE

Gutierrezia californica

Fruit: Achene: ray achenes 2.5–3.0 mm, narrow elliptic, thinly white hairy with short pappus scales; disk achenes 2.0–2.5 mm, narrow obconic, densely white hairy with long chaff scales
Seed: enclosed within fruit

Rub dried floral material over small screen then over a #20 sieve. Rescreen through #18 and #35 sieves to remove larger twig chaff and small aborted achenes. Blower to 18 to separate lighter chaff. Remaining material still contains a great quantity of twig chaff. Resieving over a #16 sieve will catch some of it. The species is easy to clean to this point but requires hand picking to achieve a perfect seed lot.

Difficulty Level 2

ASTERACEAE

Harmonia hallii

Fruit: Achene, both ray and disk achenes 3.0–4.0 mm, ray achenes tightly enclosed within subtending involucral bracts
Seed: enclosed within fruit

Rub floral material over medium screen to break up flower heads, repeat over #10 sieve. Gently rub achenes and floral chaff over rubber mat or #16 sieve to further break down chaff. Blower speed: 1.0–1.25 to remove hollow aborted achenes and chaff. Hand pick, screen, or use velvet cloth to sort out remaining heavy chaff and peduncles.

Difficulty Level 5

ASTERACEAE

Hazardia orcuttii

Fruit: Achene, 2.0–4.0 mm long, light to dark golden brown, ribbed. High percent sterile aborted fruits. Only 25% of this seed lot, 487 of 1,970 seeds, were filled. Fertile achenes tend to have wide spreading pappus.
Seed: enclosed within fruit

With finger pressure or light rubber-covered wood block, lightly rub achenes on rubber mat to remove pappus hairs from achenes. Blower speed: 1.5.

Difficulty Level 3

LAMIACEAE

Hedeoma nanum var. *californicum*

Fruit: Nutlet, 0.75–1.0 mm, elliptical, reddish brown
Seed: enclosed within fruit

Rub floral stems over #12 sieve then rub with small block on rubber mat or #18 sieve. Blower speed: 1.25, then sort through #20 sieve to remove any remaining chaff.

Difficulty Level 1

ASTERACEAE

Helianthus annuus

Fruit: Achene, 2.0–3.5 mm, obovate, short appressed hairy
Seed: enclosed within fruit

Leave flower heads on paper or in bag to dry, most fertile achenes will release into collection bag or onto paper. Blower speed: 1.75–2.75. Avoid rubbing flower heads to extract fruits since receptacle bracts in collection are difficult to separate from the achenes.

NOTE: Flower heads can be harvested as early as when petals shrivel.

Difficulty Level 2

ASTERACEAE

Helianthus gracilentus

Fruit: Achene, 2.0–3.0 mm, ovate, dark gray, smooth; both ray and disk achenes fertile
Seed: enclosed within fruit

Break open dried flower heads and sift through #12 sieve. Blower speed: 1.75 to separate aborted fruits and chaff. Remaining peduncles can be separated out by shaking material and transferring between two "rough textured" paper plates or by using velvet cloth technique.

Difficulty Level 3

HYDROPHYLLACEAE

Heliotropium curassavicum

Fruit: Nutlet, deeply set in a persistent calyx
Seed: 1.0 mm, spherical, dull dark brown to black, or lighter, smooth

Rub dried inflorescences over #14 and #30 sieves. Blow material in the #30 sieve to 30 blower speed then resieve through a #14 sieve several times to catch twig chaff.

Difficulty Level 1

LINACEAE

Hesperolinon congestum

Fruit: Capsule, tardily dehiscent
Seed: 1.8–2.0 mm, ovate-acute, dark gray, mostly smooth; average of 4.3 filled, fully developed seeds of 10 fruits examined

Rub fruits gently on rubber mat to split capsules and release seeds. Blower speed: 1.5. Repeat rubbing and blowing as necessary to separate all seeds. Some hand cleaning required to remove peduncles.

Difficulty Level 3

ROSACEAE

Heteromeles arbutifolia

Fruit: Berry, 5.0–6.0 mm, red to orange, or rarely yellow
Seed: 2.5–4.5 mm, ovoid, compressed one side, light brown

Rub fresh fruits over #12 and #18 sieves under running water to macerate fruit, place pulp and seeds on a screen in warm environment to thoroughly dry. Lightly rub dried seeds over #18 sieve to break up and to clean remaining pulp from seed. Blower speed: 2.0–2.5. For dried fruits, soak prior to macerating. A blender or food mill can also be used to macerate fruits.

CAUTION! Fresh seeds are very soft and easily damaged during maceration process.

Difficulty Level 3

ASTERACEAE

Heterotheca sessiliflora

Fruit: Achene, 1.5–2.5 mm, narrowly ovate, reddish brown, densely covered with short white hairs, pappus of firmly attached long bristles
Seed: enclosed within fruit

Filled achenes that are plump to just slightly compressed are hand sorted from the floral material. No mechanical method developed to effectively separate the high percentage of sterile achenes. See *Lessingia*.

Difficulty Level 5

SAXIFRAGACEAE

Heuchera abramsii

Fruit: Capsule, dehiscent
Seed: 0.5–0.75 mm, elliptical, black, surface with spiny velcro-like hooks

Rub floral material over #18, #30 and #60 sieves. Blower speed: 0.75. Resieve through #30 to remove large chaff.

Difficulty Level 1

SAXIFRAGACEAE

Heuchera elegans

Fruit: Capsule, dehiscent
Seed: 0.3–0.5 mm, narrowly oblong, black, spiny

Rub floral material over small screen to break up fruits and release seed, then sort through #30 and #60 sieves. Blower speed: <1.0.

Difficulty Level 1

SAXIFRAGACEAE

Heuchera rubescens var. *alpicola*

Fruit: Capsule, dehiscent
Seed: 0.5–0.8 mm, elliptical, light brown to black, spiny

Rub capsules over #14 sieve, sort through #25 and #60 sieves. Blower speed: 1.0.

Difficulty Level 1

ASTERACEAE

Holocarpha macradenia

Fruit: Achene, ray achenes 2.0–3.0 mm, broadly ovate with 2–4 prominent longitudinal ridges, dark brown; disk achenes: 2.0 mm, narrow, smooth or with ridges, light tan. Very tardily dehiscent from the receptacle
Seed: enclosed within fruit

Rub floral stems over #14 and #30 sieves. Blower speed: 1.25. Resieve material through #10 sieve.

CAUTION! Some ray achenes remain tightly enclosed within involucres—check chaff and rub material over #30 sieve or rubber mat if necessary, then reblow material at 1.25. Repeat rubbing and blowing as necessary. Hand clean small amount of remaining chaff.

Difficulty Level 3

ROSACEAE

Holodiscus microphyllus var. *microphyllus*

Fruit: Achene, 1.3 mm, ovoid, tan to brown with copious long hairs
Seed: enclosed within fruit 1.0 mm, reniform, reddish brown to tan

Fruits, leaves, and stems covered with hairs and a sticky exudate makes cleaning and sorting to high percent fill very difficult. Rub floral material over a #10 sieve to separate fruits from floral calyces and to break up the chaff; exudate can be stripped by washing in warm soapy water; after the floral material is thoroughly dried, rub lightly over a #25 sieve to break up chaff and hairs that make the material clump; 3 of 10 fruits blown out at 0.5 contained filled, viable seeds. Unable to separate chaff from filled achenes.

Difficulty Level 5

POACEAE

Hordeum intercedens

Fruit: Caryopsis, enclosed within the lemma and palea of the floret, 8.0 mm, that is actually a spikelet of 3 florets, 2 sterile and one fertile (the central floret)
Seed: enclosed within fruit

Gently rub floral material on rubber mat to detach spikelets from floral spikes and stems. Blower speed: 0.75 to remove small quantity of chaff.

Difficulty Level 3

ROSACEAE

Horkelia rybergii

Fruit: Capsule, tardily dehiscent
Seed: 1.0–1.5 mm, elliptical to kidney shaped, light to medium brown, minutely pitted under magnification

Rub inflorescences over small screen to break capsules and release seed, sort through #18 and #35 sieves. Blower speed: 1.5 to 1.8 to remove chaff. Blower to 2.25 to separate out relatively high percentage of hollow seed.

NOTE: Fertile seed only 8% to 28% in three seed lots of this species.

Difficulty Level 2

ASTERACEAE

Hulsea algida

Fruit: Achene, 5.0–8.0 mm, narrow, densely white hairy
Seed: enclosed within fruit

NOTE: Difficult—effective cleaning technique undeveloped. Rubbing achenes over screen to remove chaff spreads oils to chaff and sterile fruits making chaff and fruits clump and difficult to separate in the blower Try thorough drying, allowing fruits to dehisce naturally, or hand plucking only fully developed and ripened fruits from matured involucres.

Difficulty Level 5

ASTERACEAE

Hulsea californica

Fruit: Achene, 4.0–10.0 mm, narrow lanceolate acute, dark gray to black
Seed: enclosed within fruit

Fruits and flower parts are coated with a oily exudate that makes separation difficult. After coarse screening, achenes and chaff were put into a container of water with Dawn® dishwashing liquid and given a short 1/2–1 minute washing. Material was then thoroughly rinsed over a #40 sieve and put into a hot, sunny area for rapid drying. Gently rub over screen to break up chaff. Blower speed: 0.75 with alternating short bursts of air to break up clumps. Worked fairly well with tolerable quantities of chaff remaining.

Difficulty Level 4

ASTERACEAE

Hymenoclea salsola

Fruit: Achene, within a hard dark brown woody bur (4.0–7.0 mm) surrounded by flower bracts
Seed: enclosed within fruit

Rub floral material over medium screen or #10 sieve. Blower speed: 1.3. Repeat rubbing of burs over #12–#14 sieves with wood block to remove some of the bur bracts. Blower at successively higher speeds and dissection examination to remove hollow/aborted fruits.

Difficulty Level 2

ASTERACEAE

Hymenopappus filifolius var. *lugens*

Fruit: Achene: all disk type 5.0–6.0 mm, narrowly obovate, dark brown to black, long hairy with short pappus scales
Seed: enclosed within fruit

Rub thoroughly dried floral material on a small screen to separate fruits from plants. Flowers are firmly attached to the achene. Gently rub the fruits over a #30 sieve to remove and break up the flowers. Blower to 20 to remove the chaff and some hollow fruits. Re-rub as necessary and blow to 24 to remove aborted fruits and remaining chaff.

Difficulty Level 4

LAMIACEAE

Hyptis emoryi

Fruit: Nutlet, 1.5 mm, obovate, light brown
Seed: enclosed within fruit

Gently rub floral material over medium screen. Sort through #14 and #30 sieves with padded wood block to release seeds, then sift through #16 sieve. Blower speed: 1.0–1.5. Resieve through #16 sieve. High percentage of sterile fruits (up to 90%).

CAUTION! Seeds can be easily damaged during threshing.

Difficulty Level 2

IRIDACEAE

Iris douglasiana

Fruit: Capsule, tardily dehiscent
Seed: 3.0–4.0 mm, spherical to obovate, sometimes laterally compressed, light to dark brown to black, net-ridged or pitted

Break up capsules in #6 sieve or over a large screen. Blower speed: 1.75–2.0.

Difficulty Level 1

ASTERACEAE

Isocoma acradenia

Fruit: Achene, 2.0–4.5 mm, broadly linear, tan to light brown, densely hairy, long pappus
Seed: enclosed within fruit

Gently and lightly rub flower heads over large screen to separate achenes from floral heads. Blower speed: 1.0 to sort achenes with "buoyant" pappus up into chaff cups. Resieve twice through medium screen to separate involucral bracts.

Difficulty Level 1

ROSACEAE

Ivesia santolinoides

Fruit: Achene, 1.5–2.0 mm, mottled gray-brown, smooth
Seed: enclosed within fruit

Rub floral material over #18 and #40 sieves. Rubbing seeds on rubber mat with gentle finger pressure helps to crush and break up the many hollow aborted seed. Blower speed: 2.0.

Difficulty Level 3

PHILADELPHACEAE

Jamesia americana var. *rosea*

Fruit: Capsule, tardily dehiscent, made up of 3 woody locules, each containing ca. 6–8 seeds
Seed: 0.5–1.0 mm, narrow elliptic, dark to reddish brown, surface pitted to ridged, shiny, slightly sticky. Seeds very soft and easily damaged.

To avoid damaging seeds, allow fruits to dry and dehisce contents in the collection bag or envelope. Additional seeds remain deeply set at base of each locule. These were efficiently extracted with no observable damage by placing fruits into a rock tumbler with a small quantity of pea gravel and tumbling for 15–20 minutes. Sort material several times through #35 sieve. Blower speed: 1.0. Some hand cleaning required.

Difficulty Level 3

CUPRESSACEAE

Juniperus occidentalis var. *australis*

Fruit: 7.0–10.0 mm, spherical, reddish brown, smooth
Seed: 5.0–7.0 mm, ovate, reddish brown, ridged

Float fruits and sieve off the hollow floating fruits and chaff then let them dry out thoroughly. Fruits have a very high quantity of pitch that is difficult to remove from processing equipment. It is best to macerate the fruits when they have thoroughly dried. A blender modified with string trimmer line works well to strip the dry pulp off of the various sized fruits.

Difficulty Level 5

SCROPHULARIACEAE

Keckiella antirrhinoides

Fruit: Capsule, dehiscent
Seed: 1.5–2.0 mm, irregularly shaped, angled, dark brown, rough pitted surface

Rub floral material over medium screen, sift through #18 and #30 sieves. Blower speed: 1.25. Blowing at higher speeds will remove some broken capsule pieces with loss of some seed.

Difficulty Level 1

SCROPHULARIACEAE

Keckiella cordifolia

Fruit: Capsule, dehiscent
Seed: 1.0–1.5 mm, irregularly angled, reddish brown

Rub floral stems over medium screen to release seeds, sift through #18 and #40 sieves to separate chaff. Blower speed: 1.0.

Difficulty Level 1

CHENOPODIACEAE

Krascheninnikovia lanata

Fruit: Utricle, enclosed within 2 bracts that are densely covered with white hairs; 2.5–4.0 mm, ovate, medium to light brown, with long white pappus
Seed: enclosed within fruit

Rub fruits gently over rubber mat with padded wood block to open fruits and release seed. Use successively higher blower speed with dissection examinations to sort out chaff and aborted seeds (77% sterile in this seed lot).

Difficulty Level 3

POLEMONIACEAE

Langloisia setosissima subsp. *punctata*

Fruit: Capsule, indehiscent, 5.0 mm, white, 3-sided
Seed: 0.7–1.0 mm, ovate, pinkish tan, smooth

Rub floral material over medium screen, then sift through #16 and #35 sieves. Blower speed: 1.25.

If sand is in collection repeat blower to 2.25. This will blow seed up leaving sand and rocks in the blower cup.

Difficulty Level 1

ZYGOPHYLLACEAE

Larrea tridentata

Fruit: Nutlet, between 3–5 per flower elliptical to kidney shaped, dark brown
Seed: enclosed within fruit

Gently rub fruits over #10 or #12 sieve or rubber mat with padded wood block to separate nutlets from the fruit segments. Use blower to separate chaff and to sort for viable/filled seed.

Difficulty Level 4

ASTERACEAE

Lasthenia burkei

Fruit: Achene, ray achenes dark gray, prominently curved; disk achenes: 1.25–2.5 mm, straight, mostly sterile
Seed: enclosed within fruit

Rub floral material over small screen to release fruits from floral involucres. Rub very lightly and sift through #30 sieve to separate fruits from floral chaff. Blower speed: < 1.0.

NOTE: Collection may require additional light, gentle rubbing on rubber mat to further break down floral chaff to allow separation in blower.

Difficulty Level 4

ASTERACEAE

Lasthenia californica

Fruit: Achene, 2.0–2.5 mm, linear, sparse white hairy with long pappus scales
Seed: enclosed within fruit

Rub floral material on rubber mat to separate fruits from involucres, then sift through medium screen or sieves to remove stems and large chaff. Blower speed: <1.0.

NOTE: Collection may require additional light, gentle rubbing on rubber mat to further break down floral chaff to allow separation in blower.

Difficulty Level 3

MALVACEAE

Lavatera assurgentiflora

Fruit: Schizocarp, segments, 6–10, smooth
Seed: 4.0–4.5 mm, one each within fruit segments

Rub fruits over medium screen to break up heads and separate seed segments, Blower speed: 2.5. Unnecessary to remove seed from very hard fruit sections.

Difficulty Level 3

ASTERACEAE

Layia gaillardioides

Fruit: Achene, ray achene enclosed within involucral bracts; disk achenes: 3.0–4.0 mm, linear, dark gray, short pappus bristles
Seed: enclosed within fruit

Rub floral material over medium screen, then rub floral chaff and fruits on rubber mat to break down chaff and to separate ray achenes from involucres. Blower speed: 1.0 to sort out sterile fruits and light chaff. Repeat rubbing and blowing at 1.25 to select for filled viable achenes.

Difficulty Level 4

ASTERACEAE

Layia glandulosa

Fruit: Achene, disk achenes 4.0–5.0 mm, linear acute, black, pappus of white plumose bristles
Seed: enclosed within fruit

Gently rub fruits on and sift material through #12 sieve several times to break up chaff then re-sort through a #12 sieve. Blower speed: 1.0, slowly increasing to 1.2. Some good achenes and light chaff will be blown out. Increasing blower speed to 1.5 will blow fruits up separating heavy peduncles and twiggy chaff. Hand pick remaining chaff.

Difficulty Level 4

ASTERACEAE

Layia platyglossa var. *campestris*

Fruit: Achene, ray achene 3.0–4.0 mm, curved, black, tightly enclosed within subtending involucral bracts; disk achene: 4.0 mm, linear, dark gray, pappus of bristles

Rub floral material over medium screen to release achenes from heads and break up chaff, then sift material through #10 sieve to remove bulky chaff. Gently rub remaining material on rubber mat with padded wood block to break down chaff and release ray achenes. Blower speed: 1.25. Repeat rubbing and blowing as necessary, exercising caution not to damage achenes.

Difficulty Level 4

LAMIACEAE

Lepechinia fragrans

Fruit: Nutlet, at base of calyx, 3.5–4.5 mm, round, shiny black
Seed: enclosed within fruit

Rub floral material over medium screen to release seed, then sift through #6 and #16 sieves. Blower speed: 2.5. Float in water or use high blower speeds to sort out hollow or parasitized seed.

Difficulty Level 1

BRASSICACEAE

Lepidium jaredii

Fruit: Silicle, tardily dehiscent, 3.0–4.0 mm, ovate, flattish
Seed: 2.0 mm, obovate, reddish brown

Rub material over medium screen to separate fruits from plant. Gently rub fruits over and sift through #18 sieve or small screen to break up fruits and release seed. Blower speed: 1.5.

Difficulty Level 1

POLEMONIACEAE

Leptodactylon californicum

Fruit: Capsule, tardily dehiscent
Seed: 0.8–1.5 mm, ovate-angular, dark brown

Rub floral material over small screen to open capsules, then over #25 and #40 sieves. Blower speed: 1.25. Resieve through #20 sieve to remove remaining course chaff.

Difficulty Level 1

ASTERACEAE

Lessingia arachnoidea

Fruit: Achene, 2.0 mm, obconic, dark reddish brown to mottled with black, densely silky hairy, pappus bristles reddish
Seed: enclosed within fruit

Pappus bristles on fertile achenes are spread at right angles to the seed and will catch in a #12 sieve. Gently brush or tap achenes from harvested inflorescences onto paper. Repeatedly shake floral material through sieve to remove sterile fruits and floral bracts. Use blower at 1.25 to blow the fertile fruits up from the heavy floral chaff. Under magnification, plump, filled achenes are then hand sorted from any remaining sterile fruits and floral chaff.

Difficulty Level 5

LILIACEAE

Lilium parryi

Fruit: Capsule, tardily dehiscent
Seed: 4.0 mm, round to obovate, flat, white to light tan, stacked in capsule

Break open capsule to release seeds by gently rubbing fruits on a screen or rubber mat. Light blowing to separate capsule chaff.

Difficulty Level 1

LIMNANTHACEAE

Limnanthes douglasii subsp. *sulfurea*

Fruit: Nutlet, 4 per flower dehiscing early and easily from floral calyx; 2.5–5.0 mm, ovoid, dark reddish brown, deeply pitted, corrugated surface
Seed: enclosed within fruit

Rub floral material over large screen to break up chaff and separate seeds, then sort through #6 and #12 sieves. Blower speed: 2.75. Use higher blower speeds to remove hollow, sterile seeds.

Difficulty Level 1

LIMNANTHACEAE

Limnanthes flocossa subsp. *californica*

Fruit: Nutlet, indehiscent, held within persistant floral involucre (papery with wooly interior); 3.0–4.5 mm, ovoid, reddish brown, deeply pitted
Seed: enclosed within fruit

Rub involucres and sort material through #6, #10, and #18 sieves to loosen and separate seeds. Blower speed: 2.0 to separate chaff from seeds. Use higher blower speeds to remove hollow sterile seeds.

Difficulty Level 2

POLEMONIACEAE

Linanthus demissus

Fruit: Capsule, dehiscent
Seed: 0.5–0.7 mm, elliptical, pinkish tan to reddish

Rub floral material over #25 and #45 sieves. Blower speed: 1.0.

Difficulty Level 1

POLEMONIACEAE

Linanthus dianthiflorus

Fruit: Capsule, dehiscent
Seed: 0.5–0.6 mm, ovoid-angular, reddish brown

Rub floral material over small screen or #25 sieve to open capsules and sort out stems. Sort through #30 and #45 sieves to separate seed from chaff. Blower speed: 1.0.

Difficulty Level 1

POLEMONIACEAE

Linanthus dichotomus

Fruit: Capsule, dehiscent
Seed: 1.0–2.0 mm, elliptical, brown with white membraneous covering

Rub floral material over #16 sieve several times, then over #45 and #60 sieves. Blower speed: 1.0.

Difficulty Level 1

POLEMONIACEAE

Linanthus grandiflorus

Fruit: Capsule, dehiscent
Seed: 1.5–3.0 mm, elliptical, light tan

Rub floral stems over a medium screen to release seed from capsules and break up chaff, then sift through #14 and #25 sieves. Resieve several times through #12 sieve to catch remaining large chaff. Blower speed: 1.5.

NOTE: For large quantities use string trimmer to release seeds from flower heads. Or place harvested floral stems upside down in collection bag to ripen and much of the seeds will dehisce into the bag.

Difficulty Level 1

POLEMONIACEAE

Linanthus lemmonii

Fruit: Capsule, dehiscent
Seed: 0.4–0.6 mm, ovoid to angular, orange, shallowly pitted

Rub floral material over #45 sieve to open capsules and separate seed from chaff. Blower speed: 1.0. Resieve through #40 or #45 sieves to remove remaining chaff, repeat blowing.

Difficulty Level 2

POLEMONIACEAE

Linanthus parviflorus

Fruit: Capsule, dehiscent
Seed: 0.5–1.5 mm, oval, tan to brown

Rub material over small screen or use string trimmer for large quantities, then rub and sift through #14 and #30 sieves. Blower speed: 1.5.

Difficulty Level 1

LINACEAE

Linum lewisii

Fruit: Capsule, dehiscent, 5.0–10.0 mm
Seed: 3.5–5.0 mm, elliptical, compressed, reddish brown, smooth

Rub fruits over small sieve or screen to release seed. Blower speed: 1.25.

Difficulty Level 1

LINACEAE

Linum puberulum

Fruit: Capsule, dehiscent with 2–3 seeds per fruit chamber
Seed: 3.0 mm, narrow-elliptical, compressed, reddish brown, smooth, shiny

Rub and sort fruits through #16 and #30 sieves. Blower speed: 1.25 to separate seeds and chaff. Higher blower speed required to separate hollow, sterile seeds.

Difficulty Level 1

SAXIFRAGACEAE

Lithophragma heterophyllum

Fruit: Capsule, tardily dehiscent
Seed: 0.4 mm, ovoid, dull black, longitudinally ridged with prominent bumps along the surface ridges

Seeds will dehisce into collection bag or envelope, rub and sort floral material over #45 sieve to separate seeds from fruits. Blower speed: 1.5.

Difficulty Level 1

POLEMONIACEAE

Loeseliastrum matthewsii

Fruit: Capsule, 3.0–4.0 mm, dehiscent, 3-sided, spherical, whitish
Seed: 1.0–2.0 mm, ovate, pinkish tan

Rub floral material over medium screen, then rub and sift through #18 and #35 sieves, repeat through #18 sieve to remove course heavy chaff. Blower speed: 1.5, then at 2.25 to blow seed up, separating rocks from seed.

Difficulty Level 1

CAPRIFOLIACEAE

Lonicera conjugialis

Fruit: Berry, fleshy, 4.0–17.0 mm, red to black made up of two joined ovaries
Seed: 2.5–3.5 mm, spherical compressed, white to light brown, smooth

Macerate moist berries over small screen or #18 sieve under running water or in food mill, then dry immediately in warm environment. Rub thoroughly dried seeds on #18 sieve to remove remaining fruit pulp from seeds. Use blower to separate dried pulp from seeds.

Difficulty Level 2

FABACEAE

Lotus dendroideus var. *traskiae*

Fruit: Legume, indehiscent, 7.0–15.0 mm, oblong, tapering
Seed: 2.2–3.0 mm, oblong, greenish to tan to black, smooth

Very tough fruits. Rub floral material over medium screen to separate fruits from floral chaff and other plant material. Vigorously rub fruits over #18 sieve or rubber mat with a padded wood block to open fruits and release seed. Blower speed: 1.5 to separate chaff. Blender with the blades taped can be effective in opening fruits.

CAUTION! Seeds can be broken during threshing.

Difficulty Level 5

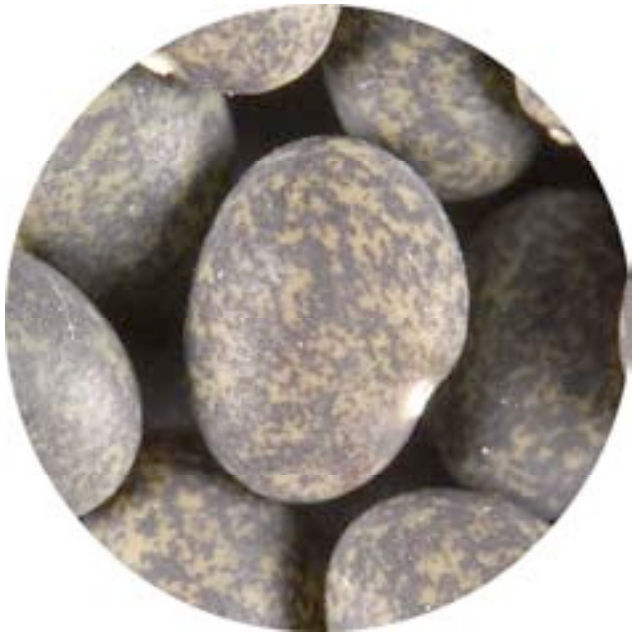
FABACEAE

Lotus otayensis

Fruit: Legume, dehiscent
Seed: 2.5 mm, ovate to kidney shaped, black with light mottling under magnification, smooth

Allow fruits to dry and dehisce into paper collection bag, or rub fruits over medium screen to release seeds. Blower speed: 7.0 (maximum speed), or float out hollow or parasitized seeds in water.

Difficulty Level 1



FABACEAE

Lotus scoparius var. *scoparius*

Fruit: Legume, indehiscent (tough)
Seed: 2.0–3.0 mm, curved, greenish with black mottling

Rub floral material with wooden block over medium screen or #16 sieve. Shaking released seeds through sieve, resieve several times through #12 sieve. Blower speed: 1.75. Resieve several times through #12 and #16 sieves.

CAUTION! Seeds can be broken during threshing.

Difficulty Level 3

FABACEAE

Lupinus hirsutissimus

Fruit: Legume, dehiscent
Seed: 3.5–5.0 mm, ovoid, gray with black mottling

Most fruits with viable seeds will dehisce into collection bag as they dry, rub fruits over coarse screen to open any remaining fruits and release seed. Blower speed: 2.0–6.0. Use higher blower speeds, float or hand sort to remove hollow and parasitized seed.

Difficulty Level 1

FABACEAE

Lupinus microcarpus var. *densiflorus*

Fruit: Legume, dehiscent
Seed: 4.0–6.0 mm, round, compressed, light brown with gray mottling

Rub floral material over large screen to open fruits and release seeds or allow fruits to dry and dehisce into collection bag. Rescreen several times to remove excess chaff, then sift through #10 sieve to remove small chaff. Blower speed: 4.0–6.0. Use higher blower speeds and hand sort to remove hollow and parasitized seed.

Difficulty Level 2

FABACEAE

Lupinus succulentus

Fruit: Legume, dehiscent
Seed: 4.0–6.0 mm, oval, dark brown to mottled

Rub floral material over large screen to open fruits and release seeds or allow fruits to dry and dehisce into collection bag. Rub unopened fruits over large screen. Blower speed: 2.0–6.0. Use higher blower speeds and hand sort to remove hollow and parasitized seed.

Difficulty Level 1

JUNCACEAE

Luzula comosa

Fruit: Capsule, spheric, greenish to dark brown.
Seed: 1.0–1.5 mm, elliptic, dark gray or red-brown to brown

Rub floral material over #18 sieve to open fruits and release seeds. Blower speed: 1.5.

Difficulty Level 2

SOLANACEAE

Lycium andersonii

Fruit: Berry
Seed: 1.5–2.0 mm, elliptical to kidney shaped, yellowish tan, shallowly pitted

Macerate fresh fruits in a food mill or over a sieve. Pour material on a #25 sieve and rinse thoroughly under running water. Place the sieve with pulp and seeds in a warm environment to dry. Rub dried material over sieve to remove dried fruit pulp from seeds. Blower speed: 1.75 to separate dried pulp and hollow seeds. Rescreen through #12 sieve to remove any large chaff. Reblow as necessary.

Difficulty Level 3

ROSACEAE

Lyonothamnus floribundus subsp. *floribundus*

Fruit: Capsule, tardily dehiscent
Seed: 2.0–2.5 mm, tan, narrow-ovate, compressed

Strip fruits from branches by hand before processing; vigorous rubbing with wood block over #25 sieve will open fruits and release seeds. Blower speed: 1.0. Rub remaining chaff and seed very lightly over #40 sieve, blow at 1.25. Resieve through #25 several passes to remove chaff. High percent of hollow seeds.

Difficulty Level 4

ASTERACEAE

Machaeranthera asteroides

Fruit: Achene, 4.0 mm, narrowly obpyramidal, tan, densely appressed white hairy with long plumose bristles
Seed: enclosed within fruit

Pappus is firmly attached. Due to the copious adherent pappus the achenes clump with chaff and sterile fruits. Filled, plump achenes must be hand picked from the floral material.

Difficulty Level

ASTERACEAE

Madia elegans

Fruit: Achene, ray achenes 5.0 mm, elongate compressed, light brown, held within outer involucral bracts; black and dark colored ray and disk achenes are sterile
Seed: enclosed within fruit

Rub floral material over medium screen, then sort through #10 and #20 sieves. Blower speed: 1.75 to 2.0 to sort out hollow, sterile achenes that can be a high percent of the seed lot.

Velvet cloth used to remove heavy twiggy chaff from cleaned fruits.

Difficulty Level 3

MALVACEAE

Malacothamnus clementinus

Fruit: Schizocarp, segment - thick walled, hard
Seed: 2.0 mm, wedge-shaped, dark brown, one seed each fruit segment

Rub dried floral material over medium screen to separate seeds, then through #12 and #20 sieves. Blower speed: 1.5 to clean and to separate out sterile and parasitized seeds.

Difficulty Level 1

ASTERACEAE

Malacothrix californica

Fruit: Achene, 2.0–3.0 mm, narrowly lanceolate, ridged, acute, pappus long hairy
Seed: enclosed within fruit

Place floral heads in a #18 sieve with 1/4"–3/8" palm seeds, marbles, stones, etc. Cover sieve and shake to knock ripe fertile achenes from the receptacles and to remove some pappus. Sort over #30 sieve. Blower speed: to 1.25. Gently rub achenes on rubber mat to remove remaining pappus, then blow to 1.5 to separate pappus and sort out sterile hollow achenes.

Difficulty Level 2

ASTERACEAE

Malacothrix coulteri

Fruit: Achene, 2.0–3.0 mm, linear, 5-angled, tan
Seed: enclosed within fruit

Gently rub floral material over small screen or rubber mat to remove involucres and cottony pappus. Blower speed: <1.0.

Difficulty Level 3

ASTERACEAE

Malacothrix glabrata

Fruit: Achene, 2.0–3.0 mm, linear, 5-angled, tan
Seed: enclosed within fruit

Gently rub floral material over small screen. Blower speed: 0.75 to remove some pappus, then rub on rubber mat. Blower speed: 1.0.

Difficulty Level 3

ANACARDIACEAE

Malosma laurina

Fruit: Drupe, 2.0–3.0 mm, brown, glabrous with a white bloom enclosing the endocarp, 2.0 mm, dark brown to gray
Seed: enclosed within fruit

Rub drupes over #18 sieve to break up outer fruit material, separate and clean off fruits. Blower speed: 2.0.

Difficulty Level 3

CACTACEAE

Mammilaria tetrancistra

Fruit: Fleshy, berry-like in form, indehiscent, cylindric, red
Seed: 2.0–3.0 mm, ovate, black with prominent brown aril, wrinkled

Split fresh fruits, scrape out seeds to dry on small screen, when dry gently rub on small sieve to clean off remaining dried pulp.

Alternate method: For large quantities use blender with taped blades with just enough water to cover fruits. Run on slow speed then let dry on sieves. Rub dried material, then use blower to separate dried fruit pulp.

Difficulty Level 2

SCROPHULARIACEAE

Maurandya antirrhiniflora

Fruit: Capsule, dehiscent
Seed: 1.0–1.2 mm, ovoid, dark brown, deeply wrinkled

Rub floral material over #16 and #35 sieves to break up capsules and release seed. Resieve twice through #16 sieve. Blower speed: 1.25 to sort out chaff and underdeveloped or hollow seed.

Difficulty Level 2

LOASACEAE

Mentzelia albicaulis

Fruit: Capsule, 8.0–28.0 mm, tardily dehiscent
Seed: 1.0–1.5 mm, elliptic to ovoid, sharply angled, densely tuberculed

Rub floral material over medium screen to release seed from capsules, sort through #6 and #18 sieves. Blower speed: 1.5.

Seeds light and buoyant, use velvet cloth to remove remaining chaff.

Difficulty Level 2

LOASACEAE

Mentzelia lindleyi

Fruit: Capsule, tardily dehiscent
Seed: 1.0–1.5 mm, irregularly shaped, angled, some compressed, grayish brown, pitted

Rub floral material over medium screen or use string trimmer to thresh large batches, sift through #14 and #25 sieves. Blower speed: 1.25–1.5.

Difficulty Level 1

LOASACEAE

Mentzelia polita

Fruit: Capsule, dehiscent
Seed: 2.0–3.0 mm across, circular disk shaped, white with prominent wing surrounding central seed, surface faintly pitted

Best not to thresh floral material but allow seeds to naturally fall or be shaken from capsules. Chaff from capsule walls are difficult to separate from seeds. Remaining floral chaff is quite rough in texture and will adhere to material when shaken over cloth or rough paper plates. Some hand cleaning required get collections very clean. Green seeds not viable.

Difficulty Level 3

SCROPHULARIACEAE

Mimulus aurantiacus

Fruit: Capsule, tardily dehiscent, 12.0–20.0 mm, enclosed within persistent calyx
Seed: 0.8–1.0 mm, oblong-acute, reddish brown

Rub floral material over small screen, then sift through #30 and #60 sieves. Blower speed: at 1.0. Resieve through #30 sieve several times to remove remaining chaff.

Avoid over rubbing seed capsules as too finely processed chaff is difficult to separate from seeds.

Difficulty Level 2

SCROPHULARIACEAE

Mimulus guttatus

Fruit: Capsule, tardily dehiscent, 5.0–12.0 mm, enclosed within persistent calyx
Seed: 0.2–0.5 mm, dark brown to black

Rub fruits over small screen, sift through #45 sieve. Blower speed: 0.75.

Difficulty Level 1

SCROPHULARIACEAE

Mimulus pictus

Fruit: Capsule, dehiscent
Seed: 0.5 mm, ovoid, reddish brown, finely ridged

Rub capsules over #40 sieve (capsules very tough requiring repeated and firm effort), rub and resieve material several times through #45 and #60 sieves to remove chaff. Blower speed: 0.75.

Alternative method: Use blender in short pulses to break open capsules.

Difficulty Level 2

CARYOPHYLLACEAE

Minuartia douglasii

Fruit: Capsule, dehiscent
Seed: 1.5–2.0 mm, ovoid-compressed, reddish brown, smooth

Rub floral material over small screen, sift through #12 and #25 sieves. Blower speed: 1.1.

Difficulty Level 1

NYCTAGINACEAE

Mirabilis bigelovii

Fruit: Nut-like, 3.0–4.0 mm, ovate, black
Seed: enclosed within fruit

Rub material over medium screen or #12 sieve to separate fruit from stems and seed from fruit. Blower speed: 1.75 or higher to separate out hollow seeds, which can be a high percentage of the seed lot.

Difficulty Level 2

NYCTAGINACEAE

Mirabilis californica

Fruit: Nut-like, 3.0-5.0 mm, ovoid, light to dark brown
Seed: enclosed within fruit

Rub material over large screen to separate fruits from stems. Rub and sift material through #6, then over #14 sieves to remove outer fruit husk. 100% of the seeds in this collection were hollow or parasitized, although 5% of the collection sank during float test.

Difficulty Level 3

SCROPHULARIACEAE

Mohavea confertiflora

Fruit: Capsule, dehiscent
Seed: 1.5–2.0 mm, ovate, flattened, black, enclosed by upturned seed wings

Gently rub and shake fruits over small screen to release seeds, sift through #16 sieve to remove large chaff. Blower speed: 1.1–1.5. Seeds light and buoyant. Use velvet cloth to separate remaining chaff from seeds.

Difficulty Level 2

LAMIACEAE

Monardella cinerea

Fruit: Nutlet, at base of whorled calyx,1.5–1.75 mm, eliptical, light to dark brown, smooth
Seed: enclosed within fruit

Rub fruits and floral material over medium screen or #16 sieve, then sift through #20 or #25 sieve to remove fine chaff. Blower speed: 1.25. Successively higher blower speeds required to separate out hollow, sterile seeds.

Difficulty Level 2

LAMIACEAE

Monardella douglasii subsp. *venosa*

Fruit: Nutlet, at base of whorled calyx, 1.2–1.6 mm, elliptic to ovate, olive green with dark markings, glabrous
Seed: enclosed within fruit

Rub floral heads over #18 sieve to separate seeds from flowers. Blower speed: 1.25 required to separate out hollow, sterile seeds.

Difficulty Level 1

LAMIACEAE

Monardella glauca

Fruit: Nutlet, indehiscent, average 1–2 seeds per flower,1.8–2.2 mm
Seed: enclosed within fruit

Rub floral material over medium screen, then rub and shake floral material through #12 and #30 sieves to release seeds. Blower speed: 1.25 to 1.5 required to separate sterile light brown seeds (> 50% this seed lot). Use velvet cloth to remove any remaining chaff.

Difficulty Level 2

LAMIACEAE

Monardella lanceolata

Fruit: Nutlet, deeply set in persistent calyx,1.5 mm, oval, brown, smooth
Seed: enclosed within fruit

Rub floral material over small screen, then sift through #18 and #30 sieves. Blower speed: 1.5 required to separate out hollow, sterile seeds.

Difficulty Level 2

ASTERACEAE

Monolopia lanceolata

Fruit: Achene, 2.0–4.0 mm, ovate, dark brown
Seed: enclosed within fruit

Rub floral material over small screen to break down chaff, then sift through #12 and #20 sieves. Blower speed: 1.25. Use velvet cloth to sort flowers from fruits.

Difficulty Level 4

ASTERACEAE

Monoptilon bellioides

Fruit: Achene, 1.1 mm, ovate-acute, grayish tan, smooth pappus of bracts equal to length of seed
Seed: enclosed within fruit

Gently rub floral material over #18 and #40 sieves or on rubber mat, then resieve repeatedly through #18 sieve. Blower speed: 1.0–1.2. Repeat rubbing and blowing as necessary to clean. Separate remaining chaff by shaking material on rough textured paper plate or velvet cloth.

Difficulty Level 3

POLYGONACEAE

Mucronea californica

Fruit: Achene, tightly enclosed within a tardily dehiscent involucre, 4.0–5.0 mm
Seed: enclosed within fruit

Rub floral material over medium screen to separate strongly attached involucres from stems, then rub and sift through #6 and #18 sieves to release seeds and remove large chaff. Blower speed: 1.25.

Difficulty Level 4

POACEAE

Muhlenbergia rigens

Fruit: Caryopsis: 1.5 mm, broadly linear, dark brown, enclosed within the lemma and palea of the floret 3.0 mm, broadly linear, greenish tan, smooth
Seed: enclosed within fruit

Separate florets from stems by stripping down the stalk over a medium size screen then rub over a small screen to break up floral chaff and sterile florets. Or rub and shake material through a #14 sieve and then on a #35 sieve to break up floral chaff. Blower at 18 to blow out the very high quantity of chaff and sterile florets (>90% this seed lot).

Difficulty Level 2

POACEAE

Nassella pulchra

Fruit: Caryopsis, enclosed within the lemma and palea of the floret
Seed: enclosed within fruit

Rub floral material over large screen, then on rubber mat to separate awns from florets. Shake material on velvet cloth to separate awns and chaff from seed. Blower speed: 1.25.

Difficulty Level 3

POLEMONIACEAE

Navarretia atractyloides

Fruit: Capsule, tardily dehiscent
Seed: 1.0 mm, irregular, angular, reddish brown minutely pitted under magnification

Rub floral material over medium screen to open capsules and release seed. Rub and sort material through #20 and #30 sieves. Blower speed: 1.5.

Difficulty Level 1

POLEMONIACEAE

Navarretia fossalis

Fruit: Capsule, with 2 chambers, each containing a packet of ca. 17 seeds
Seed: 0.5–1.0 mm, bluntly ovate, reddish to dark brown, pitted Seeds contained by an opaque to transluscent yellowish membrane

Rub floral material over #14 sieve. Blower speed: 1.1 to remove course chaff. Rub material over #25 sieve to break up packets of seeds. Blower speed: 1.25 to separate seed from remaining packets and remove additional chaff. Resieve through #14 several times to remove larger chaff. Packets of seed are easily separated by a short period in water. After the seeds are separated they can be redried.

Difficulty Level 3

POLYGONACEAE

Nemacaulis denudata

Fruit: Achene, 0.5–1.0 mm, ovate-acute, dark shiny brown to black
Seed: enclosed within fruit

Rub floral material over small screen, then through #18 and #40 sieves, Blower speed: 1.75. Resieve through #20 sieve to remove coarse chaff.

Difficulty Level 2

CAMPANULACEAE

Nemacladus rubescens var. *tenuis*

Fruit: Capsule, dehiscent
Seed: 0.3–0.6 mm, broadly elliptic

Rub material on rubber mat or #20 sieve to break capsules and release seed, Blower speed: 1.25. Resieve several passes through #25 tapping lightly to remove chaff.

Difficulty Level 1

HYDROPHYLLACEAE

Nemophila menziesii

Fruit: Nutlet
Seed: 2.0–3.0 mm, ovoid, dark brown to black with a white to yellowish aril at one end, variable seed size, irregularly shallow pitted

Rub floral material over #16 and #30 sieves. Blower speed: 2.0. Blower easily removes chaff and poor quality seed.

Difficulty Level 1

LILIACEAE

Nolina cismontana

Fruit: Capsule, papery with 1–3 seeds per fruit
Seed: 2.0–4.0 mm, globose to ovoid, yellowish to greenish brown

Rub fruits over #14 and #25 sieves to release seeds, break up fruits and chaff. Use blower to separate seeds from chaff.

NOTE: Seed quality highly variable among seed lots, check for parasitism and seed soundness.

Difficulty Level 1

ONAGRACEAE

Oenothera cavernae

Fruit: Capsule, woody, indehiscent
Seed: 2.0–3.0 mm, ovoid, concave, dark brown

Capsule hard and woody. Open capsules with pliers, rub opened capsules over medium screen to release remaining seed.

CAUTION! Seed is easily damaged during cleaning process.

Difficulty Level 5

ONAGRACEAE

Oenothera deltoides subsp. *howellii*

Fruit: Capsule, hard, woody, 30.0–60.0 mm long, very strongly attached to stems, very tardily dehiscent
Seed: 1.5–2.0 mm, ovate, tan with dark mottling

Vigorously rub capsules over medium screen, care should be taken to avoid damaging the rather soft seeds during threshing process. Sort material through #16 and #30 sieves. Use blower to separate chaff, and poor quality seeds.

Difficulty Level 2

CACTACEAE

Opuntia bigelovii

Fruit: Fleshy, berry-like in form, 10–20 mm, leathery, tardily dehiscent
Seed: 2.0–4.0 mm, round, compressed

Rub dry fruits over medium screen to break up fruits and release seeds. Sieve larger fruit pieces out through large screen. Blower speed: 3.0. Hand sort remaining seed from chaff.

If fruits are too hard, soak overnight and macerate fruits in blender. Spread fruit pulp and seeds on screen in warm place to dry thoroughly. Rub over medium screen, then use blower to remove dried pulp.

Difficulty Level 2

CACTACEAE

Opuntia erinacea

Fruit: Fleshy, berry-like in form, 25-40 mm, dry when mature, tardily dehiscent
Seed: 5.0–7.5 mm, circular disks, light tan, shallowly pitted

Rub thoroughly dried fruits over medium screen. Blower speed: 3.0 to remove chaff.

Difficulty Level 1

CACTACEAE

Opuntia parryi var. *parryi*

Fruit: Fleshy, berry-like in form, dry to leathery, tardily dehiscent
Seed: 5.0–7.0 mm, round, compressed, white

Rub dried fruits over large screen to release seed. Blower speed: 2.75.

Difficulty Level 1

POACEAE

Orcuttia californica

Fruit: Caryopsis, enclosed within the lemma and palea of the floret; 1.0–2.0 mm, narrowly elliptic
Seed: enclosed within fruit

Clean to separate florets only. Gently rub floral material on a rubber mat with padded wood block. Shake separated florets through #10 and #25 sieves, then through #12 sieve. Repeat until all florets are separated from inflorescences, then pick out twigs or try velvet cloth. Blower speed: 1.0, then resieve through #10. Blower speed: 1.75 to blow florets up to separate any soil from the collection.

Difficulty Level 4

OROBANCHACEAE

Orobanche fasciculata

Fruit: Capsule, dehiscent
Seed: 0.5 mm, elliptic, black, pitted under magnification, shiny

Rub fruits and sort seeds over #60 and #80 sieves. Good seed will not pass through a #80 sieve. Seeds fall through blower cup screen due to their extremely small size.

Difficulty Level 1

ASTERACEAE

Osmadenia tenella

Fruit: Achene, ray achenes 1.2–2.0 mm, back rounded to angled, rough to smooth; disk achenes obpyramidal, pappus of 4 short and 4 long, papery scales
Seed: enclosed within fruit

Rub floral material over medium screen to separate flower heads from stems. Lightly rub and sift through #16 and #30 sieves. To separate achenes from flower chaff, lightly rub material over a #30 sieve, shaking fine chaff through sieve. Resieve again through #16 sieve to remove coarse chaff. Blower speed: 1.25 to sort out chaff and sterile fruits.

Difficulty Level 2

ASTERACEAE

Palafoxia arida var. *arida*

Fruit: Achene, 10.0–15.0 mm, needle-like, 4-angled, pappus of 4.0–10.0 mm long scales
Seed: enclosed within fruit

Gently rub achenes on rubber mat to remove pappus scales. Blower at 1.25, then use higher blower speeds and dissection exam to sort out hollow fruits.

CAUTION! Excessive force during processing will damage fruits.

Difficulty Level 3

ASTERACEAE

Pectis papposa

Fruit: Achene, 2 types, both fertile and narrow, linear, dark brown to black; disk seed: to 3.0 mm, with crown of plumose pappus bristles; ray seed: partially enclosed and weakly adherent to involucral bract, to 4.0 mm, no pappus.
Seed: enclosed within fruit

Gently rub material on rubber mat to remove pappus from disk achenes and to separate ray achenes from involucral bracts. Blower speed: 1.0, then sort through #18 to catch achenes. Smaller broken chaff falls through. Repeat with #10 sieve to remove larger twiggy chaff.

Difficulty Level 4

BORAGINACEAE

Pectocarya penicillata

Fruit: Nutlet, 1.1–3.3 mm, oblong, narrow and straight with distinct upturned or incurved white margin, armed with prominent hooked bristles at apex and distal portion of nutlet
Seed: enclosed within fruit

Rub floral material over #12 and #25 sieves, then sort through #10 sieve several times to remove stem chaff. Blower speed: 1.5 to sort out chaff.

Difficulty Level 2

SCROPHULARIACEAE

Penstemon cedrosensis

Fruit: Capsule, dehiscent
Seed: 1.5–2.0 mm, ovoid, angular, pitted surface

Rub floral material over small screen or #14 sieve. Blower speed: 1.25. Resieve through #12 sieve several passes as necessary to remove large chaff.

Difficulty Level 2

SCROPHULARIACEAE

Penstemon grinnellii

Fruit: Capsule, dehiscent
Seed: 2.0–2.5 mm, ovate, sharply 5-angled, black to reddish brown, surface pitted

Allow fruits to dry and seeds to naturally dehisce into a collection bag. Seed capsule walls are quite thick and once broken into small pieces during threshing are very difficult to separate from the seeds. Blower speed: 1.5–1.75 to remove small amount of chaff and any hollow seed.

Difficulty Level 2

SCROPHULARIACEAE

Penstemon heterophyllus var. *australis*

Fruit: Capsule, tardily dehiscent
Seed: 1.5–2.0 mm, ovate, irregularly angled, dark brown to black, rough, surface pitted

Rub floral material over medium screen to open capsules and break up chaff. Sort through #14 and #25, and then resieve through #12 sieve. Blower speed: 1.75.

NOTE: Moderate to high parasitism on seeds and fruits in this seed lot. Use blower at successively higher speeds to sort out parasitized seed.

Difficulty Level 3

SCROPHULARIACEAE

Penstemon rostriflorus

Fruit: Capsule, tardily dehiscent
Seed: 1.0–2.0 mm, irregularly angled, medium to dark brown, rough, surface pitted

Rub and sort material through #14 and #25 sieves to open capsules and separate large chaff. Blower speed: 1.25, then resieve several times through #12 sieve to remove remaining large heavy chaff.

Difficulty Level 1

SCROPHULARIACEAE

Penstemon speciosus

Fruit: Capsule, dehiscent
Seed: 2.5–4.0 mm, 3-angled to compressed, dark shiny brown, surface pitted

Rub floral material over small screen. Blower speed: 1.5.

Difficulty Level 1

ASTERACEAE

Pentachaeta aurea

Fruit: Achene, 1.5–2.0 mm, lanceolate, densely appressed, hairy, pappus of 5 (or 4) long bristles; both ray and disk achenes fertile
Seed: enclosed within fruit

Let floral material dry and dehisce into collection bag. Manually remove stems and floral involucres. Gently rub achenes that have dehisced into the collection bag on a rubber mat to separate pappus from achenes and to break up floral chaff. Blower speed: 1.2, then repeat rubbing and blowing as necessary to break up larger chaff and separate hollow, poor quality and sterile fruits. Some hand sorting required.

Difficulty Level 4

ASTERACEAE

Pentachaeta lyonii

Fruit: Achene, 1.4–2.0 mm, narrow-linear, yellowish to greenish tan, enclosed within a membranous coat
Seed: enclosed within fruit

Gently rub floral material on a rubber mat to break up floral chaff and separate achenes from fruit coats. Blower speed: 1.0 to 1.25

Difficulty Level 2

ASTERACEAE

Perityle emoryi

Fruit: Achene, 2.5–3.0 mm, linear, gray, smooth
Seed: enclosed within fruit

Gently rub floral heads over medium screen, then rub and sift through #18 and #30 sieves. Blower speed: 1.0, repeating rubbing and blowing as necessary. Some hand sorting required.

Difficulty Level 3

ROSACEAE

Petrophyton caespitosum

Fruit: Capsule, dehiscent
Seed: 1.0–1.5 mm long, linear, light tan, smooth

Rub fruits over #18 sieve. Blower speed: 1.2 to remove floral chaff. Some hand sorting required. Care should be taken to not damage the soft seeds during the threshing process.

Difficulty Level 4

ASTERACEAE

Peucephyllum schottii

Fruit: Achene, 2.0–4.0 mm, conical, dark brown to black, with short white hairs, pappus white, 4.0–5.0 mm long
Seed: enclosed within fruit

Manually separate fruits from receptacles, then rub achenes on rubber mat to remove flowers from achenes and to break up chaff. Sort through #14 sieve to remove some larger chaff. Blower speed: 2.0. Some hand sorting required to remove chaff.

Difficulty Level 5

HYDROPHYLLACEAE

Phacelia anelsonii

Fruit: Capsule, dehiscent
Seed: 2.5–3.0 mm, oblong-concave, medium brown, pitted under magnification

Rub floral material over medium screen, then rub and sift through #12 and #25 sieves. Blower speed: 1.5. Increase blower speed to 1.7 to remove poor quality seed.

CAUTION! Seeds can be easily damaged during threshing.

Difficulty Level 2

HYDROPHYLLACEAE

Phacelia brachyloba

Fruit: Capsule, dehiscent
Seed: 0.4–1.0 mm, round, medium to dark brown

Rub floral material over small screen to release seed from capsules, then rub and sift through #18 and #25 sieves. Blower speed: 1.25.

Difficulty Level 1

HYDROPHYLLACEAE

Phacelia campanularia

Fruit: Capsule, dehiscent
Seed: 1.0–1.5 mm, oblong, reddish, pitted

Easiest to place fruiting stems upside down in bag to dry, then most seed will dehisce into the collection bag. If necessary, rub floral material over medium screen to open capsules and release seed, then rub and sift over #18 and 30 sieves. Blower speed: 1.25.

Difficulty Level 1

HYDROPHYLLACEAE

Phacelia crenulata var. *ambigua*

Fruit: Capsule, dehiscent
Seed: 2.0–3.0 mm, oblong, concave, medium brown, pitted

Rub floral material over medium screen, then rub and sift through #10 and #18 sieves. Blower speed: 1.3. Resieve through #10 sieve. Some hand cleaning required.

Difficulty Level 2

HYDROPHYLLACEAE

Phacelia fremontii

Fruit: Capsule, dehiscent
Seed: 1.0–1.5 mm, ovoid, medium brown, deeply pitted in concentric rings under magnification

Rub floral material over small screen to release seed, then rub and sift through #18 and #25 sieves. Blower speed: 1.25.

Difficulty Level 2

HYDROPHYLLACEAE

Phacelia minor

Fruit: Capsule, dehiscent, 7.0–13.0 mm
Seed: 1.0–1.2 mm, ovoid, reddish brown, pitted

Rub floral material over small screen, then through #20 and #40 sieves. Blower speed: 1.25.

Difficulty Level 1

HYDROPHYLLACEAE

Phacelia tanacetifolia

Fruit: Capsule, dehiscent
Seed: 2.5–3.0 mm, oblong, brown to black, surface cross ridged, deeply pitted

Rub floral material over medium screen, then rub and sift through #12 and #20 sieves. Blower speed: 1.5.

Difficulty Level 1

LENNOACEAE

Pholisma sonorae

Fruit: Capsule, tardily dehiscent
Seed: 0.5–1.0 mm, round to reniform, more or less flattened, brown, compressed in a ring at base of capsule

Rub fruiting flower heads over small screen or #16 sieve to break up capsules and release seed. Rub and sift through #20 and #40 sieves. Blower speed: 1.15. Reblow seeds up at 1.75 to separate seed from sand grains. Slowly sift seed through #16 sieve to catch any remaining chaff. Repeat #16 sieve as necessary or use velvet cloth.

Difficulty Level 3

HYDROPHYLLACEAE

Pholistoma membranaceum

Fruit: Capsule, dehiscent
Seed: 1.2–2.2 mm, spherical, brown, pitted to net-ridged

Rub floral material over medium screen, then rub over #8 and #18 sieves to break up capsules, release seed, and sort fine chaff. Blower speed: 1.75 to 2.5 to separate out chaff and poor quality seed.

Difficulty Level 2

SOLANACEAE

Physalis crassifolia

Fruit: Berry (sticky)
Seed: 1.75–2.0 mm, spherical, compressed, amber colored

Remove fruits from stems, soak fruits in warm soapy water for ca. 30 minutes. Gently rub fruits over #25 sieve under running water. Place macerated fruit and pulp in warm environment to dry, then gently rub over #25 sieve. Blower speed: 1.75. Some hand cleaning required.

Alternate method: Use a food mill to macerate fruits and extract seeds.

Difficulty Level 2

PINACEAE

Pinus albicaulis

Fruit: Cones, dehiscent, black, ovate, 70–80 mm, very resinous
Seed: 11.0 mm, seeds ovate, reddish brown, smooth. Average of 26 seeds per cone for this seed lot of 22 cones

Cones from this seed lot would not open following warm dry stratification or a hot water soak followed by warm dry stratification. 90% of seeds were filled but floated in water (endosperm tissue not filling seed fully) These cones were most likely collected too early.

Difficulty Level 5

PINACEAE

Pinus attenuata

Fruit: Cone,110–150 mm, gray
Seed: 6.0–8.0 mm, ovate, medium to dark gray, smooth

Place closed cones in oven at 60–66°C (140–150°F), cones will open in about 30 minutes. Tumble or shake cones to release seeds. To de-wing the seed place them in a #10 sieve with large round palm seed or marbles with a covering and vigorously shake material. This can also be done in a box or in a bag. Blower speed: 3.5 to separate out hollow seeds, which made up ca. 20% of this seed lot.

Difficulty Level 2

PINACEAE

Pinus radiata

Fruit: Cone, closed, 60–150 mm, asymmetric
Seed: 6.0–8.0 mm, elliptical, long wings

Heat closed cones in oven at 60°C (140°F) for 10–15 minutes. Let them continue to open for one week indoors on a high shelf or outdoors in a warm dry place protected from rodents. Rub seeds over medium screen to remove wings. Blower speed: 3.25 to blow out all sterile seed or place seeds into water to float out hollow ones. High quantity of empty seed in this seed lot.

Difficulty Level 3

PINACEAE

Pinus sabiniana

Fruit: Cone, dehiscent, ovate-oblong, with reflexed scale tips, 100–280 mm
Seed: 22.0 mm, oval, light brown, deeply set at base of cone scales

Dry cones in warm dry environment until scales open. Many of the seeds can be shaken out. Prying apart cone scales or tumbling cones in a cloth bag in a drier at a low setting may be required to remove remaining seeds. Tumble seeds or rub them over medium screen to remove wings. Float seeds in water or use blower to separate hollow sterile ones.

Difficulty Level 3

PLANTAGINACEAE

Plantago ovata

Fruit: Capsule, dehiscent
Seed: 1.0–2.0 mm, ovate, pink, smooth, convex one side, flat on other side

Seed easily dehisces from capsules into the collection bag. Sift floral material (seed and chaff) through #16 sieve. Blower speed: 1.5.

Difficulty Level 1

PLATANACEAE

Platanus racemosa

Fruit: Achene, attached to a spherical receptacle, 4.0–6.0 mm, cylindrical, acute at one end, yellowish brown
Seed: enclosed within fruit

Rub spherical receptacles over medium screen to separate achenes from the receptacle. Blower speed: 1.5 to separate copious hairs, then at 1.75 to separate filled, sound achenes from those that are sterile.

Difficulty Level 2

PAPAVERACEAE

Platystemon californicus

Fruit: Segments, dehiscent
Seed: 0.8–1.5 mm, ovate to reniform, gray to ashy brown, smooth, within the longitudinal ovary segments

Gently rub and sift floral material through #16 and #30 sieves. Blower speed: 1.0, then resieve through a #14 sieve several times to remove small twiggy chaff.

Difficulty Level 2

ASTERACEAE

Pluchea sericea

Fruit: Achene, 0.7–1.0 mm, ovoid-elongate, greenish tan, smooth, 4-ridged
Seed: enclosed within fruit

Gently rub floral material on rubber mat to remove cottony pappus and allow separation of fruits. Or shake floral material vigorously in paper bag. Blower speed: 1.0 to separate most of sterile achenes. Hand sort out good achenes, or try higher blower speeds.

NOTE: Very low quantity of viable fruits in this seed lot (only 18 filled fertile achenes from large bottle with estimated 5,000 seeds).

Difficulty Level 5

POACEAE

Poa secunda

Fruit: Caryopsis, enclosed within the lemma and palea of the floret, 2.5–4.0 mm, narrow elliptical, reddish tan
Seed: enclosed within fruit

Rub floral material gently on rubber mat to separate florets from stems, then sort material through a #18 sieve. Blower speed: 1.35.

Difficulty Level 3

LAMIACEAE

Pogogyne abramsii

Fruit: Nutlet, indehiscent, 0.5–1.3 mm, ovoid, dark brown to golden brown, smooth to short hairy
Seed: enclosed within fruit

Rub and sift floral material through #18 and #35 sieves. Blower speed: 1.25, then resieve through a #20 sieve. Higher blower speeds (to 1.5) required to sort out hollow, sterile seed.

Difficulty Level 2

LAMIACEAE

Pogogyne douglasii

Fruit: Nutlet, indehiscent, 1.5–2.0 mm, ovoid, light to dark brown some with dark mottling, smooth with white hairs at one end
Seed: enclosed within fruit

Rub floral whorls over medium screen, then rub and sift through #16 and #30 sieves. Sort through a #14 sieve to remove large chaff. Blower speed: 1.5–1.75. Higher blower speeds required to sort out hollow, sterile seed.

NOTE: High percentage of hollow fruits in this seed lot.

Difficulty Level 2

LAMIACEAE

Pogogyne nudiuscula

Fruit: Nutlet, indehiscent, 0.4–1.8 mm, ovoid, reddish brown to black, smooth to short hairy
Seed: enclosed within fruit

Rub and sift floral material through #18 and #30 sieves. Blower speed: 1.2. Higher blower speeds required to sort out hollow, sterile seed.

Difficulty Level 2

POLEMONIACEAE

Polemonium eximium

Fruit: Capsule, dehiscent, ca. 4.0 mm
Seed: 1.4 mm, elliptic, angled, acute at one end, dark reddish brown

Rub and sift floral material through #18 and #30 sieves. Blower speed: 1.5.

Difficulty Level 1

DRYOPTERIDACEAE

Polystichum imbricans

Fruit: Sori
Seed: Spore: 0.03–0.05 mm, light reddish brown

Rub dried fronds over #80 sieve, check material under magnification and use finer sieves as necessary to separate out the large quantity of sporangia chaff.

Difficulty Level 2

DRYOPTERIDACEAE

Polystichum imbricans subsp. *curtum*

Fruit: Sporangia
Seed: Spore: < 0.1 mm, spherical, reddish

Soon after collection allow sporangia to dehisce spores onto foil or other smooth, non-porous material as any static charge causes them to stick to whatever they are placed on. Threshing fern leaves to extract spores also macerates sporangia. Without high magnification it is impossible to determine if what you have are spores or sporangia chaff. To separate spores from sporangia chaff the material can be sorted through a #120 (125 micron) soil sieve.

Difficulty Level 1

SALICACEAE

Populus fremontii

Fruit: Capsule
Seed: 2.0–2.2 mm, ovoid, densely white hairy

Rub floral material gently over a small screen to dislodge seed from the mass of fruit hairs. Blower speed: 1.5.

Difficulty Level 2

ROSACEAE

Potentilla glandulosa

Fruit: Capsule, dehiscent
Seed: 0.8–1.2 mm, ovoid, beaked, reddish brown, smooth

Rub floral material over small screen, then sift through #30 and #45 sieves. Blower speed: 1.25.

Difficulty Level 1

MARTYNIACEAE

Proboscidea althaeifolia

Fruit: Capsule, tardily dehiscent
Seed: 6.0–10.0 mm, angled, black, corky texture, ca. 30 seeds per fruit, with the inner seeds tightly wedged behind a woody chamber wall

Use pliers to pry fruits apart to release seeds from two chambers, one outer, one inner.

CAUTION! Seeds are soft and care must be taken to limit damage to seeds during extraction.

Difficulty Level 5

ROSACEAE

Prunus ilicifolia subsp. *lyonii*

Fruit: Drupe, fleshy
Seed: 11.0–25.0 mm, ovoid to spherical, smooth

Soak fruits for about 1 hour. Remove hollow or parasitized "floaters." Rub with wood block and wash over medium screen to remove fleshy fruit coat. Dry thoroughly. Alternatively use a blender to macerate and strip pulp from fruits.

Difficulty Level 4

ASTERACEAE

Pseudobahia bahiifolia

Fruit: Achene, 1.5–2.0 mm long, ray achenes ovate, slightly curved, disk achenes straight, narrower, weakly ridged. Both ray and disk achenes dark brown with small thin covering of appressed white hairs
Seed: enclosed within fruit

Gently rub flower heads over #14 sieve to separate achenes from receptacles. Blower speed: 1.25 to 1.4 to separate fruits from chaff. Care should be exercised here as some achenes can be easily broken during the sieving process. Broken achenes and remaining chaff are removed by hand.

Difficulty Level 4

ASTERACEAE

Pseudobahia piersonii

Fruit: Achene, 2.5–3.0 mm, narrow oblanceolate, black, 3–4 angled
Seed: enclosed within fruit

Rub floral material over small screen, then rub and sift through #18 sieve.

Difficulty Level 3

ASTERACEAE

Psilostrophe cooperi

Fruit: Achene, 2.0 mm, linear, brownish green
Seed: enclosed within fruit

Rub floral material on medium screen. Blower speed: 1.5. Rub fruits and chaff gently on rubber mat, then reblow at 1.75. If necessary, blow at 2.0 to separate fruits from peduncles, or try velvet cloth.

Difficulty Level 4

FABACEAE

Psorothamnus schottii

Fruit: Legume, tardily dehiscent, one-seeded
Seed: 5.0–8.0 mm, oval, light brown, smooth, hard

Use large screen with heavy screened paddle to remove pods from stems. Rub fruits over medium screen or #6 sieve to rub casing off seed. Blower speed: 3.0. Repeat rubbing and blowing as necessary to extract seed from fruits. Blow cleaned seed at 4.0 or float to check for aborted, hollow seed.

Difficulty Level 2

POLYGONACEAE

Pterostegia drymarioides

Fruit: Achene, contained within an elliptical brown to reddish white involucre, 1.1–1.3 mm, elliptic to 3-angled, acute at both ends, green with black mottling, shiny, smooth
Seed: enclosed within fruit

Rub stems with attached floral material over medium screen to release fruits from stems. Rub screened material through #20 sieve to release seed from involucres. Blower speed: 2.5 to separate seed from chaff, then to 3.0 blower speed to thoroughly clean seed from involucres and chaff.

Difficulty Level 3

Fruits (achenes)

Involucre

RHAMNACEAE

Rhamnus californica subsp. *occidentalis*

Fruit: Drupe, 2-stoned
Seed: 5.0–7.0 mm, ovoid, brownish gray, smooth

Soak fruits for 1.5 hours or until fruit pulp has softened. Rub fruits over medium screen under running water or in a bath to extract seed from fruits. Dry thoroughly.

Difficulty Level 3

RHAMNACEAE

Rhamnus crocea

Fruit: Drupe, 2 seeds per fruit
Seed: 3.0–5.0 mm, ovate, tan, smooth, convex one side

Place moist fruits in water in blender cup, stir at low speed to separate seed from pulp, pour through screens and place material in sunny warm location to dry. Rub dried material over #14 sieve. Blower speed: 2.75 to remove dried fruit pulp.

Alternate method: Use food mill to macerate fruits and extract seed.

Difficulty Level 2

RHAMNACEAE

Rhamnus rubra var. *yosemitiana*

Fruit: Drupe, mealy, spherical to ovoid, reddish to black, smooth
Seed: 6.0–8.0 mm, spherical-convex, mostly 2 per fruit, black

Soak fruits 2–3 hours. Macerate moistened drupes over medium screen or #12 sieve under running water. Dry in a warm environment. Rub thoroughly dried seed on #18 sieve to remove remaining fruit pulp from seed. Use blower or sieves to remove dried pulp.

NOTE: All seed in this lot was empty and blew out at 2.5 blower speed.

Difficulty Level 2

ANACARDIACEAE

Rhus trilobata

Fruit: Drupe, bright red orange, one seed per fruit
Seed: 3.5–7.5 mm, spherical to ovoid, light brown, smooth, hard when mature

Soak fruits for 1 to 2 hours. Thresh material in blender with water at low speed for about 2 minutes to separate seeds from fruit pulp. Pour fruit and pulp out and rub on a #10 sieve with a wood block under running water or bath to separate remaining seeds. Place in sunny warm location to dry, then rub over a #10 sieve. Use blower to separate out dried fruit pulp.

Difficulty Level 2

GROSSULARIACEAE

Ribes amarum

Fruit: Berry, 15.0–20.0 mm, purple
Seed: 2.0–3.0 mm

Rub ripe or soaked berries under running water over small screen. Or macerate with food mill to extract seeds from fruits. Rinse pulp from seeds under running water or bath. Place rinsed seeds in sunny warm site to dry. Rub dried material over medium screen to separate seeds from fruit pulp. Rub and sift through #10 and #25 sieves. Blower speed: 2.0.

Difficulty Level 2

GROSSULARIACEAE

Ribes montigenum

Fruit: Berry, oblong, orange-red, glabrous
Seed: 1.5–3.0 mm, ovate, brown, 3-angled

Rub ripe or soaked berries under running water over small screen or sieve or macerate with food mill to extract seeds from fruits. Rinse pulp from seeds under running water or bath, then place rinsed seeds in sunny warm site to dry. Rub seed over a #18 sieve or small screen to remove remaining dried pulp from seed. Blower speed: 1.5.

Difficulty Level 2

GROSSULARIACEAE

Ribes nevadense

Fruit: Berry, 6.0–8.0 mm, blue black, glaucous
Seed: 1.0–2.0 mm, ovate, acute, gray

Seeds easily released from dried fruit by rubbing over a #12 sieve. Blower speed: 1.75.

Difficulty Level 1

GROSSULARIACEAE

Ribes tortuosum

Fruit: Berry, bright deep orange to red, 5.0–7.0 mm
Seed: 2.0–3.0 mm, ovate convex, orange, surface shallowly wavy-ridged, dryish within

Run moist fruits through food mill to macerate them, then wash pulp and seeds over a #18 or a #20 sieve. Place outdoors in a sunny warm place or indoors in an oven set at less than 38°C (100°F) Rub thoroughly dried material with a wooden block to break up dried pulp. Blower speed: 3.0 to separate dried pulp chaff from seed.

Difficulty Level 2

ROSACEAE

Rosa gymnocarpa

Fruit: Berry
Seed: 3.0–5.0 mm, ovoid, light tan, smooth

Rub dried fruits through coarse screen to release seeds. Blower speed: 2.0 to separate seeds from chaff.

Difficulty Level 2

ROSACEAE

Rosa woodsii var. *ultramontana*

Fruit: Berry, 5.0–12.0 mm
Seed: 3.0–4.0 mm, ovoid, tan, smooth

Soak dried fruits 24 hours to soften if necessary. Rub ripe or soaked berries under running water over small screen or sieve or macerate with food mill to extract seeds from fruits. Rinse pulp from seeds under running water or bath. Place rinsed seeds in sunny warm site to dry. Blower speed: 1.5 to separate chaff from seed.

Difficulty Level 2

LAMIACEAE

Salazaria mexicana

Fruit: Nutlet, developed within an inflated calyx
Seed: 1.8–3.0 mm, irregular shaped, seed coat with prominent stem, mature seed dark brown, deeply tuberculed

Gently thresh fruits over medium screen, blower to 2.0 to remove chaff. Hand sort out large quantity of floral peduncles.

CAUTION! Seeds can be easily damaged during threshing.

Difficulty Level 4

CHENOPODIACEAE

Salicornia bigelovii

Seed: 1.5 mm, oval, dark brown, smooth with appressed translucent hairs on the surface

Rub inflorescences over #18 and #35 sieves, blower to 27 to separate seed from chaff. Rub seed over a #35 sieves to break up and remove salt incrusted soil particles. Reblow at 28.

Difficulty Level 1

SALICACEAE

Salix arctica

Fruit: Capsule, dehiscent
Seed: 1.0–1.25 mm, club-shaped, green, ridged

Rub floral material over #25 sieve to separate seeds from capsules and from the copious fruit hairs, then sort through #30 sieve to remove some large chaff. Blower speed: 1.0–1.25.

Difficulty Level 3

LAMIACEAE

Salvia apiana

Fruit: Nutlet, indehiscent, 2.0–2.5 mm, elliptical, angled on 2 sides; light to medium brown with some dark mottling, shiny smooth
Seed: enclosed within fruit

Rub ripened flower whorls over medium screen, then lightly rub and sort material through #14 and #25 sieves. Blower speed: 1.5–2.0 to separate chaff. Higher blower speeds required to remove sterile seed.

Difficulty Level 2

LAMIACEAE

Salvia carduacea

Fruit: Nutlet, indehiscent, 2.5 mm, ovoid-elliptic, gray to tan (dark flecked)
Seed: enclosed within fruit

Rub flower heads over large screen; most seed already released if dried with stems upside down in a paper collection bag. Sift material through medium screen to remove large chaff, then through #18 sieve to remove dirt and fine chaff. Blower speed: 1.5.

Difficulty Level 2

LAMIACEAE

Salvia clevelandii

Fruit: Nutlet, indehiscent, 2.0–2.5 mm, ovoid, dark gray mottled to medium brown, smooth
Seed: enclosed within fruit

Rub dried floral material over #16 and #30 sieves. Blower speed: 1.75–2.0. Higher blower speed required to remove sterile seed.

Difficulty Level 2

LAMIACEAE

Salvia columbariae

Fruit: Nutlet, indehiscent,1.5–2.2 mm, ovoid-eliptic, tan to gray with black mottling, smooth, shiny
Seed: enclosed within fruit

Floral stems that are inverted in a paper collection bag to dry will release most of the seed directly into the bag. Rub remaining floral whorls over medium screen. Rub and sift through #16 and #25 sieves. Blower speed: 1.5.

Difficulty Level 1

LAMIACEAE

Salvia dorrii

Fruit: Nutlet, indehiscent, 2.0–2.5 mm, ovoid
Seed: enclosed within fruit

Rub floral material over #10 and #25 sieves. Blower speed: 2.25 to sort out the high percentage of sterile and/or parasitized seed, (65% this seed lot).

Difficulty Level 2

LAMIACEAE

Salvia mellifera

Fruit: Nutlet, indehiscent, 1.8–2.5 mm, ovoid, dark shiny brown
Seed: enclosed within fruit

Rub floral material over medium screen, rub and sift through #12 and #25 sieves. Blower speed: 1.5. Higher blower speed required to remove sterile seed.

Difficulty Level 2

LAMIACEAE

Salvia sonomensis

Fruit: Nutlet, indehiscent, 2.0–2.5 mm, ovoid-elliptic, brownish
Seed: enclosed within fruit

Rub floral material over medium screen to break up floral whorls and release seed, then rub and sift through #12 and #20 sieves. Blower speed: 1.75. Higher blower speed required to separate out what can be a high percentage of hollow sterile seed.

Difficulty Level 1

CAPRIFOLIACEAE

Sambucus racemosa var. *microbotrys*

Fruit: Drupe, spherical, bright red
Seed: 2.0–3.0 mm, elliptical, tan, pitted

Macerate soft ripe fruits on small screen under running water or through a food mill, dry thoroughly. Rub dried pulp and seeds over #20 sieve. Blower speed: 1.75 to separate seeds from chaff. High blower speed required to sort out hollow sterile seeds (25% in this seed lot).

Difficulty Level 2

APIACEAE

Sanicula bipinnatifida

Fruit: Schizocarp, 4.0–5.0 mm, splitting into 2 mericarps, densely covered with hooked prickles, inner surface smooth / grooved
Seed: enclosed within fruit

Rub floral material over small screen to break up fruits and chaff, sift through #12 sieve to remove small chaff. Blower speed: 1.8.

Difficulty Level 2

SAXIFRAGACEAE

Saxifraga tolmiei

Fruit: Capsule, dehiscent
Seed: less than 1.0 mm within wing-like membraneous sack, about 1.2 mm, seeds appearing shriveled

Allow capsules from floral material to dehisce contents into collection bag. Sift through #18 sieve. Blower speed: 0.8. Collection may have a low percent of viable seed and may be difficult to separate empty seed from filled ones. Seed is easily blown up with the chaff.

Difficulty Level 2

CRASSULACEAE

Sedum obtusatum

Fruit: Follicle, dehiscent
Seed: 1.0–1.2 mm, narrow elliptic, reddish brown to tan

Rub floral material over #25 and #60 sieves to open capsules and release seeds. Blower speed: 1.0, then resieve through #35 and #40 sieves. Reblow as necessary.

Difficulty Level 1

CRASSULACEAE

Sedum spathulifolium subsp. *anomalum*

Fruit: Follicle, tardily dehiscent, 4.0–8.0 mm
Seed: 0.5–1.0 mm, oblong, acute, pinkish tan

Rub floral material over small screen, then rub and sift through #40 and #60 sieves. Blower speed: 1.25, then resieve several passes through #30 to remove remaining large chaff.

Difficulty Level 1

ASTERACEAE

Senecio astephanus

Fruit: Achene, 2.0 mm, narrow oblong to cylindric, weakly ribbed, with long, white, cottony pappus
Seed: enclosed within fruit

Gently rub achenes on rubber mat to separate pappus from fruits and break up floral chaff. Difficult to separate in blower due to equal weights of achenes and chaff. Requires much additional hand cleaning. May be easier to separate in blower, blowing seed up, if pappus is left attached to fruits. Or, hand pluck ripened achenes.

Difficulty Level 5

ASTERACEAE

Senecio californicus

Fruit: Achene, 2.0–2.5mm, linear, gray, sparsely short hairy
Seed: enclosed within fruit

If possible, pluck fully ripened fruits from involucres to avoid mixing excessive receptacle chaff with the fruits. Gently rub small quantities of fruits on a rubber mat with wood block to remove pappus. Blow as needed to separate chaff (mostly disk flower parts and pappus) from good, filled achenes. Repeat rubbing and blowing as necessary. Very messy, use dust mask or process outdoors.

Difficulty Level 3

ASTERACEAE

Senecio flaccidus

Fruit: Achene, 4.0–5.0 mm, light tan, cylindrical, ridged, with dense, short appressed hairs; pappus bristles 1.5 to 2 times as long as achene
Seed: enclosed within fruit

Pappus loosely attached to achenes. Place small quantity of floral material in #12 sieve, attach a lid cover, and vigorously shake. Placing small objects in sieve helps to detach pappus. (Palm seeds work well but small erasers, cardboard squares, etc. will also work). Most achenes will fall through the sieve. Blower speed: 1.5 to sort out chaff, then blow to 1.75 to separate sterile achenes. To remove pappus, floral material can also be placed into a paper bag and shaken vigorously as above.

Difficulty Level 2

ASTERACEAE

Senecio lyonii

Fruit: Achene, 2.3–3.0mm, linear, gray to tan, with copious quantity of cottony pappus
Seed: enclosed within fruit

Pappus loosely attached to achenes. Place small quantity of floral material in #12 sieve, attach a lid cover, and vigorously shake. Placing small objects in sieve helps to detach pappus. (Palm seeds work well but small erasers, cardboard squares, etc. will also work). Most achenes will fall through the sieve. Blower speed: 1.5 to sort out chaff, then blow to 1.75 to separate sterile achenes. To remove pappus, floral material can also be placed into a paper bag and shaken vigorously as above.

Difficulty Level 3

ASTERACEAE

Senecio mohavensis

Fruit: Achene, Disk achenes 2.0–3.0mm, cylindrical, gray, long, hairy, smaller than ray achenes
Seed: enclosed within fruit

Pappus loosely attached to achenes. Place small quantity of floral material in #12 sieve, attach a lid cover, and vigorously shake. Placing small objects in sieve helps to detach pappus. (Palm seeds work well but small erasers, cardboard squares, etc. will also work). Most achenes will fall through the sieve. Blower speed: 1.5 to sort out chaff, blow to 1.75 to separate sterile achenes. To remove pappus, floral material can also be placed into a paper bag and shaken vigorously as above.

Difficulty Level 4

TAXODIACEAE

Sequoiadendron giganteum

Fruit: Cone, dehiscent
Seed: 7.0–9.0 mm long, flat disk-shaped, reddish tan wings surrounding the tiny gray linear embryo

Allow cones to dry in a warm environment. Cones will open in 2–3 weeks. Periodically shake opening cones in paper or cloth bags to speed release of seeds. Blower speed: 1.5 to sort out hollow seeds (20–25% of this seed lot).

Difficulty Level 2

BRASSICACEAE

Sibara filifolia

Fruit: Silique, tardily dehiscent, purple to tan, 25.0–30.0 mm long, 1 mm wide
Seed: 0.5–1.0 mm, elliptical, tan to reddish

For small quantities, hand strip fruits from stems, then rub fruits over #25 and #45 sieves to open and release seed. Resieve through #25 sieve twice to remove larger chaff. Blower speed: 1.0, then resieve repeatedly to remove remaining chaff.

Difficulty Level 2

BRASSICACEAE

Sibaropsis hammittii

Fruit: Silique, very tardily dehiscent
Seed: 1.0–1.8 mm, oblong, medium golden brown, compressed and longitudinally ridged, shallowly winged margins

Rub thoroughly dried fruits with fingers on rubber mat or over a #14 to #16 sieve to release seed. Then sift through #18 and #45 sieves, repeat as needed. Blower speed: 1.0.

CAUTION! Rather soft seeds are easily damaged.

Difficulty Level 2

MALVACEAE

Sidalcea hickmanii subsp. *anomala*

Fruit: Schizocarp, made up of hard wedge-shaped sections
Seed: 1.5–2.0 mm, black to brown within a tan segment coat

Rub floral material over #25 sieve to separate and release fruit sections and release seed from some of the coatings. Blower speed: 1.25–1.5.

Difficulty Level 3

MALVACEAE

Sidalcea oregana subsp. *valida*

Fruit: Schizocarp, hard wedge-shaped sections
Seed: 1.5–2.5 mm, seeds mostly reniform, mostly dark brown with a tan segment coat

Rub floral material over #10 and #25 sieves to break up fruits, then rub segments gently on rubber mat or #25 sieve to remove the thin membraneous coats. Blower speed: 2.5 to separate chaff and any hollow or parasitized seed.

Difficulty Level 2

ASTERACEAE

Solidago spectabilis

Fruit: Achene,1.6 mm long, ovoid, greenish tan, shallowly ribbed, 10–15 pappus bristles
Seed: enclosed within fruit

Rub floral material over #14 sieve then over #20 sieve to remove pappus. Blow small batches slowly to 1.0. Resieve several times through #20 sieve, then reblow to 1.1 to sort out hollow or parasitized fruits.

Difficulty Level 2

CARYOPHYLLACEAE

Spergularia macrotheca var. *macrotheca*

Fruit: Capsule, dehiscent
Seed: 0.6–0.8 mm, spherical to ovoid flattened, dark brown, prominent membranous wing around the circumference

Rub floral material over small screen or #12 sieve to release seed, then sift through #25 sieve. Blower speed: 1.75, then resieve through #25 sieve to catch large chaff.

Difficulty Level 2

MALVACEAE

Sphaeralcea ambigua var. *ambigua*

Fruit: Schizocarp, hard wedge-shaped sections, each containing 0–2 seeds
Seed: 1.5–2.0 mm, kidney-shaped, reddish to gray-brown, sparsely short hairy

Rub floral heads over #12 sieve to break up segments and release seeds. Blower speed: 2.0–2.25 to separate high percentage of hollow, sterile seeds from the plump, filled seed. Some fruit segments very hard and resistant to releasing seeds.

Difficulty Level 2

ROSACEAE

Spiraea densiflora

Fruit: Capsule, tardily dehiscent
Seed: 1.0 mm, narrow, fusiform, orange, shallowly ridged

Rub floral material with wood block over #35 and #45 sieves. Blower speed: 0.75. Resieve several times through #45 sieve to remove small chaff, and through #30 to remove larger. Hand sort out the large quantity of remaining peduncles. Check for filled, sound seed.

Difficulty Level 5

POACEAE

Sporobolus cryptandrus

Fruit: Caryopsis, 0.7–1.0 mm, ovoid to spherical, white to orange, smooth, enclosed within lemma and palea of the floret, 1.2–1.5 mm, ovate, ivory to gray
Seed: enclosed within fruit

Clean to florets only. Hand strip florets from inflorescence stems. Blower to 18 to separate out sterile florets and chaff.

Difficulty Level 1

LAMIACEAE

Stachys albens

Fruit: Nutlet, 1.5–2.0 mm, ovoid to spherical, dark gray
Seed: enclosed within fruit

Rub dried floral material over #14 and #30 sieves. Blower speed: 1.5. High blower speed required to remove hollow seeds (60% this seed lot).

Difficulty Level 1

ASTERACEAE

Stephanomeria cichoriacea

Fruit: Achene, 5.0–6.5 mm, linear, light brown, ridged, pappus of long feathery bristles; fertile achenes are noticeably plumper than sterile ones
Seed: enclosed within fruit

Gently rub flower heads and achenes on rubber mat with padded wood block to remove some of the pappus and break down chaff. Blower speed: 1.5 to remove chaff. Repeat rubbing and blowing as necessary. Difficult to obtain good separation of sterile and fertile achenes

Difficulty Level 3

BRASSICACEAE

Streptanthus albidus subsp. *peramoenus*

Fruit: Silique, tardily dehiscent, linear 70.0–110.0 mm long
Seed: 2.0 mm, elliptic flattened, dark brown to light reddish brown, with short membraneous wing or none

Roll pods on rubber mat with gentle finger pressure to pop open fruits. Rub "emptied" pods over #14 sieve to remove any seeds remaining attached to the middle fruit membrane. Blower speed: 1.5 to remove any chaff.

NOTE: Seeds are soft and easily damaged during processing.

Difficulty Level 3

BRASSICACEAE

Streptanthus bernardinus

Fruit: Silique, tardily dehiscent, 50.0–80.0 mm, straight
Seed: 1.5 mm, elliptic to rectangular, brownish orange

Rub floral material over small screen to break open fruits and release seed, then rub and sift through #12 and #20 sieves. Blower speed: 1.25. May require some additional hand cleaning or repeated screening and blowing.

NOTE: Seeds are soft and easily damaged during processing.

Difficulty Level 2

BRASSICACEAE

Streptanthus insignis

Fruit: Silique, tardily dehiscent, 10.0–80.0 mm, straight
Seed: 1.5 mm, elliptical flattened, tannish to greenish brown

Gently rub fruits on rubber mat to release seeds, then rub and sift through #10 and #25 sieves. Blower speed: 1.25. Some hand cleaning required.

NOTE: Seeds are soft and easily damaged during processing.

Difficulty Level 3

ASTERACEAE

Stylocline gnaphaloides

Fruit: Achene, 0.75 mm, ovoid, greenish brown, smooth
Seed: enclosed within fruit

Rub cottony inflorescences over a #30 sieve, then sort material through a #35 sieve. Blower speed: 1.25.

Difficulty Level 2

PAPAVERACEAE

Stylomecon heterophylla

Fruit: Capsule, dehiscent, through terminal pores
Seed: 0.4 mm, reniform, brown or black, strongly net-ridged

Most seed will dehisce from fruits from by placing stems upside down into collection bag. To extract any remaining seeds in fruits, rub floral material over small screen, then rub and sift through #20 sieve. Blower speed: 1.25. Resieve through #20 sieve, or increase blower speed to remove larger chaff.

Difficulty Level 1

CAPRIFOLIACEAE

Symphoricarpos mollis

Fruit: Berry:
Seed: Ovoid, 2.5–3.0 mm, white to tan, smooth

Soak fruits in warm soapy water until soft, macerate berries through a food mill to extract seeds from pulp. Place macerated material on a small screen or sieve then wash material under a forceful water spray to clean pulp from seeds then. Dry pulp and seeds thoroughly then rub material to break up and separate seeds from pulp. Use blower to separate seeds from dried pulp.

Difficulty Level 3

ASTERACEAE

Syntrichopappus lemmonii

Fruit: Achene, 1.6–2.0 mm, linear, gray
Seed: enclosed within fruit

As with many composites, cleaning is sometimes simplified if the flower parts (phyllaries and receptacle) are not ground up and mixed with the seed material. Pluck or shake out achenes then rub them on a rubber mat to remove pappus. Blower speed: 1.0, then repeat gentle rubbing and blowing as necessary to sort out poor quality fruits and remove pappus.

Difficulty Level 3

ASTERACEAE

Taraxacum californicum

Fruit: Achene, 2.5–4.0mm, narrowly ovoid to linear, greenish brown, longitudinally ridged, beaked end with prominent spines
Seed: enclosed within fruit

Rub collected achenes with fingers or padded block over small sieve or a rubber mat to detach pappus from fruits. Blower speed: 1.0–1.25. Repeat rubbing and blowing as necessary. Higher blower speed will separate out hollow, sterile fruits.

Difficulty Level 2

EUPHORBIACEAE

Tetracoccus dioicus

Fruit: Capsule, dehiscent, spherical, brownish
Seed: 5.0 mm, seeds ovate, tan to dark brown, shiny, smooth

Seeds easily dehisce into collection bag. Sieve through #6 and #10 sieves. Blower speed: 4.5. This seed lot 100% filled.

Difficulty Level 1

ASTERACEAE

Tetradymia axillaris

Fruit: Achene, 4.0–5.0 mm long, linear-cylindrical, yellow brown, completely and densely covered with firmly attached long, white cottony hairs
Seed: enclosed within fruit

Use blower to separate fertile from sterile achenes. Achenes blown out at 1.0 blower speed (1 of 10 good); remaining heavier fruits (18 of 50) filled and moist within. Blow slowly at 1.25 to get a higher percentage of fertile fruits in the collection. High percentage parasitized achenes removed with blower.

Difficulty Level 4

ASTERACEAE

Tetradymia canescens

Fruit: Achene, 6.0–8.0 mm, narrowly ovate, brownish green, densely white hairy with long 8.0–12.0 mm long pappus bristles
Seed: enclosed within fruit

Pappus bristles are tightly attached to the achene, and it is difficult to separate the many sterile fruits from the fertile ones as they all clump together in the blower. Best to manually select heavy, plump fruits using light to moderate magnification. Ca. 1/3 of the fruit were fertile in this seed lot.

Difficulty Level 5

RANUNCULACEAE

Thalictrum fendleri

Fruit: Achene: tardily dehiscent, 5.0–7.0 mm, crescent shaped, tan
Seed: 3.0–3.5 mm, narrowly ovate, gray brown, shallowly pitted surface

Sort floral material through a large screen to remove stems then rub over a #14 sieve to extract seed from fruits. Blower to 47 to separate chaff and any broken seeds. Resieve over a #16 sieve to separate seeds from any remaining fruits.

Difficulty Level 2

ASTERACEAE

Trichoptilium incisum

Fruit: Achene, 2.0–3.0 mm, obpyramidal, pappus of 4-pointed bracts; smaller achenes with plumose pappus appear to be mostly sterile
Seed: enclosed within fruit

Shake material through large screen, then sift it over #10 sieve. Good achenes with bracts are caught in sieve; sterile achenes and chaff fall through. Blower speed: 1.0–1.25 to blow seed up. Repeat and increase blower speed as necessary. Some hand sorting required.

Difficulty Level 4

LAMIACEAE

Trichostema lanatum

Fruit: Nutlet, deeply set in persistent calyx, 3.0 mm, oblong, dark brown to black, ridged, puberulent
Seed: enclosed within fruit

Rub floral material over coarse screen, then rub and sift through #12 and #18 sieves to separate seed and chaff. Blower speed: 1.5.

Difficulty Level 1

LAMIACEAE

Trichostema lanceolatum

Fruit: Nutlet, deeply set in persistant calyx, 2.0–2.5 mm, ovoid, light reddish brown, irregularly net-ridged to pitted, densely short hairy
Seed: enclosed within fruit

Rub floral material over medium screen, then rub and sift through #8 and #25 sieves. Blower speed: 1.5, then use velvet cloth to separate twigs from seed. Some hand cleaning required.

NOTE: High percentage of sterile seed this seed lot.

Difficulty Level 3

LAMIACEAE

Trichostema parishii

Fruit: Nutlet, deeply set in persistent calyx, 4.0 mm, ovoid-elliptic, brown, irregularly ridged
Seed: enclosed within fruit

Rub floral material over medium screen, then rub and sift through #6 and #12 sieves. Blower speed: 2.0.

Difficulty Level 1

LAMIACEAE

Trichostema rubrisepalum

Fruit: Nutlet, deeply set in persistent calyx, 2.5 mm, ovoid, dark brown, net-ridged to pitted, short hairy surface
Seed: enclosed within fruit

Rub floral material over #16 and #30 sieves to open floral calyces, dislodge nutlets, and break up chaff. Blower speed: 1.75.

Difficulty Level 2

FABACEAE

Trifolium amoenum

Fruit: Legume, ovoid
Seed: 2.0 mm, seed ovate to spherical, yellow, smooth, one seed per fruit

Rub fruits on rubber mat to extract seed. Blower speed: 1.75 to separate chaff and poor quality seed.

NOTE: 375 filled viable seeds from about 800 flowers (this seed lot from garden generated, open pollinated plants).

Difficulty Level 1

LILIACEAE

Triteleia laxa

Fruit: Capsule, dehiscent
Seed: 1.3 mm, ovoid, black

Rub floral material over medium screen to release seed from capsules, then rub and sift through #12 and #25 sieves. Blower speed: 1.5.

Difficulty Level 1

PINACEAE

Tsuga mertensiana

Fruit: Cone, ovoid to oblong, 120–750 mm
Seed: 15.0 mm, winged

Dry cones in warm environment or in oven at lowest setting (140°F) for 10–15 minutes. Tumbling will help release seeds or manually shake cones. Blower 1.25 to blow winged fruits up leaving chaff below. Rub seed over medium screen to remove wings. Seeds are fragile and easily damaged during cleaning.

Difficulty Level 3

POACEAE

Tuctoria fragilis

Fruit: Caryopsis, 1.0 mm, oblong, light brown to yellow, enclosed within the lemma and palea of the floret
Seed: enclosed within fruit

Clean only to separate fertile florets. Gently rub inflorescences on rubber mat with fingers, then sift through #10, #12, and #30 sieves. Repeat if necessary to separate all florets. Avoid excessive rubbing on mat as seeds will be separated out of the florets. Blower speed: 1.25. Resieve through #12 and #18 sieves to separate fertile florets from caryopsis if desired.

Difficulty Level 3

SCROPHULARIACEAE

Turricula parryi

Fruit: Capsule, dehiscent
Seed: 1.0 mm, oblong-ovoid to elliptical, shiny black, finely ridged to minutely net-veined

Rub floral material over small screen to break up fruits and release seed, then sift through #20 and #40 sieves. Blower speed: 1.2.

CAUTION!! Avoid skin contact and breathing dust. Irritating hairs and chemical compounds in plant can cause severe skin irritation and dermatitis.

Difficulty Level 1

TYPHACEAE

Typha domingensis

Fruit: Achene, 0.5–0.9 mm, fusiform, reddish brown, smooth with copious hairs attached to the pedicel
Seed: enclosed within fruit

Rub floral "fluff" in small batches over a #35 sieve, sort through #30 sieve, then rub material on a rubber mat. Blower speed: <1.0. Repeat rubbing on the rubber mat and blowing. Re-sort through a #45 sieve.

Difficulty Level 4

ASTERACEAE

Uropappus lindleyi

Fruit: Achene, 8.0–15.0 mm, needle-like, dark brown to black, ridged with bumps on ridges
Seed: enclosed within fruit

Place very ripe dry floral material in a large paper bag or sealed container, then shake vigorously to separate pappus from fruits. Blower speed: 1.25.

Difficulty Level 1

ASTERACEAE

Verbesina dissita

Fruit: Achene, 6.0–7.5 mm, broadly ovate, dark brown with two pappus hooks at top of achene attached to yellowish tan wings
Seed: enclosed within fruit

Sort floral material through large screen several times to remove large chaff. Blower speed: 1.25. Lighter weight fruits blown out at 1.25 (2 of 10 hollow). Heavier fruits in blower cup at 1.25 (9 of 10 filled and moist). Considerable hand cleaning required.

Difficulty Level 5

ASTERACEAE

Viguiera laciniata

Fruit: Achene, disk fruits fertile, 2.5–3.5 mm, obovate, dark gray, pappus of chaffy bracts set between long chaff scales; ray achenes sterile
Seed: enclosed within fruit

Very difficult to clean using conventional mechanical methods, hand cleaning required. Best to let mature fruits fall out of floral involucres. Chaff and bracts from flower heads cannot be separated in blower. Check achenes for viable embryos. Use blower to separate viable fruits. This seed lot 90% sterile.

Difficulty Level 5

ASTERACEAE

Viguiera parishii

Fruit: Achene, 3.0–4.0 mm, disk achenes held within bracts, obovate, dark gray, hairy; ray achenes are slightly smaller than disk achenes

Very difficult to clean using mechanical methods. Best to let mature fruits fall out of floral involucres. Chaff and bracts from flower heads cannot be separated in blower. Check achenes for viable embryos. Use blower to separate viable fruits. This seed lot contained a high percentage of hollow, aborted fruits.

Difficulty Level 5

ARECACEAE

Washingtonia filifera

Fruit: Drupe, ovoid, shiny black
Seed: 6.0–7.0 mm, ovoid, reddish brown, smooth

Soak fruits to soften sticky fruit coat, run in blender (blades replaced with round lawn trimmer line, approx. .065 inch diameter) covered with water, drain and let dry on screen. Rub with screened paddle to remove any dried fruit pulp remaining on seeds.

Difficulty Level 1

ERICACEAE

Xylococcus bicolor

Fruit: Drupe, indehiscent, about 9.0 mm wide, smooth
Seed: Stones generally 5, fused into a smooth, 3–5 seeded sphere

Fruits are placed into blender equipped with nylon string trimmer line attached to the blades. The fruits are covered with water then the blender is run for a few minutes then repeated as necessary to strip fruit pulp from hard woody seeds. Float seeds to sort out hollow or parasitized fruits. This method was more effective at stripping fruit pulp than rubbing on screens as it strips pulp from both larger and smaller sized fruits.

Difficulty Level 3

ASTERACEAE

Xylorhiza cognata

Fruit: Achene, 5.0 mm, white, hairy, long silky pappus
Seed: enclosed within fruit

Hand pluck good achenes that are easily removed from the flower receptacles, then hand sort out chaff and receptacle bracts. Blower speed: 1.5 to sort out some of the lighter sterile fruits.

NOTE: Higher blower speed (1.75) for *X. tortifolia*

Difficulty Level 4

ASTERACEAE

Xylorhiza orcuttii

Fruit: Achene, 5.0 mm, white from the dense long hairs; long, silky, yellowish pappus
Seed: enclosed within fruit

Hand pluck good achenes that are easily removed from the flower receptacles. Sort out high percentage of sterile achenes by placing small quantities of the fruits in an air sorter at 1.9 blower speed. Some hand sorting required. 88% (1,760 of more than 2,000) of achenes was sterile in this seed lot.

Difficulty Level 5

LILIACEAE

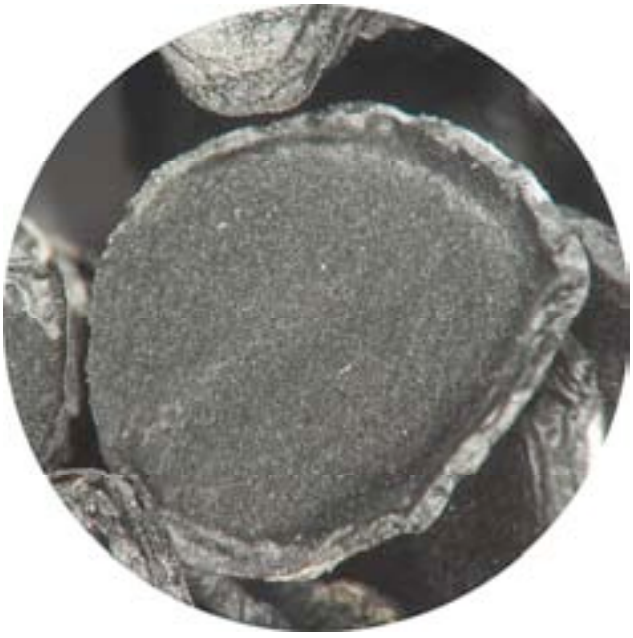
Yucca brevifolia

Fruit: Capsule, tardily dehiscent
Seed: 8.0–13.0 mm, spherical, flat, compressed, stacked in rows within the fruit chambers, black, smooth

Best to separate seed from fruits by hand, avoiding breaking up dried fruit, since heavy capsule chaff will be difficult to separate from seed in blower unit. Blower speed: 1.5 to remove small quantity of chaff and any parasitized seed. Some hand cleaning. Seed often heavily parasitized. Check for damaged seed and insect larvae. Higher blower speeds sometimes required to separate parasitized seed. 25–50 healthy, viable seeds per fruit for four seed lots cleaned.

NOTE: Seed is *Yucca brevifolia* var. *herbertii*

Difficulty Level 2



LILIACEAE

Yucca whipplei

Fruit: Capsule, tardily dehiscent
Seed: 6.0 mm, spherical, thin, black, stacked in rows within fruit chamber, smooth

Best to separate seed from fruits by hand, avoiding breaking up dried fruit as the heavy capsule chaff will be difficult to separate from seed in blower. Blower speed: 1.5 to remove small quantity of chaff and any parasitized seed. Some hand cleaning. Seed often heavily parasitized. Check for damaged seed and insect larvae. Higher blower speeds sometimes required to separate parasitized seed.

Difficulty Level 3

Processing Seeds

Fruit Types

ACHENE

ASTERACEAE

Deinandra conjugens

Disc achene Ray achene

ANTHOCARP

NYCTAGINACEAE

Abronia maritima

BERRY

CAPRIFOLIACEAE

Lonicera hispidula
var. *vacillans*

BUR

ASTERACEAE

Ambrosia chamissonis

Processing Seeds

Fruit Types

CAPSULE

LILIACEAE
Calochortus kennedyi
var. *kennedyi*

PAPAVERACEAE
Romneya coulteri

CARYOPSIS

POACEAE

Achnatherum hymenoides

Bouteloua gracilis

CONE

PINACEAE
Pinus sabiniana

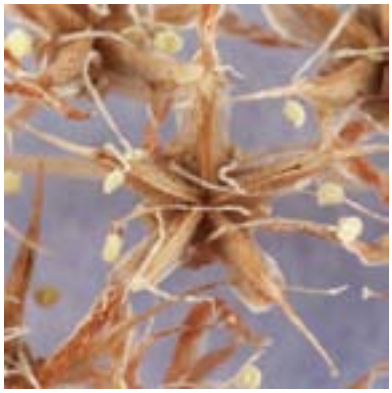
CUPRESSACEAE
Cupressus forbesii

DRUPE

ULMACEAE

Celtis reticulata

Processing Seeds
Fruit Types



FOLLICLE

CRASSULACEAE
Dudleya densiflora

LEGUME

FABACEAE
Cercis occidentalis

NUT

JUGLANDACEAE
Juglans californica

NUTLET

LAMIACEAE
Trichostema austromontana
subsp. *compactum*

SAMARA

ACERACEAE
Acer macrophyllum

Processing Seeds
Fruit Types

SCHIZOCARP

MALVACEAE

Sphaeralcea ambigua var. *rosacea*

Fruit Fruit segment

SCHIZOCARP

APIACEAE

Lomatium dasycarpum

Lomatium utriculatum

SILICLE

BRASSICACEAE
Draba verna

SILIQUE

BRASSICACEAE
Sibaropsis hammittii

UTRICLE

CHENOPODIACEAE

Atriplex hymenelytra

achene
A small, dry indehiscent fruit with a single locule and a single seed (ovule), and with the seed attached to the ovary wall at a single point, as in the sunflower[3].

acuminate
Gradually tapering to a sharp point and forming concave sides along the tip, as do certain leaves[3]

acute
Tapering to a pointed apex with more or less straight sides, as do certain leaves[3]

adherent
Sticking together of unlike parts[3]

anthocarp
A fruit with some portion of the flower besides the pericarp persisting, with the fleshy perianth tube surrounding the pericarp; as in a pome, e.g., apple[3]

appressed
Lying close and flat; pressed against closely and flatly along the entire length of an organ or part[1]

aril
The exterior covering or appendage of certain seeds that develops after fertilization as an outgrowth from the point of attachment of the ovule[4]

awn
A stiff bristle-like projection; the glumes and lemmas of grasses commonly possess awns, as do some fruits, and less commonly leaves. An awn may act to bury a fruit in the soil by uncoiling in damp conditions, and in so doing pushes the fruit into the ground[2].

berry
A fleshy fruit developing from a single pistil, with several or many seeds, as the tomato[3]

bract
A leaf-like structure subtending an inflorescence. Bracts are sometimes brightly colored and petal-like, as in poinsettia. The glumes, lemmas, and paleae of grass spikes are also examples of bracts[2].

bur
The prickly or spiny casing around a fruit[4]

ca.
Abbreviation of *circa*; Latin word meaning used to indicate an approximate figure[5]

calyx
The outer perianth whorl; the collective term for all of the sepals of a flower[3]

capitulum
An inflorescence consisting of a head of small closely packed stalk-less flowers arising from the same level on a flattened axis. Capitula are often made up of two distinct types of flowers: disk and ray[2].

Processing Seeds
Glossary

capsule
A dry, usually many-seeded fruit composed of two or more fused carpels that split at maturity to release their seeds[4]

carpels
The structure that bears and encloses the ovules in flowering plants. It normally comprises the ovary, style, and stigma[2].

caryopsis
A dry, one-seeded, indehiscent fruit with the seed coat fused to the pericarp, as in the fruits of the grass family; a grain, enclosed within the lemma and palea of the floret[3]

chaff
Small membranous scales or bracts on the receptacle of composites, the floral parts of cereals usually separated from the grain during threshing or winnowing, the glumes of grasses[1]

composite
Plants recognized by their characteristic head-like inflorescence; the capitulum, which superficially resembles a single flower[2]

concave
Having a surface that curves inward[5]

cone
Reproductive structure composed of an axis, scales, and sometimes bracts. 1. Non-woody structure producing spores (e.g., clubmosses, horsetails) or pollen (e.g., conifers). 2. Generally woody structures producing seeds (e.g., most conifers, alders)[6]

convex
Having a surface that curves outward, like the surface of a sphere[5]

corolla
The collective name for all of the petals of a flower; the inner perianth whorl[3]

dehisce
To split open at maturity to discharge contents, as a capsule discharging seeds[4]

disk flower
In Asteraceae, the generally bisexual, generally radial, ligule-less flower with a five- (rarely four-) lobed corolla[6]

distal
Toward the tip, or the end of the organ opposite the end of attachment[3]

drupe
A fleshy, indehiscent fruit with a stony endocarp surrounding a usually single seed, as in a peach or cherry[3]

elliptic
In the shape of an ellipse, or a narrow oval; broadest at the middle and narrower at the two equal ends[3]

endocarp
The inner layer of the pericarp of a fruit[3]

endosperm
The storage tissue surrounding the embryo in angiosperms that consists of thin-walled cells rich in carbohydrates. The endosperm of gymnosperms is the female gametophyte[4].

exudates
A substance exuded or excreted from a plant[3]

floret
A small flower; an individual flower within a dense cluster, as a grass flower in a spikelet, or a flower of the Asteraceae (Compositae) in an involucrate head[3]

funiculus
The stalk connecting the ovule to the placenta; the stalk of a seed[3]

follicle
A dry, dehiscent one-celled fruit composed of a single carpel and splitting open on only one side, as in individual fruits of a magnolia cone or a milkweed pod[3,4]

fusiform
Spindle-shaped; broadest near the middle and tapering toward both ends[3]

glabrous
Smooth; without hairs or down[4]

glaucous
Covered with a whitish or bluish waxy coating (bloom), as on the surface of a plum[3]

globose
Globe-shaped; spherical[3]

hilum
The scar at the point of attachment of a seed; the eye of a seed[1]

hypanthium
A cup-shaped extension of the floral axis usually formed from the union of the basal parts of the calyx, corolla, and androecium (all of the stamens in a flower, collectively), commonly surrounding or enclosing the pistils[3]

indehiscent
Describing a fruit or fruiting body that does not open to disperse its contents; seeds or spores are released either when the surrounding wall decays or when it is eaten by an animal[2]

inflorescence
The flowering part of a plant; a flower cluster; the arrangement of the flowers on the flowering axis[3]

involucre – involucral
A whorl of bracts subtending a flower or flower cluster[3]

lanceolate
Lance-shaped; much longer than wide; with the widest point below the middle[3]

legume
A dry, dehiscent fruit derived from a single carpel and usually opening along two lines of dehiscence, as a pea pod; a plant belonging to the Fabaceae (Leguminosae) family[3]

lemma (flower glume)
The lower of the two bracts (lemma and palea) that subtends a grass floret, often partially surrounding the palea[3]

lenticular
Lentil-shaped; lens-shaped[3]

linear
Resembling a line; long and narrow with more or less parallel sides, as in certain leaves[3]

locules
A chamber or cavity within which specialized organs may develop; most usually the ovules or pollen grains[2]

macerate
To remove the soft, pulpy tissue from fruits[4]

membranous
Thin, flexible, and more or less translucent; with the texture of a membrane or parchment[1]

mericarp
A section of schizocarp, one of two halves of the fruit in Apiaceae[3]

micropyle
The opening in the integuments of the ovule[3]

nut
A hard, dry, indehiscent fruit, usually with a single seed[3]

nutlet
A small nut; one of the lobes or sections of the mature ovary of some members of the Boraginaceae, Verbenaceae, and Lamiaceae[3]

obconic
Conical or cone-shaped, with the attachment at the narrow end[3]

oblanceolate
Long and narrow but broadening outward, lance-shaped with the tapering point downward[1]

obovate
Inversely ovate, with the attachment at the narrow end[3]

obpyramidal
Inversely pyramidal[1]

ovate/ovoid
Egg-shaped with the broad end toward the point of attachment[4]

ovule
The unfertilized young seed in the ovary; the structure which, after fertilization, develops into a seed; a rudimentary seed[1]

palea
A chaffy scale or bract; the uppermost of the two bracts (lemma and palea) that subtends a grass floret; often partially surrounded by the lemma[3]

papillate
Having a projection from a cell, usually of the epidermis. Papillae are often swollen and covered with wax and in xerophytes may serve to protect from sunlight and excessive water loss[2]

pappus
A modified calyx made up of a ring of fine hairs, scales, or teeth that persist after fertilization and aid in the wind dispersal of the fruit, often by forming a parachute-like structure; occurs in members of Asteraceae (Compositae), e.g., dandelions and thistles[2]

pedicel
The stalk of a single flower within a flower cluster[4]

peduncle
A stalk that bears a flower or flower cluster[4]

pericarp
The wall of a fruit, derived from the maturing ovary wall. In fleshy fruits, the pericarp usually has three distinct layers, of which the outermost exocarp may be variously thickened or membranous. In dry fruits, the pericarp tends to become papery or leathery[2].

perigynium
A scale-like bract enclosing the pistil in *Carex*[3]

phyllaries
The bracts forming the involucre of the flower head in Asteraceae (Compositae)[1]

plumose
Feathery; with hairs or fine bristles on both sides of a main axis, as a plume[3]

puberulent
Minutely pubescent; with fine, short hairs[3]

ray
The strap-like portion of a ligulate flower (or the ligulate flower itself) in Asteraceae (Compositae)[3]

receptacle
The end of the flower stalk on which the floral organs are borne[4]

reniform
Kidney-shaped[1]

reticulate
In the form of a network; net-veined[3]

samara
A dry, indehiscent, winged fruit that is 1- or 2-seeded[4]. This membranous fruit aids wind dispersal of the seed, such as in *Fraxinus* (ash) [2].

scarify
To conduct the mechanical abrasion or chemical treatment of the surface of a hard seed to make it permeable to water and/or gases and so hasten germination[2,4]

schizocarp
A dry, indehiscent fruit that splits into separate one-seeded segments (carpels) at maturity[3]

silicle
A dry dehiscent fruit derived from two carpels fused together to form a flattened pod with two loculi separated by a false septum[2]

silique
A dry dehiscent fruit similar to a silicle except that it is long and narrow. It is the typical fruit in the genus *Brassica*[2].

sorus (pl. sori)
In ferns, fungi, etc., a cluster of sporangia with a cover.[1] A cluster of sporangia on the surface of a fern leaf.[3]

spherical
Shaped like a sphere; globular[5]

sporangia
A spore-bearing case or sac[3]

spore
A reproductive cell from meiotic cell division within a sporangium[3]

stellate
Star-shaped, as in hairs with several to many branches radiating from the base[3]

stratification
A pregerminative treatment to break dormancy in seeds; accomplished by exposing seeds for a specific time to moisture in cold or warm conditions[4]

style
The usually narrowed portion of the pistil connecting the stigma to the ovary[3]

subtending
To be below and close to, as a bract may subtend an inflorescence[3]

tubercule
A small tuber-like swelling or projection[3]

utricle
A bladdery, one-seeded, usually indehiscent fruit consisting of an achene surrounded by bracts[4]

whorl
A ring-like arrangement of similar parts arising from a common point or node[3]

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Conservation is a state of harmony between man and land

Aldo Leopold

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ACERACEAE	*Acer glabrum*	maple, mountain
AMARANTHACEAE	*Amaranthus fimbriatus*	pigweed, fringed
ANACARDIACEAE	*Malosma laurina*	sumac, laurel
ANACARDIACEAE	*Rhus trilobata*	skunkbush
APIACEAE	*Eryngium aristulatum* var. *hooveri*	celery, Hoover's
APIACEAE	*Sanicula bipinnatifida*	sanicle, poison
ARECACEAE	*Washingtonia filifera*	palm, California fan
ARISTOLOCHIACEAE	*Aristolochia californica*	California Dutchman's pipe
ASCLEPIADACEAE	*Asclepias albicans*	milkweed, white-stemmed
ASCLEPIADACEAE	*Asclepias californica*	milkweed, California
ASCLEPIADACEAE	*Asclepias erosa*	milkweed, desert
ASCLEPIADACEAE	*Asclepias fascicularis*	milkweed, narrow-leafed
ASTERACEAE	*Acamptopappus shockleyi*	goldenhead, Shockley's
ASTERACEAE	*Acamptopappus sphaerocephalus*	goldenhead, rayless
ASTERACEAE	*Achillea millefolium*	yarrow
ASTERACEAE	*Achyrachaena mollis*	blow wives
ASTERACEAE	*Acourtia microcephala*	sacapellote
ASTERACEAE	*Ageratina occidentalis*	snakeroot, western
ASTERACEAE	*Agoseris grandiflora*	agoseris, big flower
ASTERACEAE	*Agoseris retrorsa*	agoseris, spearleaf
ASTERACEAE	*Amblyopappus pusillus*	coastweed, dwarf
ASTERACEAE	*Ambrosia chamissonis* var. *bipinnatifida*	bur, beach
ASTERACEAE	*Ambrosia chenopodifolia*	bur sage, San Diego
ASTERACEAE	*Ambrosia dumosa*	burro-weed
ASTERACEAE	*Anisocoma acaulis*	scalebud
ASTERACEAE	*Arnica chamissonis* subsp. *foliosa*	Chamisso arnica
ASTERACEAE	*Artemisia californica*	sagebrush, California
ASTERACEAE	*Artemisia douglasiana*	mugwort
ASTERACEAE	*Artemisia dracunculus*	tarragon
ASTERACEAE	*Artemisia ludoviciana*	sagebrush, white
ASTERACEAE	*Artemisia tridentata*	sagebrush, big
ASTERACEAE	*Aster foliaceus*	aster, alpine leafybract
ASTERACEAE	*Baccharis salicifolia*	mule fat
ASTERACEAE	*Baileya multiradiata*	marigold, wild
ASTERACEAE	*Baileya pauciradiata*	lax flower

ASTERACEAE	*Blennosperma bakeri*	Sonoma sunshine
ASTERACEAE	*Blepharizonia plumosa*	tarweed, big
ASTERACEAE	*Brickellia arguta*	brickellbush, pungent
ASTERACEAE	*Brickellia californica*	brickellbush, California
ASTERACEAE	*Brickellia incana*	brickellbush, woolly
ASTERACEAE	*Centromadia pungens* subsp. *laevis*	tarplant, smooth
ASTERACEAE	*Chaenactis glabriuscula*	pincushion, yellow
ASTERACEAE	*Chrysothamnus nauseosus*	rabbitbush, rubber
ASTERACEAE	*Cirsium neomexicanum*	thistle, desert
ASTERACEAE	*Coreopsis bigelovii*	tickseed, Bigelow's
ASTERACEAE	*Deinandra clementina*	tarplant, island
ASTERACEAE	*Deinandra conjugens*	tarplant, Otay
ASTERACEAE	*Deinandra kelloggi*	tarweed, Kellogg's
ASTERACEAE	*Deinandra mohavensis*	tarplant, Mojave
ASTERACEAE	*Deinandra palmeri*	tarweed, Guadelupe Island
ASTERACEAE	*Encelia californica*	brittlebush, California
ASTERACEAE	*Encelia farinosa*	brittlebush
ASTERACEAE	*Ericameria cooperi*	goldenbush, Cooper's
ASTERACEAE	*Ericameria linearifolia*	goldenbush, interior
ASTERACEAE	*Erigeron breweri*	fleabane, Brewer's
ASTERACEAE	*Erigeron foliosus*	fleabane, leafy
ASTERACEAE	*Erigeron glaucus*	daisy, seaside
ASTERACEAE	*Eriophyllum confertiflorum*	yarrow, golden
ASTERACEAE	*Eriophyllum lanatum*	Oregon sunshine
ASTERACEAE	*Eriophyllum nevinii*	eriophyllum, Nevin's
ASTERACEAE	*Eriophyllum wallacei*	daisy, Wallace's woolly
ASTERACEAE	*Geraea canescens*	sunflower, desert
ASTERACEAE	*Gnaphalium californicum*	tobacco, ladies
ASTERACEAE	*Gnaphalium canescens* subsp. *thermale*	cudweed, Wright's
ASTERACEAE	*Gutierrezia californica*	matchweed, California
ASTERACEAE	*Harmonia hallii*	madia, Hall's
ASTERACEAE	*Hazardia orcuttii*	hazardia, Orcutt's
ASTERACEAE	*Helianthus annuus*	sunflower, hairy-leafed
ASTERACEAE	*Helianthus gracilentus*	sunflower, slender
ASTERACEAE	*Heterotheca sessiliflora*	false golden aster, sessileflower

ASTERACEAE	*Holocarpha macradenia*	tarplant, Santa Cruz
ASTERACEAE	*Hulsea algida*	hulsea, Pacific
ASTERACEAE	*Hulsea californica*	sunflower, San Diego
ASTERACEAE	*Hymenoclea salsola*	burrobrush
ASTERACEAE	*Hymenopappus filifolius* var. *lugens*	hymenopappus, Idaho
ASTERACEAE	*Isocoma acradenia*	goldenbush, alkali
ASTERACEAE	*Lasthenia burkei*	goldenfields, Burke's
ASTERACEAE	*Lasthenia californica*	goldenfields, California
ASTERACEAE	*Layia gaillardioides*	tidytips, woodland
ASTERACEAE	*Layia glandulosa*	tidytips, white
ASTERACEAE	*Layia platyglossa* var. *campestris*	tidytips, plains
ASTERACEAE	*Lessingia arachnoidea*	lessingia, Crystal Springs
ASTERACEAE	*Machaeranthera asteroides*	aster, New Mexico tansy
ASTERACEAE	*Madia elegans*	madia, common
ASTERACEAE	*Malacothrix californica*	dandelion, desert
ASTERACEAE	*Malacothrix coulteri*	snake's head
ASTERACEAE	*Malacothrix glabrata*	dandelion, desert
ASTERACEAE	*Monolopia lanceolata*	monolopia, common
ASTERACEAE	*Monoptilon bellioides*	desert star, Mojave
ASTERACEAE	*Osmadenia tenella*	rosinwood, false
ASTERACEAE	*Palafoxia arida* var. *arida*	Spanish needle, desert
ASTERACEAE	*Pectis papposa*	chinchweed
ASTERACEAE	*Pentachaeta aurea*	pentachaeta, golden-rayed
ASTERACEAE	*Pentachaeta lyonii*	pentachaeta, Lyon's
ASTERACEAE	*Perityle emoryi*	daisy, Emory's rock
ASTERACEAE	*Peucephyllum schottii*	cedar, pygmy
ASTERACEAE	*Pluchea sericea*	arrow weed
ASTERACEAE	*Pseudobahia bahiifolia*	pseudobahia, Hartweg's
ASTERACEAE	*Pseudobahia piersonii*	pseudobahia, Tulare
ASTERACEAE	*Psilostrophe cooperi*	daisy, paper
ASTERACEAE	*Senecio astephanus*	ragwort, San Gabriel
ASTERACEAE	*Senecio californicus*	ragwort, California
ASTERACEAE	*Senecio flaccidus*	groundsel, green
ASTERACEAE	*Senecio lyonii*	senecio, island
ASTERACEAE	*Senecio mohavensis*	groundsel, Mojave

ASTERACEAE	*Solidago spectabilis*	goldenrod, showy
ASTERACEAE	*Stephanomeria cichoriacea*	wirelettuce, chicoryleaf
ASTERACEAE	*Stylocline gnaphaloides*	nest straw, everlasting
ASTERACEAE	*Syntrichopappus lemmonii*	syntrichoppapus, Lemmon's
ASTERACEAE	*Taraxacum californicum*	dandelion, California
ASTERACEAE	*Tetradymia axillaris*	horsebrush, longspine
ASTERACEAE	*Tetradymia canescens*	horsebrush, gray
ASTERACEAE	*Trichoptilium incisum*	dome, yellow
ASTERACEAE	*Uropappus lindleyi*	silver puff
ASTERACEAE	*Verbesina dissita*	crownbeard
ASTERACEAE	*Viguiera laciniata*	viguera, San Diego County
ASTERACEAE	*Viguiera parishii*	goldeneye, Parrish's
ASTERACEAE	*Xylorhiza cognata*	aster, Mecca
ASTERACEAE	*Xylorhiza orcuttii*	aster, Orcutt's woody
BERBERIDACEAE	*Berberis nevinii*	barberry, Nevin's
BORAGINACEAE	*Amsinckia vernicosa* var. *furcata*	fiddleneck, forked
BORAGINACEAE	*Cryptantha circumcissa*	catseye, cushion
BORAGINACEAE	*Cryptantha flavoculata*	catseye, roughseed
BORAGINACEAE	*Cryptantha intermedia*	catseye, clearwater
BORAGINACEAE	*Cryptantha micrantha*	catseye, redroot
BORAGINACEAE	*Cryptantha muricata*	catseye, pointed
BORAGINACEAE	*Cryptantha traskiae*	cryptantha, Trask's
BORAGINACEAE	*Cryptantha virginensis*	forget-me-not, tufted
BORAGINACEAE	*Pectocarya penicillata*	comb-bur, hairy-leafed
BRASSICACEAE	*Arabis hoffmanii*	rock cress, Hoffman's
BRASSICACEAE	*Caulanthus heterophyllus*	wild cabbage, San Diego
BRASSICACEAE	*Caulanthus inflatus*	desert candle
BRASSICACEAE	*Draba corrugata*	draba, southern California
BRASSICACEAE	*Draba cuneifolia*	draba, wedgeleaf
BRASSICACEAE	*Guillenia flavescens*	mustard, yellow
BRASSICACEAE	*Guillenia lemmonii*	mustard, Lemmon's
BRASSICACEAE	*Lepidium jaredii*	peppergrass, Jared's
BRASSICACEAE	*Sibara filifolia*	rock cress, Santa Cruz Island
BRASSICACEAE	*Sibaropsis hammittii*	claycress, Hammit's
BRASSICACEAE	*Streptanthus albidus* subsp. *peramoenus*	jewelflower, uncommon

BRASSICACEAE	*Streptanthus bernardinus*	jewelflower, Laguna Mountain
BRASSICACEAE	*Streptanthus insignis*	jewelflower, San Benito
BUDDLEJACEAE	*Buddleja utahensis*	butterfly bush, Panamint
CACTACEAE	*Echinocereus engelmannii*	cactus, hedgehog
CACTACEAE	*Echinocereus maritimus*	cactus, hedgehog
CACTACEAE	*Ferocactus cylindraceus*	cactus, California barrel
CACTACEAE	*Mammilaria tetrancistra*	cactus, fishhook
CACTACEAE	*Opuntia bigelovii*	cholla, teddy-bear
CACTACEAE	*Opuntia erinacea*	cactus, Mojave prickly-pear
CACTACEAE	*Opuntia parryi* var. *parryi*	cholla, cane
CAMPANULACEAE	*Campanula exigua*	harebell, chaparral
CAMPANULACEAE	*Githopsis diffusa* subsp. *diffusa*	blue cup, spreading
CAMPANULACEAE	*Nemacladus rubescens* var. *tenuis*	threadplant, desert
CAPRIFOLIACEAE	*Lonicera conjugialis*	honeysuckle, purpleflower
CAPRIFOLIACEAE	*Sambucus racemosa* var. *microbotrys*	elderberry, red
CAPRIFOLIACEAE	*Symphoricarpos mollis*	snowberry, creeping
CARYOPHYLLACEAE	*Arenaria macradenia* var. *arcuifolia*	sandwort, Mojave
CARYOPHYLLACEAE	*Minuartia douglasii*	stitchwort, Douglas'
CARYOPHYLLACEAE	*Spergularia macrotheca* var. *macrotheca*	sandspurry, sticky
CHENOPODIACEAE	*Atriplex hymenelytra*	holly, desert
CHENOPODIACEAE	*Atriplex leucophylla*	saltbush, beach
CHENOPODIACEAE	*Krascheninnikovia lanata*	winter fat
CHENOPODIACEAE	*Salicornia bigelovii*	saltwart, dwarf
CORNACEAE	*Cornus nuttallii*	dogwood, mountain
CRASSULACEAE	*Dudleya caespitosa*	sea lettuce
CRASSULACEAE	*Dudleya cymosa*	liveforever, canyon
CRASSULACEAE	*Dudleya densiflora*	liveforever, San Gabriel Mountains
CRASSULACEAE	*Dudleya pulverulenta*	dudleya, chale
CRASSULACEAE	*Dudleya setchellii*	dudleya, Santa Clara Valley
CRASSULACEAE	*Dudleya variegata*	dudleya, variegated
CRASSULACEAE	*Sedum obtusatum*	stonecrop, Sierra
CRASSULACEAE	*Sedum spathulifolium* subsp. *anomalum*	stonecrop, broadleaf
CROSSOSOMATACEAE	*Crossosoma californicum*	crossosoma, Catalina
CUCURBITACEAE	*Brandegea bigelovii*	starvine, desert
CUCURBITACEAE	*Cucurbita foetidissima*	calabizilla

CUPRESSACEAE	*Calocedrus decurrens*	cedar, incense
CUPRESSACEAE	*Cupressus forbesii*	cypress, Tecate
CUPRESSACEAE	*Juniperus occidentalis* var. *australis*	juniper, Sierra
CYPERACEAE	*Carex alma*	sedge, alma
CYPERACEAE	*Carex aquatilis* var. *aquatilis*	sedge, water
DRYOPTERIDACEAE	*Polystichum imbricans*	sword fern, narrowleaf
DRYOPTERIDACEAE	*Polystichum imbricans* subsp. *curtum*	sword fern, rock
EPHEDRACEAE	*Ephedra californica*	tea, desert
ERICACEAE	*Arbutus menziesii*	madrone, Pacific
ERICACEAE	*Arctostaphylos australis*	manzanita, Australian
ERICACEAE	*Arctostaphylos catalinae*	manzanita, Santa Catalina Island
ERICACEAE	*Arctostaphylos gabrielensis*	manzanita, San Gabriel
ERICACEAE	*Arctostaphylos glandulosa*	manzanita, Eastwood's
ERICACEAE	*Arctostaphylos glauca*	manzanita, big berry
ERICACEAE	*Arctostaphylos pungens*	manzanita, pointleaf
ERICACEAE	*Xylococcus bicolor*	manzanita, mission
EUPHORBIACEAE	*Chamaesyce platysperma*	spurge, flat seeded
EUPHORBIACEAE	*Chamaesyce setiloba*	sandmat, Yuma
EUPHORBIACEAE	*Croton californicus*	croton, California
EUPHORBIACEAE	*Tetracoccus dioicus*	tetracoccus, Parry's
FABACEAE	*Astragalus agnicidus*	milkvetch, Humboldt
FABACEAE	*Astragalus brauntonii*	milkvetch, Braunton's
FABACEAE	*Astragalus lentiginosus* var. *coachellae*	milkvetch, Coachella Valley
FABACEAE	*Astragalus nevinii*	milkvetch, San Clemente Island
FABACEAE	*Astragalus pycnostachyus* var. *lanosissimus*	milkvetch, Ventura Marsh
FABACEAE	*Lotus dendroideus* var. *traskiae*	lotus, Trask's island
FABACEAE	*Lotus otayensis*	lotus, Otay Mountain
FABACEAE	*Lotus scoparius* var. *scoparius*	broom, California
FABACEAE	*Lupinus hirsutissimus*	lupine, stinging
FABACEAE	*Lupinus microcarpus* var. *densiflorus*	lupine, valley
FABACEAE	*Lupinus succulentus*	lupine, arroyo
FABACEAE	*Psorothamnus schottii*	dalea, Schott's false
FABACEAE	*Trifolium amoenum*	clover, showy Indian
FOUQUIERIACEAE	*Fouquiera splendens*	ocotillo
GARRYACEAE	*Garrya veitchii*	silktassel, canyon

GENTIANACEAE	*Centaurium venustum*	canchalagua
GERANIACEAE	*Geranium carolinianum*	cranesbill, Carolina
GROSSULARIACEAE	*Ribes amarum*	gooseberry, bitter
GROSSULARIACEAE	*Ribes montigenum*	gooseberry, mountain
GROSSULARIACEAE	*Ribes nevadense*	currant, mountain pink
GROSSULARIACEAE	*Ribes tortuosum*	gooseberry, twisted
HYDROPHYLLACEAE	*Emmenanthe penduliflora*	whispering bells
HYDROPHYLLACEAE	*Eriodictyon crassifolium*	yerba santa, thickleaf
HYDROPHYLLACEAE	*Heliotropium curassavicum*	quail plant
HYDROPHYLLACEAE	*Nemophila menziesii*	baby blue eyes 'pennie black'
HYDROPHYLLACEAE	*Phacelia anelsonii*	phacelia, Aven Nelson's
HYDROPHYLLACEAE	*Phacelia brachyloba*	phacelia, short lobe
HYDROPHYLLACEAE	*Phacelia campanularia*	desert bells
HYDROPHYLLACEAE	*Phacelia crenulata* var. *ambigua*	caterpillar weed
HYDROPHYLLACEAE	*Phacelia fremontii*	phacelia, Fremont's
HYDROPHYLLACEAE	*Phacelia minor*	canterbury-bells
HYDROPHYLLACEAE	*Phacelia tanacetifolia*	phacelia, tansy-leafed
HYDROPHYLLACEAE	*Pholistoma membranaceum*	fiesta flower, white
IRIDACEAE	*Iris douglasiana*	iris, Douglas
JUNCACEAE	*Luzula comosa*	woodrush, Pacific
LAMIACEAE	*Acanthomintha lanceolata*	thornmint, Santa Clara
LAMIACEAE	*Hedeoma nanum* var. *californicum*	mock pennyroyal, California
LAMIACEAE	*Hyptis emoryi*	lavendar, desert
LAMIACEAE	*Lepechinia fragrans*	pitcher sage, fragrant
LAMIACEAE	*Monardella cinerea*	monardella, gray
LAMIACEAE	*Monardella douglasii* subsp. *venosa*	monardella, veiny
LAMIACEAE	*Monardella glauca*	monardella, blue
LAMIACEAE	*Monardella lanceolata*	mint, mustang
LAMIACEAE	*Pogogyne abramsii*	mesa mint, San Diego
LAMIACEAE	*Pogogyne douglasii*	pogogyne, Douglas'
LAMIACEAE	*Pogogyne nudiuscula*	mesa mint, Otay
LAMIACEAE	*Salazaria mexicana*	sage, bladder
LAMIACEAE	*Salvia apiana*	sage, white
LAMIACEAE	*Salvia carduacea*	sage, thistle
LAMIACEAE	*Salvia clevelandii*	sage, Cleveland

LAMIACEAE	*Salvia columbariae*	chia
LAMIACEAE	*Salvia dorrii*	sage, purple
LAMIACEAE	*Salvia mellifera*	sage, black
LAMIACEAE	*Salvia sonomensis*	sage, creeping
LAMIACEAE	*Stachys albens*	hedgenettle, white
LAMIACEAE	*Trichostema lanatum*	bluecurls, woolly
LAMIACEAE	*Trichostema lanceolatum*	vinegar weed
LAMIACEAE	*Trichostema parishii*	bluecurls, Parish's
LAMIACEAE	*Trichostema rubrisepalum*	bluecurls, Hernandez
LENNOACEAE	*Pholisma sonorae*	sand food
LILIACEAE	*Allium fimbriatum*	onion, fringed
LILIACEAE	*Allium parryi*	onion, Parry's fringed
LILIACEAE	*Allium praecox*	onion, early
LILIACEAE	*Brodiaea kinkiensis*	brodiaea, San Clemente Island
LILIACEAE	*Calochortus catalinae*	mariposa lily, Catalina
LILIACEAE	*Calochortus palmeri* subsp. *munzii*	mariposa lily, Munz's
LILIACEAE	*Calochortus weedii* var. *weedii*	mariposa lily, Weed's
LILIACEAE	*Lilium parryi*	lily, lemon
LILIACEAE	*Nolina cismontana*	beargrass, peninsular
LILIACEAE	*Triteleia laxa*	Ithuriel's spear
LILIACEAE	*Yucca brevifolia*	Joshua tree
LILIACEAE	*Yucca whipplei*	our lord's candle
LIMNANTHACEAE	*Limnanthes douglasii* subsp. *sulfurea*	meadowfoam, Point Reyes
LIMNANTHACEAE	*Limnanthes flocossa* subsp. *californica*	meadowfoam, woolly
LINACEAE	*Hesperolinon congestum*	flax, Marin dwarf
LINACEAE	*Linum lewisii*	flax, blue
LINACEAE	*Linum puberulum*	flax, desert
LOASACEAE	*Mentzelia albicaulis*	blazing star, white
LOASACEAE	*Mentzelia lindleyi*	blazing star, Lindley's
LOASACEAE	*Mentzelia polita*	blazing star, polished
MALVACEAE	*Eremalche rotundifolia*	five spot, desert
MALVACEAE	*Lavatera assurgentiflora*	mallow, island
MALVACEAE	*Malacothamnus clementinus*	mallow, San Clemente Island bush
MALVACEAE	*Sidalcea hickmanii* subsp. *anomala*	checkerbloom, Cuesta Pass
MALVACEAE	*Sidalcea oregana* subsp. *valida*	checkerbloom, Kenwood Marsh

MALVACEAE	*Sphaeralcea ambigua* var. *ambigua*	mallow, desert
MARTYNIACEAE	*Proboscidea althaeifolia*	devil's claw
NYCTAGINACEAE	*Abronia maritima*	verbena, red sand
NYCTAGINACEAE	*Abronia villosa*	verbena, desert sand
NYCTAGINACEAE	*Boerhavia coccinea*	spiderling, scarlet
NYCTAGINACEAE	*Mirabilis bigelovii*	four o'clock, Bigelow's
NYCTAGINACEAE	*Mirabilis californica*	wishbone bush
OLEACEAE	*Fraxinus dipetala*	ash, California
ONAGRACEAE	*Camissonia boothii*	evening primrose, Boothe's
ONAGRACEAE	*Camissonia brevipes*	suncup, golden
ONAGRACEAE	*Camissonia californica*	evening primrose, California
ONAGRACEAE	*Camissonia claviformis* subsp. *claviformis*	browneyes
ONAGRACEAE	*Camissonia guadalupensis* subsp. *clementina*	evening primrose, San Clemente Island
ONAGRACEAE	*Clarkia amoena*	clarkia, (farewell-to-spring)
ONAGRACEAE	*Clarkia bottae*	godetia, punch-bowl
ONAGRACEAE	*Clarkia epilobioides*	clarkia, canyon
ONAGRACEAE	*Clarkia gracilis* subsp. *sonomensis*	clarkia, Sonoma
ONAGRACEAE	*Clarkia purpurea*	clarkia, winecup
ONAGRACEAE	*Clarkia rubicunda*	clarkia, ruby chalice
ONAGRACEAE	*Clarkia unguiculata*	clarkia, elegant
ONAGRACEAE	*Clarkia virgata*	clarkia, Sierra
ONAGRACEAE	*Clarkia williamsonii*	clarkia, Fort Miller
ONAGRACEAE	*Epilobium sp.*	fireweed
ONAGRACEAE	*Oenothera cavernae*	evening primrose, cave dwelling
ONAGRACEAE	*Oenothera deltoides* subsp. *howellii*	evening primrose, Antioch Dunes
OROBANCHACEAE	*Orobanche fasciculata*	broom-rape, clustered
PAPAVERACEAE	*Canbya candida*	poppy, pigmy
PAPAVERACEAE	*Dendromecon rigida*	poppy, bush
PAPAVERACEAE	*Eschscholzia caespitosa*	poppy, foothill
PAPAVERACEAE	*Eschscholzia californica*	poppy, California
PAPAVERACEAE	*Eschscholzia lemmonii*	poppy, Lemmon's
PAPAVERACEAE	*Eschscholzia lobbii*	frying pans
PAPAVERACEAE	*Platystemon californicus*	cream cups
PAPAVERACEAE	*Stylomecon heterophylla*	poppy, wind
PHILADELPHACEAE	*Carpenteria californica*	anemone, tree

PHILADELPHACEAE	*Jamesia americana* var. *rosea*	cliffbush, fivepetal
PINACEAE	*Pinus albicaulis*	pine, whitebark
PINACEAE	*Pinus attenuata*	pine, knobcone
PINACEAE	*Pinus radiata*	pine, Monterey
PINACEAE	*Pinus sabiniana*	pine, gray
PINACEAE	*Tsuga mertensiana*	hemlock, mountain
PLANTAGINACEAE	*Plantago ovata*	plantain, desert
PLATANACEAE	*Platanus racemosa*	sycamore, California
PLUMBAGINACEAE	*Armeria maritima*	sea pink
POACEAE	*Achnatherum coronatum*	grass, giant rice
POACEAE	*Achnatherum hymenoides*	grass, indian rice
POACEAE	*Achnatherum speciosum*	grass, desert needle
POACEAE	*Aristida purpurea*	three-awn, purple
POACEAE	*Bouteloua gracilis*	blue grama
POACEAE	*Bromus carinatus*	brome, California
POACEAE	*Deschampsia danthonioides*	hairgrass, annual
POACEAE	*Elymus glaucus*	wildrye, blue
POACEAE	*Hordeum intercedens*	barley, bobtail
POACEAE	*Muhlenbergia rigens*	deergrass
POACEAE	*Nassella pulchra*	needlegrass, purple
POACEAE	*Orcuttia californica*	Orcutt grass, California
POACEAE	*Poa secunda*	bluegrass, big
POACEAE	*Sporobolus cryptandrus*	dropseed, sand
POACEAE	*Tuctoria fragilis*	tuctoria, fragile
POLEMONIACEAE	*Eriastrum densifolium* subsp. *elongatum*	woollystar, giant
POLEMONIACEAE	*Eriastrum densifolium* subsp. *sanctorum*	woollystar, Santa Ana River
POLEMONIACEAE	*Eriastrum sapphirinum*	woollystar, sapphire
POLEMONIACEAE	*Gilia capitata*	gilia, globe
POLEMONIACEAE	*Gilia latifolia*	gilia, broad-leaved
POLEMONIACEAE	*Gilia nevinii*	gilia, Nevin's
POLEMONIACEAE	*Gilia transmontana*	gilia, transmontane
POLEMONIACEAE	*Gilia tricolor*	gilia, bird's-eye
POLEMONIACEAE	*Langloisia setosissima* subsp. *punctata*	lilac sunbonnet
POLEMONIACEAE	*Leptodactylon californicum*	phlox, prickly
POLEMONIACEAE	*Linanthus demissus*	snow, desert

POLEMONIACEAE	*Linanthus dianthiflorus*	linanthus, fringed
POLEMONIACEAE	*Linanthus dichotomus*	snow, evening
POLEMONIACEAE	*Linanthus grandiflorus*	linanthus, large-flower
POLEMONIACEAE	*Linanthus lemmonii*	linanthus, Lemmon's
POLEMONIACEAE	*Linanthus parviflorus*	linanthus, variable
POLEMONIACEAE	*Loeseliastrum matthewsii*	calico, desert
POLEMONIACEAE	*Navarretia atractyloides*	pincushion plant, hollyleaf
POLEMONIACEAE	*Navarretia fossalis*	pincushion plant, vernal pool
POLEMONIACEAE	*Polemonium eximium*	sky pilot
POLYGONACEAE	*Centrostegia thurberi*	spineflower, Thurber's
POLYGONACEAE	*Chorizanthe brevicornu*	spineflower, brittle
POLYGONACEAE	*Chorizanthe fimbriata* var. *fimbriata*	spineflower, fringed
POLYGONACEAE	*Chorizanthe parryi* var. *fernandina*	spineflower, San Fernando Valley
POLYGONACEAE	*Chorizanthe parryi* var. *fernandina*	spineflower, San Fernando Valley
POLYGONACEAE	*Chorizanthe polygonoides*	spineflower, knotweed
POLYGONACEAE	*Chorizanthe rigida*	spiny herb
POLYGONACEAE	*Chorizanthe valida*	spineflower, Sonoma
POLYGONACEAE	*Dodecahema leptoceras*	spineflower, slender-horned
POLYGONACEAE	*Eriogonum cinereum*	buckwheat, coastal
POLYGONACEAE	*Eriogonum crocatum*	buckwheat, conejo
POLYGONACEAE	*Eriogonum davidsonii*	buckwheat, Davidson's wild
POLYGONACEAE	*Eriogonum fasciculatum* var. *foliolosum*	buckwheat, California
POLYGONACEAE	*Eriogonum giganteum*	buckwheat, Santa Catalina Island
POLYGONACEAE	*Eriogonum gracile*	buckwheat, slender woolly
POLYGONACEAE	*Eriogonum microthecum* var. *johnstonii*	buckwheat, Johnston's
POLYGONACEAE	*Eriogonum nudum*	buckwheat, naked stem
POLYGONACEAE	*Eriogonum ovalifolium* subsp. *vineum*	buckwheat, Cushenbury
POLYGONACEAE	*Eriogonum saxatile*	buckwheat, hoary
POLYGONACEAE	*Eriogonum thomasii*	buckwheat, Thomas'
POLYGONACEAE	*Eriogonum trichopes* var. *trichopes*	desert trumpet, little
POLYGONACEAE	*Eriogonum umbellatum* subsp. *nevadense*	buckwheat, Nevada
POLYGONACEAE	*Eriogonum wrightii* subsp. *subscaposum*	sage, bastard
POLYGONACEAE	*Mucronea californica*	spineflower, California
POLYGONACEAE	*Nemacaulis denudata*	woolly-heads
POLYGONACEAE	*Pterostegia drymarioides*	pterostegia

PORTULACACEAE	*Calandrinia ciliata*	red maids
PORTULACACEAE	*Calyptridium monandrum*	sandcress
PORTULACACEAE	*Claytonia perfoliata*	miner's lettuce
PRIMULACEAE	*Dodecatheon clevelandii*	shooting star, padre's
PRIMULACEAE	*Dodecatheon redolens*	shootingstar, scented
RANUNCULACEAE	*Clematis lasiantha*	pipestems
RANUNCULACEAE	*Delphinium californicum*	larkspur, Hospital Canyon
RANUNCULACEAE	*Delphinium cardinale*	larkspur, scarlet
RANUNCULACEAE	*Thalictrum fendleri*	meadow rue, Torrey's
RHAMNACEAE	*Ceanothus leucodermis*	whitethorn, chaparral
RHAMNACEAE	*Ceanothus megacarpus* var. *insularis*	ceanothus, big-pod
RHAMNACEAE	*Ceanothus oliganthus*	ceanothus, hairy
RHAMNACEAE	*Rhamnus californica* subsp. *occidentalis*	coffeeberry, California
RHAMNACEAE	*Rhamnus crocea*	redberry, spiny
RHAMNACEAE	*Rhamnus rubra* var. *yosemitiana*	coffeeberry, Sierra
ROSACEAE	*Adenostoma fasciculatum*	chamise
ROSACEAE	*Adenostoma sparsifolium*	red shank
ROSACEAE	*Cercocarpus betuloides*	mountain mahogany, birch-leaf
ROSACEAE	*Cercocarpus ledifolius*	mountain mahogany, curl-leaf
ROSACEAE	*Fallugia paradoxa*	Apache plume
ROSACEAE	*Heteromeles arbutifolia*	toyon
ROSACEAE	*Holodiscus microphyllus* var. *microphyllus*	spiraea, rock
ROSACEAE	*Horkelia rybergii*	horkelia, Cleveland's
ROSACEAE	*Ivesia santolinoides*	ivesia, mousetail
ROSACEAE	*Lyonothamnus floribundus* subsp. *floribundus*	ironwood, Santa Catalina Island
ROSACEAE	*Petrophyton caespitosum*	rock spirea, mat
ROSACEAE	*Potentilla glandulosa*	cinquefoil, gland
ROSACEAE	*Prunus ilicifolia* subsp. *lyonii*	cherry, holly-leafed
ROSACEAE	*Rosa gymnocarpa*	rose, wood
ROSACEAE	*Rosa woodsii* var. *ultramontana*	rose, interior
ROSACEAE	*Spiraea densiflora*	meadowsweet, rose
RUBIACEAE	*Galium angustifolium*	bedstraw, narrow-leaved
SALICACEAE	*Populus fremontii*	cottonwood, Fremont's
SALICACEAE	*Salix arctica*	willow, arctic
SAURURACEAE	*Anemopsis californica*	yerba mansa

SAXIFRAGACEAE	*Boykinia rotundifolia*	boykinia, round-leaved
SAXIFRAGACEAE	*Heuchera abramsii*	alumroot, Abram's
SAXIFRAGACEAE	*Heuchera elegans*	alumroot, urn-flowered
SAXIFRAGACEAE	*Heuchera rubescens* var. *alpicola*	alumroot, pink
SAXIFRAGACEAE	*Lithophragma heterophyllum*	woodland star, hillside
SAXIFRAGACEAE	*Saxifraga tolmiei*	saxifraga, Tolmie's
SCROPHULARIACEAE	*Antirrhinum coulterianum*	snapdragon, Coulter's
SCROPHULARIACEAE	*Castilleja foliolosa*	indian paint brush, woolly
SCROPHULARIACEAE	*Collinsia concolor*	blue-eyed Mary, single color
SCROPHULARIACEAE	*Collinsia heterophylla*	Chinese houses
SCROPHULARIACEAE	*Collinsia parviflora*	blue-eyed Mary
SCROPHULARIACEAE	*Cordylanthus maritimus* subsp. *maritimus*	bird's-beak, salt marsh
SCROPHULARIACEAE	*Cordylanthus palmatus*	bird's-beak, palmate
SCROPHULARIACEAE	*Cordylanthus rigidus* subsp. *setigerus*	bird's-beak, stiffbranch
SCROPHULARIACEAE	*Cordylanthus tenuis* subsp. *capillaris*	bird's-beak, Pennell's
SCROPHULARIACEAE	*Galvezia speciosa*	snapdragon, Snowy Island
SCROPHULARIACEAE	*Keckiella antirrhinoides*	penstemon, snapdragon
SCROPHULARIACEAE	*Keckiella cordifolia*	keckiella, heartleaf
SCROPHULARIACEAE	*Maurandya antirrhiniflora*	snapdragon, violet twining
SCROPHULARIACEAE	*Mimulus aurantiacus*	monkeyflower, orange bush
SCROPHULARIACEAE	*Mimulus guttatus*	monkeyflower, common
SCROPHULARIACEAE	*Mimulus pictus*	monkeyflower, calico
SCROPHULARIACEAE	*Mohavea confertiflora*	ghost flower
SCROPHULARIACEAE	*Penstemon cedrosensis*	penstemon, Cedros Island
SCROPHULARIACEAE	*Penstemon grinnellii*	penstemon, Grinell's
SCROPHULARIACEAE	*Penstemon heterophyllus* var. *australis*	penstemon, bunchleaf
SCROPHULARIACEAE	*Penstemon rostriflorus*	beardtongue, beaked
SCROPHULARIACEAE	*Penstemon speciosus*	clover, prairie
SCROPHULARIACEAE	*Turricula parryi*	poodle-dog bush
SIMAROUBACEAE	*Castela emoryi*	crucifixion thorn
SOLANACEAE	*Lycium andersonii*	wolfberry, Anderson's
SOLANACEAE	*Physalis crassifolia*	cherry, yellow nightshade ground
STERCULIACEAE	*Fremontodendron californicum*	flannelbush, California
TAXODIACEAE	*Sequoiadendron giganteum*	sequoia, giant
TYPHACEAE	*Typha domingensis*	cattail, southern

ZYGOPHYLLACEAE	*Larrea tridentata*	creosote bush

Rancho Santa Ana Botanic Garden

Appendix B (alpha by common name, family, genus, species)

agoseris, big flower	ASTERACEAE	*Agoseris grandiflora*
agoseris, spearleaf	ASTERACEAE	*Agoseris retrorsa*
alumroot, Abram's	SAXIFRAGACEAE	*Heuchera abramsii*
alumroot, pink	SAXIFRAGACEAE	*Heuchera rubescens* var. *alpicola*
alumroot, urn-flowered	SAXIFRAGACEAE	*Heuchera elegans*
anemone, tree	PHILADELPHACEAE	*Carpenteria californica*
Apache plume	ROSACEAE	*Fallugia paradoxa*
arrow weed	ASTERACEAE	*Pluchea sericea*
ash, California	OLEACEAE	*Fraxinus dipetala*
aster, alpine leafybract	ASTERACEAE	*Aster foliaceus*
aster, Mecca	ASTERACEAE	*Xylorhiza cognata*
aster, New Mexico tansy	ASTERACEAE	*Machaeranthera asteroides*
aster, Orcutt's woody	ASTERACEAE	*Xylorhiza orcuttii*
baby blue eyes 'pennie black'	HYDROPHYLLACEAE	*Nemophila menziesii*
barberry, Nevin's	BERBERIDACEAE	*Berberis nevinii*
barley, bobtail	POACEAE	*Hordeum intercedens*
beardtongue, beaked	SCROPHULARIACEAE	*Penstemon rostriflorus*
beargrass, peninsular	LILIACEAE	*Nolina cismontana*
bedstraw, narrow-leaved	RUBIACEAE	*Galium angustifolium*
bird's-beak, palmate	SCROPHULARIACEAE	*Cordylanthus palmatus*
bird's-beak, Pennell's	SCROPHULARIACEAE	*Cordylanthus tenuis* subsp. *capillaris*
bird's-beak, salt marsh	SCROPHULARIACEAE	*Cordylanthus maritimus* subsp. *maritimus*
bird's-beak, stiffbranch	SCROPHULARIACEAE	*Cordylanthus rigidus* subsp. *setigerus*
blazing star, Lindley's	LOASACEAE	*Mentzelia lindleyi*
blazing star, polished	LOASACEAE	*Mentzelia polita*
blazing star, white	LOASACEAE	*Mentzelia albicaulis*
blow wives	ASTERACEAE	*Achyrachaena mollis*
blue cup, spreading	CAMPANULACEAE	*Githopsis diffusa* subsp. *diffusa*
blue grama	POACEAE	*Bouteloua gracilis*
blue-eyed Mary	SCROPHULARIACEAE	*Collinsia parviflora*
blue-eyed Mary, single color	SCROPHULARIACEAE	*Collinsia concolor*
bluecurls, Hernandez	LAMIACEAE	*Trichostema rubrisepalum*
bluecurls, Parish's	LAMIACEAE	*Trichostema parishii*
bluecurls, woolly	LAMIACEAE	*Trichostema lanatum*
bluegrass, big	POACEAE	*Poa secunda*

Rancho Santa Ana Botanic Garden

Appendix B (alpha by common name, family, genus, species)

boykinia, round-leaved	SAXIFRAGACEAE	*Boykinia rotundifolia*
brickellbush, California	ASTERACEAE	*Brickellia californica*
brickellbush, pungent	ASTERACEAE	*Brickellia arguta*
brickellbush, woolly	ASTERACEAE	*Brickellia incana*
brittlebush	ASTERACEAE	*Encelia farinosa*
brittlebush, California	ASTERACEAE	*Encelia californica*
brodiaea, San Clemente Island	LILIACEAE	*Brodiaea kinkiensis*
brome, California	POACEAE	*Bromus carinatus*
broom-rape, clustered	OROBANCHACEAE	*Orobanche fasciculata*
broom, California	FABACEAE	*Lotus scoparius* var. *scoparius*
browneyes	ONAGRACEAE	*Camissonia claviformis* subsp. *claviformis*
buckwheat, California	POLYGONACEAE	*Eriogonum fasciculatum* var. *foliolosum*
buckwheat, coastal	POLYGONACEAE	*Eriogonum cinereum*
buckwheat, conejo	POLYGONACEAE	*Eriogonum crocatum*
buckwheat, Cushenbury	POLYGONACEAE	*Eriogonum ovalifolium* subsp. *vineum*
buckwheat, Davidson's wild	POLYGONACEAE	*Eriogonum davidsonii*
buckwheat, hoary	POLYGONACEAE	*Eriogonum saxatile*
buckwheat, Johnston's	POLYGONACEAE	*Eriogonum microthecum* var. *johnstonii*
buckwheat, naked stem	POLYGONACEAE	*Eriogonum nudum*
buckwheat, Nevada	POLYGONACEAE	*Eriogonum umbellatum* subsp. *nevadense*
buckwheat, Santa Catalina Island	POLYGONACEAE	*Eriogonum giganteum*
buckwheat, slender woolly	POLYGONACEAE	*Eriogonum gracile*
buckwheat, Thomas'	POLYGONACEAE	*Eriogonum thomasii*
bur sage, San Diego	ASTERACEAE	*Ambrosia chenopodifolia*
bur, beach	ASTERACEAE	*Ambrosia chamissonis* var. *bipinnatifida*
burro-weed	ASTERACEAE	*Ambrosia dumosa*
burrobrush	ASTERACEAE	*Hymenoclea salsola*
butterfly bush, Panamint	BUDDLEJACEAE	*Buddleja utahensis*
cactus, California barrel	CACTACEAE	*Ferocactus cylindraceus*
cactus, fishhook	CACTACEAE	*Mammilaria tetrancistra*
cactus, hedgehog	CACTACEAE	*Echinocereus engelmannii*
cactus, hedgehog	CACTACEAE	*Echinocereus maritimus*
cactus, Mojave prickly-pear	CACTACEAE	*Opuntia erinacea*
calabizilla	CUCURBITACEAE	*Cucurbita foetidissima*
calico, desert	POLEMONIACEAE	*Loeseliastrum matthewsii*

California Dutchman's pipe	ARISTOLOCHIACEAE	*Aristolochia californica*
canchalagua	GENTIANACEAE	*Centaurium venustum*
canterbury-bells	HYDROPHYLLACEAE	*Phacelia minor*
caterpillar weed	HYDROPHYLLACEAE	*Phacelia crenulata* var. *ambigua*
catseye, clearwater	BORAGINACEAE	*Cryptantha intermedia*
catseye, cushion	BORAGINACEAE	*Cryptantha circumcissa*
catseye, pointed	BORAGINACEAE	*Cryptantha muricata*
catseye, redroot	BORAGINACEAE	*Cryptantha micrantha*
catseye, roughseed	BORAGINACEAE	*Cryptantha flavoculata*
cattail, southern	TYPHACEAE	*Typha domingensis*
ceanothus, big-pod	RHAMNACEAE	*Ceanothus megacarpus* var. *insularis*
ceanothus, hairy	RHAMNACEAE	*Ceanothus oliganthus*
cedar, incense	CUPRESSACEAE	*Calocedrus decurrens*
cedar, pygmy	ASTERACEAE	*Peucephyllum schottii*
celery, Hoover's	APIACEAE	*Eryngium aristulatum* var. *hooveri*
chamise	ROSACEAE	*Adenostoma fasciculatum*
Chamisso arnica	ASTERACEAE	*Arnica chamissonis* subsp. *foliosa*
checkerbloom, Cuesta Pass	MALVACEAE	*Sidalcea hickmanii* subsp. *anomala*
checkerbloom, Kenwood Marsh	MALVACEAE	*Sidalcea oregana* subsp. *valida*
cherry, holly-leafed	ROSACEAE	*Prunus ilicifolia* subsp. *lyonii*
cherry, yellow nightshade ground	SOLANACEAE	*Physalis crassifolia*
chia	LAMIACEAE	*Salvia columbariae*
chinchweed	ASTERACEAE	*Pectis papposa*
Chinese houses	SCROPHULARIACEAE	*Collinsia heterophylla*
cholla, cane	CACTACEAE	*Opuntia parryi* var. *parryi*
cholla, teddy-bear	CACTACEAE	*Opuntia bigelovii*
cinquefoil, gland	ROSACEAE	*Potentilla glandulosa*
clarkia, (farewell-to-spring)	ONAGRACEAE	*Clarkia amoena*
clarkia, canyon	ONAGRACEAE	*Clarkia epilobioides*
clarkia, elegant	ONAGRACEAE	*Clarkia unguiculata*
clarkia, Fort Miller	ONAGRACEAE	*Clarkia williamsonii*
clarkia, ruby chalice	ONAGRACEAE	*Clarkia rubicunda*
clarkia, Sierra	ONAGRACEAE	*Clarkia virgata*
clarkia, Sonoma	ONAGRACEAE	*Clarkia gracilis* subsp. *sonomensis*
clarkia, winecup	ONAGRACEAE	*Clarkia purpurea*

claycress, Hammit's	BRASSICACEAE	*Sibaropsis hammittii*
cliffbush, fivepetal	PHILADELPHACEAE	*Jamesia americana* var. *rosea*
clover, prairie	SCROPHULARIACEAE	*Penstemon speciosus*
clover, showy Indian	FABACEAE	*Trifolium amoenum*
coastweed, dwarf	ASTERACEAE	*Amblyopappus pusillus*
coffeeberry, California	RHAMNACEAE	*Rhamnus californica* subsp. *occidentalis*
coffeeberry, Sierra	RHAMNACEAE	*Rhamnus rubra* var. *yosemitiana*
comb-bur, hairy-leafed	BORAGINACEAE	*Pectocarya penicillata*
cottonwood, Fremont's	SALICACEAE	*Populus fremontii*
cranesbill, Carolina	GERANIACEAE	*Geranium carolinianum*
cream cups	PAPAVERACEAE	*Platystemon californicus*
creosote bush	ZYGOPHYLLACEAE	*Larrea tridentata*
crosossoma, Catalina	CROSSOSOMATACEAE	*Crossosoma californicum*
croton, California	EUPHORBIACEAE	*Croton californicus*
crownbeard	ASTERACEAE	*Verbesina dissita*
crucifixion thorn	SIMAROUBACEAE	*Castela emoryi*
cryptantha, Trask's	BORAGINACEAE	*Cryptantha traskiae*
cudweed, Wright's	ASTERACEAE	*Gnaphalium canescens* subsp. *thermale*
currant, mountain pink	GROSSULARIACEAE	*Ribes nevadense*
cypress, Tecate	CUPRESSACEAE	*Cupressus forbesii*
daisy, Emory's rock	ASTERACEAE	*Perityle emoryi*
daisy, paper	ASTERACEAE	*Psilostrophe cooperi*
daisy, seaside	ASTERACEAE	*Erigeron glaucus*
daisy, Wallace's woolly	ASTERACEAE	*Eriophyllum wallacei*
dalea, Schott's false	FABACEAE	*Psorothamnus schottii*
dandelion, California	ASTERACEAE	*Taraxacum californicum*
dandelion, desert	ASTERACEAE	*Malacothrix californica*
dandelion, desert	ASTERACEAE	*Malacothrix glabrata*
deergrass	POACEAE	*Muhlenbergia rigens*
desert bells	HYDROPHYLLACEAE	*Phacelia campanularia*
desert candle	BRASSICACEAE	*Caulanthus inflatus*
desert star, Mojave	ASTERACEAE	*Monoptilon bellioides*
desert trumpet, little	POLYGONACEAE	*Eriogonum trichopes* var. *trichopes*
devil's claw	MARTYNIACEAE	*Proboscidea althaeifolia*
dogwood, mountain	CORNACEAE	*Cornus nuttallii*

dome, yellow	ASTERACEAE	*Trichoptilium incisum*
draba, southern California	BRASSICACEAE	*Draba corrugata*
draba, wedgeleaf	BRASSICACEAE	*Draba cuneifolia*
dropseed, sand	POACEAE	*Sporobolus cryptandrus*
dudleya, chale	CRASSULACEAE	*Dudleya pulverulenta*
dudleya, Santa Clara Valley	CRASSULACEAE	*Dudleya setchellii*
dudleya, variegated	CRASSULACEAE	*Dudleya variegata*
elderberry, red	CAPRIFOLIACEAE	*Sambucus racemosa* var. *microbotrys*
eriophyllum, Nevin's	ASTERACEAE	*Eriophyllum nevinii*
evening primrose, Antioch Dunes	ONAGRACEAE	*Oenothera deltoides* subsp. *howellii*
evening primrose, Boothe's	ONAGRACEAE	*Camissonia boothii*
evening primrose, California	ONAGRACEAE	*Camissonia californica*
evening primrose, cave dwelling	ONAGRACEAE	*Oenothera cavernae*
evening primrose, San Clemente Island	ONAGRACEAE	*Camissonia guadalupensis* subsp. *clementina*
false golden aster, sessileflower	ASTERACEAE	*Heterotheca sessiliflora*
fiddleneck, forked	BORAGINACEAE	*Amsinckia vernicosa* var. *furcata*
fiesta flower, white	HYDROPHYLLACEAE	*Pholistoma membranaceum*
fireweed	ONAGRACEAE	*Epilobium sp.*
five spot, desert	MALVACEAE	*Eremalche rotundifolia*
flannelbush, California	STERCULIACEAE	*Fremontodendron californicum*
flax, blue	LINACEAE	*Linum lewisii*
flax, desert	LINACEAE	*Linum puberulum*
flax, Marin dwarf	LINACEAE	*Hesperolinon congestum*
fleabane, Brewer's	ASTERACEAE	*Erigeron breweri*
fleabane, leafy	ASTERACEAE	*Erigeron foliosus*
forget-me-not, tufted	BORAGINACEAE	*Cryptantha virginensis*
four o'clock, Bigelow's	NYCTAGINACEAE	*Mirabilis bigelovii*
frying pans	PAPAVERACEAE	*Eschscholzia lobbii*
ghost flower	SCROPHULARIACEAE	*Mohavea confertiflora*
gilia, bird's-eye	POLEMONIACEAE	*Gilia tricolor*
gilia, broad-leaved	POLEMONIACEAE	*Gilia latifolia*
gilia, globe	POLEMONIACEAE	*Gilia capitata*
gilia, Nevin's	POLEMONIACEAE	*Gilia nevinii*
gilia, transmontane	POLEMONIACEAE	*Gilia transmontana*
godetia, punch-bowl	ONAGRACEAE	*Clarkia bottae*

goldenbush, alkali	ASTERACEAE	*Isocoma acradenia*
goldenbush, Cooper's	ASTERACEAE	*Ericameria cooperi*
goldenbush, interior	ASTERACEAE	*Ericameria linearifolia*
goldeneye, Parrish's	ASTERACEAE	*Viguiera parishii*
goldenfields, Burke's	ASTERACEAE	*Lasthenia burkei*
goldenfields, California	ASTERACEAE	*Lasthenia californica*
goldenhead, rayless	ASTERACEAE	*Acamptopappus sphaerocephalus*
goldenhead, Shockley's	ASTERACEAE	*Acamptopappus shockleyi*
goldenrod, showy	ASTERACEAE	*Solidago spectabilis*
gooseberry, bitter	GROSSULARIACEAE	*Ribes amarum*
gooseberry, mountain	GROSSULARIACEAE	*Ribes montigenum*
gooseberry, twisted	GROSSULARIACEAE	*Ribes tortuosum*
grass, desert needle	POACEAE	*Achnatherum speciosum*
grass, giant rice	POACEAE	*Achnatherum coronatum*
grass, indian rice	POACEAE	*Achnatherum hymenoides*
groundsel, green	ASTERACEAE	*Senecio flaccidus*
groundsel, Mojave	ASTERACEAE	*Senecio mohavensis*
hairgrass, annual	POACEAE	*Deschampsia danthonioides*
harebell, chaparral	CAMPANULACEAE	*Campanula exigua*
hazardia, Orcutt's	ASTERACEAE	*Hazardia orcuttii*
hedgenettle, white	LAMIACEAE	*Stachys albens*
hemlock, mountain	PINACEAE	*Tsuga mertensiana*
holly, desert	CHENOPODIACEAE	*Atriplex hymenelytra*
honeysuckle, purpleflower	CAPRIFOLIACEAE	*Lonicera conjugialis*
horkelia, Cleveland's	ROSACEAE	*Horkelia rybergii*
horsebrush, gray	ASTERACEAE	*Tetradymia canescens*
horsebrush, longspine	ASTERACEAE	*Tetradymia axillaris*
hulsea, Pacific	ASTERACEAE	*Hulsea algida*
hymenopappus, Idaho	ASTERACEAE	*Hymenopappus filifolius* var. *lugens*
indian paint brush, woolly	SCROPHULARIACEAE	*Castilleja foliolosa*
iris, Douglas	IRIDACEAE	*Iris douglasiana*
ironwood, Santa Catalina Island	ROSACEAE	*Lyonothamnus floribundus* subsp. *floribundus*
Ithuriel's spear	LILIACEAE	*Triteleia laxa*
ivesia, mousetail	ROSACEAE	*Ivesia santolinoides*
jewelflower, Laguna Mountain	BRASSICACEAE	*Streptanthus bernardinus*

jewelflower, San Benito	BRASSICACEAE	*Streptanthus insignis*
jewelflower, uncommon	BRASSICACEAE	*Streptanthus albidus* subsp. *peramoenus*
Joshua tree	LILIACEAE	*Yucca brevifolia*
juniper, Sierra	CUPRESSACEAE	*Juniperus occidentalis* var. *australis*
keckiella, heartleaf	SCROPHULARIACEAE	*Keckiella cordifolia*
larkspur, Hospital Canyon	RANUNCULACEAE	*Delphinium californicum*
larkspur, scarlet	RANUNCULACEAE	*Delphinium cardinale*
lavendar, desert	LAMIACEAE	*Hyptis emoryi*
lax flower	ASTERACEAE	*Baileya pauciradiata*
lessingia, Crystal Springs	ASTERACEAE	*Lessingia arachnoidea*
lilac sunbonnet	POLEMONIACEAE	*Langloisia setosissima* subsp. *punctata*
lily, lemon	LILIACEAE	*Lilium parryi*
linanthus, fringed	POLEMONIACEAE	*Linanthus dianthiflorus*
linanthus, large-flower	POLEMONIACEAE	*Linanthus grandiflorus*
linanthus, Lemmon's	POLEMONIACEAE	*Linanthus lemmonii*
linanthus, variable	POLEMONIACEAE	*Linanthus parviflorus*
liveforever, canyon	CRASSULACEAE	*Dudleya cymosa*
liveforever, San Gabriel Mountains	CRASSULACEAE	*Dudleya densiflora*
lotus, Otay Mountain	FABACEAE	*Lotus otayensis*
lotus, Trask's island	FABACEAE	*Lotus dendroideus* var. *traskiae*
lupine, arroyo	FABACEAE	*Lupinus succulentus*
lupine, stinging	FABACEAE	*Lupinus hirsutissimus*
lupine, valley	FABACEAE	*Lupinus microcarpus* var. *densiflorus*
madia, common	ASTERACEAE	*Madia elegans*
madia, Hall's	ASTERACEAE	*Harmonia hallii*
madrone, Pacific	ERICACEAE	*Arbutus menziesii*
mallow, desert	MALVACEAE	*Sphaeralcea ambigua* var. *ambigua*
mallow, island	MALVACEAE	*Lavatera assurgentiflora*
mallow, San Clemente Island bush	MALVACEAE	*Malacothamnus clementinus*
manzanita, Australian	ERICACEAE	*Arctostaphylos australis*
manzanita, big berry	ERICACEAE	*Arctostaphylos glauca*
manzanita, Eastwood's	ERICACEAE	*Arctostaphylos glandulosa*
manzanita, mission	ERICACEAE	*Xylococcus bicolor*
manzanita, pointleaf	ERICACEAE	*Arctostaphylos pungens*
manzanita, San Gabriel	ERICACEAE	*Arctostaphylos gabrielensis*

manzanita, Santa Catalina Island	ERICACEAE	*Arctostaphylos catalinae*
maple, mountain	ACERACEAE	*Acer glabrum*
marigold, wild	ASTERACEAE	*Baileya multiradiata*
mariposa lily, Catalina	LILIACEAE	*Calochortus catalinae*
mariposa lily, Munz's	LILIACEAE	*Calochortus palmeri* subsp. *munzii*
mariposa lily, Weed's	LILIACEAE	*Calochortus weedii* var. *weedii*
matchweed, California	ASTERACEAE	*Gutierrezia californica*
meadow rue, Torrey's	RANUNCULACEAE	*Thalictrum fendleri*
meadowfoam, Point Reyes	LIMNANTHACEAE	*Limnanthes douglasii* subsp. *sulfurea*
meadowfoam, woolly	LIMNANTHACEAE	*Limnanthes flocossa* subsp. *californica*
meadowsweet, rose	ROSACEAE	*Spiraea densiflora*
mesa mint, Otay	LAMIACEAE	*Pogogyne nudiuscula*
mesa mint, San Diego	LAMIACEAE	*Pogogyne abramsii*
milkvetch, Braunton's	FABACEAE	*Astragalus brauntonii*
milkvetch, Coachella Valley	FABACEAE	*Astragalus lentiginosus* var. *coachellae*
milkvetch, Humboldt	FABACEAE	*Astragalus agnicidus*
milkvetch, San Clemente Island	FABACEAE	*Astragalus nevinii*
milkvetch, Ventura Marsh	FABACEAE	*Astragalus pycnostachyus* var. *lanosissimus*
milkweed, California	ASCLEPIADACEAE	*Asclepias californica*
milkweed, desert	ASCLEPIADACEAE	*Asclepias erosa*
milkweed, narrow-leafed	ASCLEPIADACEAE	*Asclepias fascicularis*
milkweed, white-stemmed	ASCLEPIADACEAE	*Asclepias albicans*
miner's lettuce	PORTULACACEAE	*Claytonia perfoliata*
mint, mustang	LAMIACEAE	*Monardella lanceolata*
mock pennyroyal, California	LAMIACEAE	*Hedeoma nanum* var. *californicum*
monardella, blue	LAMIACEAE	*Monardella glauca*
monardella, gray	LAMIACEAE	*Monardella cinerea*
monardella, veiny	LAMIACEAE	*Monardella douglasii* subsp. *venosa*
monkeyflower, calico	SCROPHULARIACEAE	*Mimulus pictus*
monkeyflower, common	SCROPHULARIACEAE	*Mimulus guttatus*
monkeyflower, orange bush	SCROPHULARIACEAE	*Mimulus aurantiacus*
monolopia, common	ASTERACEAE	*Monolopia lanceolata*
mountain mahogany, birch-leaf	ROSACEAE	*Cercocarpus betuloides*
mountain mahogany, curl-leaf	ROSACEAE	*Cercocarpus ledifolius*
mugwort	ASTERACEAE	*Artemisia douglasiana*

mule fat	ASTERACEAE	*Baccharis salicifolia*
mustard, Lemmon's	BRASSICACEAE	*Guillenia lemmonii*
mustard, yellow	BRASSICACEAE	*Guillenia flavescens*
needlegrass, purple	POACEAE	*Nassella pulchra*
nest straw, everlasting	ASTERACEAE	*Stylocline gnaphaloides*
ocotillo	FOUQUIERIACEAE	*Fouquiera splendens*
onion, early	LILIACEAE	*Allium praecox*
onion, fringed	LILIACEAE	*Allium fimbriatum*
onion, Parry's fringed	LILIACEAE	*Allium parryi*
Orcutt grass, California	POACEAE	*Orcuttia californica*
Oregon sunshine	ASTERACEAE	*Eriophyllum lanatum*
our lord's candle	LILIACEAE	*Yucca whipplei*
palm, California fan	ARECACEAE	*Washingtonia filifera*
penstemon, bunchleaf	SCROPHULARIACEAE	*Penstemon heterophyllus* var. *australis*
penstemon, Cedros Island	SCROPHULARIACEAE	*Penstemon cedrosensis*
penstemon, Grinell's	SCROPHULARIACEAE	*Penstemon grinnellii*
penstemon, snapdragon	SCROPHULARIACEAE	*Keckiella antirrhinoides*
pentachaeta, golden-rayed	ASTERACEAE	*Pentachaeta aurea*
pentachaeta, Lyon's	ASTERACEAE	*Pentachaeta lyonii*
peppergrass, Jared's	BRASSICACEAE	*Lepidium jaredii*
phacelia, Aven Nelson's	HYDROPHYLLACEAE	*Phacelia anelsonii*
phacelia, Fremont's	HYDROPHYLLACEAE	*Phacelia fremontii*
phacelia, short lobe	HYDROPHYLLACEAE	*Phacelia brachyloba*
phacelia, tansy-leafed	HYDROPHYLLACEAE	*Phacelia tanacetifolia*
phlox, prickly	POLEMONIACEAE	*Leptodactylon californicum*
pigweed, fringed	AMARANTHACEAE	*Amaranthus fimbriatus*
pincushion plant, hollyleaf	POLEMONIACEAE	*Navarretia atractyloides*
pincushion plant, vernal pool	POLEMONIACEAE	*Navarretia fossalis*
pincushion, yellow	ASTERACEAE	*Chaenactis glabriuscula*
pine, gray	PINACEAE	*Pinus sabiniana*
pine, knobcone	PINACEAE	*Pinus attenuata*
pine, Monterey	PINACEAE	*Pinus radiata*
pine, whitebark	PINACEAE	*Pinus albicaulis*
pipestems	RANUNCULACEAE	*Clematis lasiantha*
pitcher sage, fragrant	LAMIACEAE	*Lepechinia fragrans*

plantain, desert	PLANTAGINACEAE	*Plantago ovata*
pogogyne, Douglas'	LAMIACEAE	*Pogogyne douglasii*
poodle-dog bush	SCROPHULARIACEAE	*Turricula parryi*
poppy, bush	PAPAVERACEAE	*Dendromecon rigida*
poppy, California	PAPAVERACEAE	*Eschscholzia californica*
poppy, foothill	PAPAVERACEAE	*Eschscholzia caespitosa*
poppy, Lemmon's	PAPAVERACEAE	*Eschscholzia lemmonii*
poppy, pigmy	PAPAVERACEAE	*Canbya candida*
poppy, wind	PAPAVERACEAE	*Stylomecon heterophylla*
pseudobahia, Hartweg's	ASTERACEAE	*Pseudobahia bahiifolia*
pseudobahia, Tulare	ASTERACEAE	*Pseudobahia piersonii*
pterostegia	POLYGONACEAE	*Pterostegia drymarioides*
quail plant	HYDROPHYLLACEAE	*Heliotropium curassavicum*
rabbitbush, rubber	ASTERACEAE	*Chrysothamnus nauseosus*
ragwort, California	ASTERACEAE	*Senecio californicus*
ragwort, San Gabriel	ASTERACEAE	*Senecio astephanus*
red maids	PORTULACACEAE	*Calandrinia ciliata*
red shank	ROSACEAE	*Adenostoma sparsifolium*
redberry, spiny	RHAMNACEAE	*Rhamnus crocea*
rock cress, Hoffman's	BRASSICACEAE	*Arabis hoffmanii*
rock cress, Santa Cruz Island	BRASSICACEAE	*Sibara filifolia*
rock spirea, mat	ROSACEAE	*Petrophyton caespitosum*
rose, interior	ROSACEAE	*Rosa woodsii* var. *ultramontana*
rose, wood	ROSACEAE	*Rosa gymnocarpa*
rosinwood, false	ASTERACEAE	*Osmadenia tenella*
sacapellote	ASTERACEAE	*Acourtia microcephala*
sage, bastard	POLYGONACEAE	*Eriogonum wrightii* subsp. *subscaposum*
sage, black	LAMIACEAE	*Salvia mellifera*
sage, bladder	LAMIACEAE	*Salazaria mexicana*
sage, Cleveland	LAMIACEAE	*Salvia clevelandii*
sage, creeping	LAMIACEAE	*Salvia sonomensis*
sage, purple	LAMIACEAE	*Salvia dorrii*
sage, thistle	LAMIACEAE	*Salvia carduacea*
sage, white	LAMIACEAE	*Salvia apiana*
sagebrush, big	ASTERACEAE	*Artemisia tridentata*

sagebrush, California	ASTERACEAE	*Artemisia californica*
sagebrush, white	ASTERACEAE	*Artemisia ludoviciana*
saltbush, beach	CHENOPODIACEAE	*Atriplex leucophylla*
saltwart, dwarf	CHENOPODIACEAE	*Salicornia bigelovii*
sand food	LENNOACEAE	*Pholisma sonorae*
sandcress	PORTULACACEAE	*Calyptridium monandrum*
sandmat, Yuma	EUPHORBIACEAE	*Chamaesyce setiloba*
sandspurry, sticky	CARYOPHYLLACEAE	*Spergularia macrotheca* var. *macrotheca*
sandwort, Mojave	CARYOPHYLLACEAE	*Arenaria macradenia* var. *arcuifolia*
sanicle, poison	APIACEAE	*Sanicula bipinnatifida*
saxifraga, Tolmie's	SAXIFRAGACEAE	*Saxifraga tolmiei*
scalebud	ASTERACEAE	*Anisocoma acaulis*
sea lettuce	CRASSULACEAE	*Dudleya caespitosa*
sea pink	PLUMBAGINACEAE	*Armeria maritima*
sedge, alma	CYPERACEAE	*Carex alma*
sedge, water	CYPERACEAE	*Carex aquatilis* var. *aquatilis*
senecio, island	ASTERACEAE	*Senecio lyonii*
sequoia, giant	TAXODIACEAE	*Sequoiadendron giganteum*
shooting star, padre's	PRIMULACEAE	*Dodecatheon clevelandii*
shootingstar, scented	PRIMULACEAE	*Dodecatheon redolens*
silktassel, canyon	GARRYACEAE	*Garrya veitchii*
silver puff	ASTERACEAE	*Uropappus lindleyi*
skunkbush	ANACARDIACEAE	*Rhus trilobata*
sky pilot	POLEMONIACEAE	*Polemonium eximium*
snake's head	ASTERACEAE	*Malacothrix coulteri*
snakeroot, western	ASTERACEAE	*Ageratina occidentalis*
snapdragon, Coulter's	SCROPHULARIACEAE	*Antirrhinum coulterianum*
snapdragon, Snowy Island	SCROPHULARIACEAE	*Galvezia speciosa*
snapdragon, violet twining	SCROPHULARIACEAE	*Maurandya antirrhiniflora*
snow, desert	POLEMONIACEAE	*Linanthus demissus*
snow, evening	POLEMONIACEAE	*Linanthus dichotomus*
snowberry, creeping	CAPRIFOLIACEAE	*Symphoricarpos mollis*
Sonoma sunshine	ASTERACEAE	*Blennosperma bakeri*
Spanish needle, desert	ASTERACEAE	*Palafoxia arida* var. *arida*
spiderling, scarlet	NYCTAGINACEAE	*Boerhavia coccinea*

spineflower, brittle	POLYGONACEAE	*Chorizanthe brevicornu*
spineflower, California	POLYGONACEAE	*Mucronea californica*
spineflower, fringed	POLYGONACEAE	*Chorizanthe fimbriata* var. *fimbriata*
spineflower, knotweed	POLYGONACEAE	*Chorizanthe polygonoides*
spineflower, San Fernando Valley	POLYGONACEAE	*Chorizanthe parryi* var. *fernandina*
spineflower, San Fernando Valley	POLYGONACEAE	*Chorizanthe parryi* var. *fernandina*
spineflower, slender-horned	POLYGONACEAE	*Dodecahema leptoceras*
spineflower, Sonoma	POLYGONACEAE	*Chorizanthe valida*
spineflower, Thurber's	POLYGONACEAE	*Centrostegia thurberi*
spiny herb	POLYGONACEAE	*Chorizanthe rigida*
spiraea, rock	ROSACEAE	*Holodiscus microphyllus* var. *microphyllus*
spurge, flat seeded	EUPHORBIACEAE	*Chamaesyce platysperma*
starvine, desert	CUCURBITACEAE	*Brandegea bigelovii*
stitchwort, Douglas'	CARYOPHYLLACEAE	*Minuartia douglasii*
stonecrop, broadleaf	CRASSULACEAE	*Sedum spathulifolium* subsp. *anomalum*
stonecrop, Sierra	CRASSULACEAE	*Sedum obtusatum*
sumac, laurel	ANACARDIACEAE	*Malosma laurina*
suncup, golden	ONAGRACEAE	*Camissonia brevipes*
sunflower, desert	ASTERACEAE	*Geraea canescens*
sunflower, hairy-leafed	ASTERACEAE	*Helianthus annuus*
sunflower, San Diego	ASTERACEAE	*Hulsea californica*
sunflower, slender	ASTERACEAE	*Helianthus gracilentus*
sword fern, narrowleaf	DRYOPTERIDACEAE	*Polystichum imbricans*
sword fern, rock	DRYOPTERIDACEAE	*Polystichum imbricans* subsp. *curtum*
sycamore, California	PLATANACEAE	*Platanus racemosa*
syntrichoppapus, Lemmon's	ASTERACEAE	*Syntrichopappus lemmonii*
tarplant, island	ASTERACEAE	*Deinandra clementina*
tarplant, Mojave	ASTERACEAE	*Deinandra mohavensis*
tarplant, Otay	ASTERACEAE	*Deinandra conjugens*
tarplant, Santa Cruz	ASTERACEAE	*Holocarpha macradenia*
tarplant, smooth	ASTERACEAE	*Centromadia pungens* subsp. *laevis*
tarragon	ASTERACEAE	*Artemisia dracunculus*
tarweed, big	ASTERACEAE	*Blepharizonia plumosa*
tarweed, Guadelupe Island	ASTERACEAE	*Deinandra palmeri*
tarweed, Kellogg's	ASTERACEAE	*Deinandra kelloggi*

tea, desert	EPHEDRACEAE	*Ephedra californica*
tetracoccus, Parry's	EUPHORBIACEAE	*Tetracoccus dioicus*
thistle, desert	ASTERACEAE	*Cirsium neomexicanum*
thornmint, Santa Clara	LAMIACEAE	*Acanthomintha lanceolata*
threadplant, desert	CAMPANULACEAE	*Nemacladus rubescens* var. *tenuis*
three-awn, purple	POACEAE	*Aristida purpurea*
tickseed, Bigelow's	ASTERACEAE	*Coreopsis bigelovii*
tidytips, plains	ASTERACEAE	*Layia platyglossa* var. *campestris*
tidytips, white	ASTERACEAE	*Layia glandulosa*
tidytips, woodland	ASTERACEAE	*Layia gaillardioides*
tobacco, ladies	ASTERACEAE	*Gnaphalium californicum*
toyon	ROSACEAE	*Heteromeles arbutifolia*
tuctoria, fragile	POACEAE	*Tuctoria fragilis*
verbena, desert sand	NYCTAGINACEAE	*Abronia villosa*
verbena, red sand	NYCTAGINACEAE	*Abronia maritima*
viguera, San Diego County	ASTERACEAE	*Viguiera laciniata*
vinegar weed	LAMIACEAE	*Trichostema lanceolatum*
whispering bells	HYDROPHYLLACEAE	*Emmenanthe penduliflora*
whitethorn, chaparral	RHAMNACEAE	*Ceanothus leucodermis*
wild cabbage, San Diego	BRASSICACEAE	*Caulanthus heterophyllus*
wildrye, blue	POACEAE	*Elymus glaucus*
willow, arctic	SALICACEAE	*Salix arctica*
winter fat	CHENOPODIACEAE	*Krascheninnikovia lanata*
wirelettuce, chicoryleaf	ASTERACEAE	*Stephanomeria cichoriacea*
wishbone bush	NYCTAGINACEAE	*Mirabilis californica*
wolfberry, Anderson's	SOLANACEAE	*Lycium andersonii*
woodland star, hillside	SAXIFRAGACEAE	*Lithophragma heterophyllum*
woodrush, Pacific	JUNCACEAE	*Luzula comosa*
woolly-heads	POLYGONACEAE	*Nemacaulis denudata*
woollystar, giant	POLEMONIACEAE	*Eriastrum densifolium* subsp. *elongatum*
woollystar, Santa Ana River	POLEMONIACEAE	*Eriastrum densifolium* subsp. *sanctorum*
woollystar, sapphire	POLEMONIACEAE	*Eriastrum sapphirinum*
yarrow	ASTERACEAE	*Achillea millefolium*
yarrow, golden	ASTERACEAE	*Eriophyllum confertiflorum*
yerba mansa	SAURURACEAE	*Anemopsis californica*

yerba santa, thickleaf	HYDROPHYLLACEAE	*Eriodictyon crassifolium*

Rancho Santa Ana Botanic Garden

Michael Wall started work at the Garden in 1990 in the Horticulture Department working with Walter Wisura, the Curator of the Living Collections, Orlando Mistretta, Endangered Species Coordinator, and the Director of Horticulture, Mr. Bart O'Brien. In 1996 he took on the newly established Seed Curator position and soon after assumed the Program Manager position.

The Fletcher Jones Education Center for the Preservation of Biodiversity (Seed Conservation Program and storage facility)

John Macdonald retired in 1997, after 32 years with the California Highway Patrol, the last 20 as a sergeant. One of his post retirement pursuits was to photograph wildflowers. An ad in the Victor Valley Daily Press led him to Rancho Santa Ana Botanic Garden to learn more about native plants. He took a class on seeds from Michael Wall and learned of the volunteer program. He completed volunteer training in 2000 and was assigned to the seed program in 2001. Shortly after that he began photographing seeds which, in turn, led to the development of this publication.