



Seed Cleaning Manual

Updated: February 2024

The Southwest Seed Partnership Seed Cleaning Manual is intended to be used as an introduction to the uses of different kinds of seed cleaning equipment and as a source for potential methods of cleaning various species of seeds collected in the southwest.

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Species are listed in alphabetical order. New species are added periodically as we develop cleaning protocols for them.	



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SWSP Seed Cleaning Machines and Equipment

Westrup LA-H Brush Machine (De-bearder/De-awner)



Mantles: square wire sizes 8, 12, 16, and 20
Brushes: 0.5mm nylon medium, 0.9mm coarse nylon

Description:

The Brush machine uses different size mantles and continuous rotating brushes to break apart plant material and seed capsules to release seed from plant. It is often the first stage in rough cleaning the seed, and will usually need additional cleaning with the clipper or air separator to isolate and finely clean seed.

Safety Precautions

- There are rotating blades in the funnel of the machine between the feeder and brushes. DO NOT stick any fingers or objects into the machine while it is in operation, it can cause damage to you and to the machine.
- Long sleeve shirts, masks and safety glasses can be worn to help reduce dust inhalation and eye and skin irritation.
- Be aware of the location of emergency shutoff key.



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Operations

To turn the brush machine on:

1. Plug brush machine and vacuum into external power outlet.
2. Brush machine must be properly assembled with the front panel screwed tightly down using screw in arms so red magnetic strips are lined up.
3. There are start and stop buttons on the back of the table, and start button must be pushed first, then the power button on the black power box at the back of the machine to turn the brush machine on.
4. Turn on the vacuum, which is located on the bottom shelf of the table, by turning the knob to manual, then adjusting the power of the vacuum using the turtle - rabbit knob -it is very important to turn the vacuum on before feeding material into the machine.
5. The speed of the rotating brushes can be turned faster or slower using the arrows on top of the black box next to the power button.
6. Feed plant material in through the hopper, there is a small lever that opens the neck of the hopper to feed material through the machine.
7. The silver knob on top of the machine closes or opens the front door/vent at the end of the mantle. Seeds will be pushed out through this door depending on how far open it is.
8. Be careful not to overload the brush machine or it won't clean as well, and check periodically for material build up especially stemmy species like grasses.
9. To turn the brush machine off, push the power button on the black box at the back of the machine, then hit the white stop button on the back of the table, then turn off the vacuum.

Choosing & Fitting Brush

- There are two size brushes, a 'gentler' brush at .05mm and a 'rougher' brush at .09mm.
- Unless you are cleaning something with a tough casing you need to break through, use the .05mm brush.
- Know that changing out brushes is difficult and time consuming so plan accordingly.
- As the brushes wear down over time, you can adjust the width they are set at using the brush width tool.

Choosing & Fitting Mantle

- There are two mindsets you can use to choose a mantle. The first is that you want the seed to pass all the way through the brush machine and come out the mouth of the front panel mostly clean - examples of this include *Bouteloua curtipendula* and *Elymus elymoides*. Then there are species that you want the seed to fall through the mantle, and larger debris to pass all the way through the machine coming out the other side - examples of this are *Sporobolus sp.*
- Once you have selected a mantle, put it into the front of the brush machine, fitting the two holes on one side of the mantle with the two metal prongs in the back. Similarly, there are



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two prongs on the front piece of the brush machine that will have to fit through the holes in the mantle to secure it. If this is tricky, just lift the mantle up a bit to fit the front part of the machine on.

- When you are finished cleaning a species, remove the mantle before pulling the catchment bins away as material gets caught in the mantle and will come spilling out.

Cleaning the machine

- Remove both catchment bins and clean them out with Shop Vac or air compressor.
- Take off front cover and blow out the inside of it with the air compression tank.
- Pull out the mantle, remove the hose from the top and take the top off; then vacuum all pieces off including the mantle.
- Vacuum out the machine with the shop vac and blow out the hopper with the air compressor.
- Vacuum bags will have to be replaced periodically.

Super 248BDH Clipper (Clipper office tester)



Description:

The Clipper at its most basic separate plant parts, seeds, dirt, and fine chaff into 5 different catchment bins based on size and weight. When in operation, the entire machine vibrates, moving material over a series of two screens, while allowing air to pass through and separate materials. It cleans seed to a completely finished product.



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Clipper screens:

Type	Sizes
Round Perforated Metal	15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5.5, 1/12, 1/14, 1/16, 1/18, 1/20, 1/22, 1/25
Wire Mesh	6x22, 6x32, 6x42, 10x10, 14x14, 20x20, 25x25, 30x30, 40x40, 50x50, 60x60
Oblong Slotted	1/24x1/4, 1/24x1/2, 1/22x1/2, 1/22x1/4, 1/20x1/2, 1/20x1/4, 1/18x1/2, 1/18x1/4, 1/16x1/2, 1/16x1/4, 1/14x1/4, 1/14x1/2, 1/12x1/4, 1/12x1/2, 3x5/16, 6x3/4, 10x3/4

*We created a “solid” screen by duct-taping over a screen for a smooth surface.

Safety Precautions

- **DO NOT stick any fingers or objects into the machine while it is in operation**, it can cause damage to you and to the machine.
- Long sleeve shirts, masks and safety glasses can be worn to help reduce dust inhalation and eye and skin irritation.

Operations

- To turn on the machine, there is an on/ off switch located on the power cord, which must be plugged into an external power source.
- There must be two screens inserted into the back of the machine following the wooden tracts. The smaller screen should be put in first on the lower track, the larger screen on the top on the upper track. (See Choosing screens below for more detail).
- There is a metal hook on the back of the machine on a spring that should be hooked around the back of the top screen for Clipper to operate effectively.
- Place two catchment bins on either side of the machine below the metal spouts.
- Make sure the seed tray, small wooden drawer, and screened-in air flow catchment are all properly assembled onto the machine.
- Adjust the Blast Fan with the side plates to blow out lightweight chaff.
- Plant material should be slowly fed through the hopper at the top of the machine, you do not want to feed too much at a time or the machine won't work to the best of its abilities.
- The opening in the hopper can be adjusted using the screw on the side of it.

Choosing Screens

- To select a top screen, you want to choose the smallest size you can that **will allow** seed to pass through. The goal is for larger stemmy material to be siphoned off while the seed falls through.
- To select a bottom screen, you want to choose the largest screen possible that **will not** allow the healthy seed through. The goal is for dirt, flower parts and small underdeveloped seeds through.



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Placing 5 catchment bins

- Two catchment bins should be placed on either side of the machine where the outflow 'spouts' are to catch the small and large debris that were either too large to pass through the top screen or small enough to pass through the lower screen.
- The 'seed bin' should be placed in the bottom of the machine and catches material that was small enough to pass through the top screen but too big to pass through the lower screen.
- There is a small wooden drawer on the front of the machine that catches material that passed through the middle of the two screens but was blown by air movement away from the seed bin. May be full of non-viable seed and seed sized plant parts, but if it looks full of good seed then air flow needs to be adjusted.
- The screened-in air flow catchment hooks onto the top, front of the clipper and catches material that was blown off by air flow. This is usually flower parts and chaff, but can strategically be used to catch air-blown seed such as *Machaeranthera sp.* etc.

Adjusting Air Flow

- The intensity of air flow can be adjusted by sliding the white covers over the circular air flow vents on either side of the clipper.
- Air flow can be used strategically to blow seed or chaff into different catchment bins, depending on what is being cleaned.
- May need to play around with air flow when cleaning a new species.

Tips & Tricks

- You want most of the good seed to fall through by the time they cross the first half of the top screen.
- Play with air flow, it can be advantageous for certain species (such as asters) to blow clean seed into screened-in air catchment.

Cleaning the Clipper

- Remove all 5 catchment bins and clean them separately with an air compressor hose.
- Blow out machine making sure to get any material left in the hopper.
- Blow out all openings, there are many places seed can get lodged in the Clipper and cause contamination with the next species you clean.
- Add a few drops of lightweight oil per every 50 hours of use to small oil holes at the top of the two wood bearings that hold the bottom fan shaft and the top of the eccentric bearing that pushes the shoe back and forth (See manual for more information)



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Mater Continuous Air Separator (Seed Blower)



Description:

The continuous seed separator utilizes airflow, which is generated by a blower motor which pushes air through a column to separate material based on weight. The air lifts light fluffy material or empty seed hulls into the removable seed bucket at the top of the column, while heavier good seed drop into the bottom bucket.

Safety precautions

Long sleeve shirts, masks and safety glasses can be worn to help reduce dust inhalation and eye and skin irritation.

Operations

- Plug air separator into an external power source.
- Black on/off switch located above the power cord input on front control panel.
- Adjust airflow using small black knob on the control panel, air speed ranges from 0 – 999.
- Typically kept the blower set to low using the silver switch.
- Control speed with which material is fed through the machine using the large black feeder speed knob on the control panel.



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- All plant material is fed through silver funnel hopper on right hand side of machine, and can be fed multiple times until desired result is reached.

Controlling blower speed ----->



<----- Controlling feeder speed

Power switch ----->

Choosing Air and Feeder Speed

- If there are suggestions on airflow speed in the seed cleaning manual, set the airflow speed to 100 using the black knob located on the control panel to start.
- Feed a handful or two of material into the silver funnel hopper on the right.
- Set the feeder speed to 5.
- Wait for the material to be processed through, focusing your attention on the outflow buckets - the goal is seed to fall to the bottom bucket, chaff to blow off to the top bucket.
- If chaff is flowing out the bottom to the lower bucket, turn speed up continuously until it starts flowing to the top bucket.
- Alternatively, if seed is blowing up to the top bucket, turn speed down until it comes out the bottom, and the chaff is blowing out the top to the top bucket.
- Continue to adjust knobs and re-feed the material through the hopper until you are happy with the final clean seed result.



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Tips & Tricks

- Seed with tail or long awns such as *Hesperostipa sp.*, *Achnatherum sp.*, etc can get tangled and clog the machine, so feed through very slowly.
- Seed with fine hairs that clump together in the brush machine will most likely need to be hand cleaned, as clumps get caught in air separator and don't blow off.

Cleaning The Air Separator

- Turn the air speed up to 900 and let the machine dislodge any stuck seed.
- The Air Separator can be disassembled by lifting the plastic column up and off the tracks at the top, with the metal box still attached.
- Use a compressed air tank hose to blow out the plastic tube, metal box, and most importantly the silver hopper to dislodge any seed.

Cheat Sheet for choosing Air speed

Air Speed	Species
100 - 200	<i>Sporobolus sp.</i> <i>Bouteloua sp.</i>
200 - 300	<i>Thelesperma megapotamicum</i> <i>Bouteloua curtipendula</i>
300 - 400	<i>Asclepias sp.</i> <i>Dalea candida</i>
400 - 500	<i>Cleome sp.</i> <i>Polanisia dodecandra</i>
500 - 600	<i>Iris missouriensis</i>

“Seed Boat”

Description:

Homemade apparatus with application similar to brush machine. Crushing plant material in the boat breaks apart seed capsules to release seed from plant. This is the first stage in rough cleaning the seed and will usually need additional cleaning after to finely clean seed. Most useful for cleaning collections too small to justify use of brush machine.

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Silver Sieves

Description:

Silver sieves are used for cleaning seeds by hand. They are most useful for collections too small to justify use of the Clipper.

Item	Vendor	Details
I 8/64" silver sieve	Seedburo	https://seedburo.com/products/3266
J 10/64" silver sieve	Seedburo	https://seedburo.com/products/3266
K 2-1/2/64" silver sieve	Seedburo	https://seedburo.com/products/3266
U 4-1/2/64" silver sieve	Seedburo	https://seedburo.com/products/3266
W 5/64" silver sieve	Seedburo	https://seedburo.com/products/3266
X 5-1/2/64" silver sieve	Seedburo	https://seedburo.com/products/3266
Y 6/64" silver sieve	Seedburo	https://seedburo.com/products/3266
Z 6-1/2/64" silver sieve	Seedburo	https://seedburo.com/products/3266



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Brass Sieves

Description:

Brass sieves are used for cleaning seeds by hand. They are most useful for collections too small to justify use of the Clipper.

Item	Vendor	Details
#10 brass sieve	Seedburo	https://seedburo.com/products/us-testing-sieves-8in-full-height-brass
#18 brass sieve	Seedburo	https://seedburo.com/products/us-testing-sieves-8in-full-height-brass
#35 brass sieve	Seedburo	https://seedburo.com/products/us-testing-sieves-8in-full-height-brass
#60 brass sieve	Seedburo	https://seedburo.com/products/us-testing-sieves-8in-full-height-brass
Bottom pan	Seedburo	https://seedburo.com/products/us-testing-sieves-8in-full-height-brass

Box Screens

Description:

Large, homemade sieves for drying and hand cleaning seed. Size A is smaller, with wire mesh 3mm x 3mm; size B is larger, with wire mesh 5mm x 5mm.





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Cleaning Protocols for SWSP Species

Note: These are not exact rules, but suggestions and a place to start for an unfamiliar plant species. The quality, quantity, and size of seed and amount of chaff can vary across collections of the same species and methods should be adjusted as needed.

<p>Abronia fragrans</p>	<p><u>Cleaning Processes:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use the hardest (0.9mm) brush and size #12 mantle on high speed. <ol style="list-style-type: none"> a. Close the mouth most of the way so the seed capsules spend as much time as possible in the machine. b. Requires multiple passes through the brush machine to break up as many capsules as possible. c. After at least 5 passes through, use the hand tools to break up remaining capsules. 2. Air Separator <p><u>Notes:</u> The capsules that the seeds are inside are hard to break apart. This species requires multiple runs through the brush machine.</p>
<p>Achillea millefolium</p>	<p><u>Cleaning Process: (small collection)</u></p> <ol style="list-style-type: none"> 1. Silver sieve K 2. Clipper screen: 6x42 wire 3. Clipper screen: 50x50 wire <p><u>Notes:</u> This species can be difficult to clean as the seeds are very small and light. I tried crushing the seed heads with a hand tool over a brass screen and found that this added extra chaff of a very similar size and weight as the seed, and made it much more difficult to clean - with only a minimal gain in good seed. I instead only cleaned the seed that freely fell out when run through the silver sieve.</p> <p>I used the clipper screens by hand over the silver sieve bottom pan with the frame facing up, and just tapped on the frame to get material to pass through.</p>
<p>Achnatherum hymenoides</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush machine: 0.5mm brush w/ #8 mantle with front door all the way open. 2. Brush machine: 0.5mm brush w/ #12 mantle with front door open about ½ inch. 3. Silver sieve: Z 4. Air separator: highest speed - 510



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	<p><u>Notes:</u> Feed through brush machine with 5 mantle first to break up stems and inflorescence. Feed through again with 10 mantle to remove the fuzz from the seeds and separate out chaff. Seed will come out of the front door. Many empty/underdeveloped seeds will be separated out when running through the air separator.</p>
<p>Achnatherum robustum</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: either 0.5 or 0.9mm brush, used #8 mantle. 2. Air Separator: highest speed used 285. <p><u>Notes:</u> Need to feed through all machines very slowly or the seeds just get tangled in a mass and they clog, especially the air separator. Very time consuming.</p>
<p>Acourtia nana</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine # 12, lower speed. 2. Air separator
<p>Allium cernuum</p>	<p><u>Cleaning process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: #8 mantle, use rough .09mm brush. <ol style="list-style-type: none"> a. Vent half open, speed medium low (doesn't seem to impact results much). 2. Clipper: top screen 1/14 round; bottom screen 6 round. <ol style="list-style-type: none"> a. Air flow high; this part mostly removes small particles. 3. Air Separator: start at about 250 <ol style="list-style-type: none"> a. Hand sieving may be needed to remove heavy stems.
<p>Andropogon gerardii</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine #8, 0.5mm brush; close end door all the way. 2. Clipper <ol style="list-style-type: none"> a. Top screen 10x3/4 slot b. Bottom screen 1/18 round c. Air flow between 1/4 to 1/2 open
<p>Asclepias subverticillata</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: #12 mantle, 0.5mm brush, slow speed <ol style="list-style-type: none"> a. Vent half to fully open. 2. Air Separator: highest speed used 330 <ol style="list-style-type: none"> a. 100-110 for starting. 3. Can also use silver sieve J with large holes to sift out plant material.
<p>Asclepias speciosa</p>	<p><u>Cleaning Process:</u> See Asclepias subverticillata</p>



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Atriplex canescens	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: #12 mantle; 0.5mm brush, high speed <ol style="list-style-type: none"> a. Close vent most of the way b. Run through 2-3 times. 2. Air Separator: Highest speed 300 <p><u>Notes:</u> Can be very dusty, turn vacuum on Brush machine up.</p>
Atriplex obovata	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine #12 mantle, High speed <ol style="list-style-type: none"> a. Close vent most of the way b. Run through 2-3 times 2. Air Separator: Highest speed 300 3. Clipper top screen 14 round, bottom 1/18 round <p><u>Notes:</u> Can be very dusty, turn vacuum up on brush machine.</p>
Bahia dissecta	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Used #12 mantle, 0.5mm brush, medium speed. <ol style="list-style-type: none"> a. Alternatively: hand crush in seed boat 2. Air Separator: Max speed ~140 <ol style="list-style-type: none"> a. Run through silver sieve Z if large stems or other plant materials are present. <p><u>Notes:</u> Finished seed may still have some yellow flower parts attached.</p>
Baileya multiradiata	<p><u>For Large Bag:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: #12 mantle, 0.5mm brush 2. Use silver sieve U to separate seed from fluff. 3. Air Separator: Highest speed used 215 <p><u>For Small bag:</u></p> <ol style="list-style-type: none"> 1. Silver sieve: U 2. Brass sieve: #18 <p><u>Notes:</u> Don't skip the step of using silver sieve to sieve out fluff, the fluff clogs the air separator and is heavy enough to fall to the lower bucket.</p>
Bouteloua curtipendula	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use the 0.5mm brush and size #12 mantle. <ol style="list-style-type: none"> a. Open vent ¼ of the way. b. Take two or three passes. 2. Air Separator: 120



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	<p><u>Notes:</u> Seed will fall into both catchment bins so be sure to run them both through the air separator.</p>
<p>Bouteloua eriopoda</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Dump seed over wooden box screen and pick out as many large stems as possible. 2. Brush Machine: with #16 or #20 mantle at slow speed. 3. Clipper: Bottom screen 50x50 wire; top screen 12 round <ol style="list-style-type: none"> a. Open air vent slightly less than ½ way. b. Empty seed and chaff should blow up into the top. c. Good seed should end up in the bottom drawer and small middle drawer. 4. Silver sieve Z to remove large stems. 5. Air separator: around 130
<p>Bouteloua gracilis</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use the 0.5mm brush and #8 mantle. 2. Clipper: Top screen 14 round; bottom 18 round <ol style="list-style-type: none"> a. Air open ~⅓ of the way, seed should blow upward. b. Run through multiple times. 3. Air Separator: 200 <ol style="list-style-type: none"> a. Feed slowly into hopper to minimize clogging. <p><u>Alternative Process (mass production):</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use the 0.5mm brush and #8 mantle. 2. Clipper: Top screen 14 round; bottom Solid <ol style="list-style-type: none"> a. Air open ~¾, seed will blow up and into middle drawer and bottom drawer. b. Attach vacuum to end of top catchment to mitigate dust. c. Run through Clipper a second time. <ol style="list-style-type: none"> i. Top screen 12 round; bottom Solid ii. Air open ~¼, seed will blow into middle and bottom drawer, chaff will blow into top catchment. <p><u>Notes:</u> If you are cleaning more than one bag, clean out brush machine every ~2 bags or machine will clog. If you have a smaller collection you can use 'B' wooden box screen instead of brush machine.</p>
<p>Bothriochloa barbinodis</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Dump out over wooden box screen A. 2. Detach any seed from stems. 3. Pick out stems and debris.



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	<p><u>Notes:</u> Trying to de-fuzz using brush machine seemed ineffective, and hairs that come off seed are very irritating to skin. The brush machine is unable to completely de-fuzz seed, and fuzz can be hard to further separate from 'clean' seed.</p>
Bromus ciliatus	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 3. Brush Machine: Use 0.5mm or 0.9mm brush and size #8 mantle. <ol style="list-style-type: none"> a. Should only take one pass through to clean off the chaff, maybe two passes. 4. Air Separator: Ran through multiple times, highest setting used 200-250
Bromus porteri	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush machine: #8 mantle, .09mm brush 2. Air separator: Air speed 200
Cleome serrulata	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Pour out bag over J silver round sieve on top of base silver round sieve for small collections or over Box Screen B for large collections. 2. Crush seed pods with a hand tool until you are confident all the seed has been released to the base. 3. Air Separator: Highest speed used 500, May need to run through multiple times, or pick out last few stems.
Dalea candida	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. *see notes below* 2. Clipper: top screen 9 round; bottom 1/16 round 3. Crush any large seed heads that end up in large chaff bin and run through again. 4. Air Separator: 315 highest speed used. <p><u>Notes:</u> Be sure to check seeds for bugs. Small holes in the seed can be seen indicating the presence of weevils.</p>
Dalea purpurea	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. *see notes below* 2. Brush machine, #12 mantle with 0.5mm brush, vent completely closed and on highest speed. 3. Air separator, speed 200 <ol style="list-style-type: none"> a. Run through again at higher speeds if necessary, up to 350. <p><u>Notes:</u> Be sure to check seeds for bugs. Small holes in the seed can be seen indicating the presence of weevils.</p>



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<p>Digitaria californica</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Rub seed off stems using wooden box screen B. 2. Pick out large debris. <p><u>Notes:</u> Ineffective to put through brush machine and air separator because all the fuzz clumps up and is hard to filter out - I'd recommend just hand cleaning unless you have huge collections. Small hairs are irritating to skin and clog equipment.</p>
<p>Dimorphocarpa wislizeni</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Clipper, air flow fully closed, top screen slot 10 x 3/4, bottom screen round 10. <p><u>Notes:</u> Seed capsules are fragile and it is not recommended to try and remove seeds from the pods; as a result there is no easy way to separate filled from unfilled seeds, as filled seeds are too light for the air separator.</p>
<p>Elymus elymoides</p>	<p><u>Cleaning Process:</u></p> <p>Crushing paper bags to break up inflorescences prior to dumping seeds out helped to make seeds easier to run through brush machine.</p> <ol style="list-style-type: none"> 1. Brush Machine: #8 mantle, 0.5mm brush <ol style="list-style-type: none"> a. Slower speed b. Vent ¼ of the way open 2. Brush Machine: #20 mantle 0.5mm brush <ol style="list-style-type: none"> a. Slower speed b. Vent ¼ of the way open 3. Air Separator: highest speed - 220 4. Use silver sieve E to separate out any large stems.
<p>Eriogonum abertianum</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use 0.5mm brush and #12 mantle. <ol style="list-style-type: none"> a. Run through multiple times. 2. Air Separator: Run through multiple times.
<p>Festuca arizonica</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: brush size 0.5mm and #8 mantle 2. Clipper: bottom screen- 1/14 x ½ slot, top screen 10 round; air ¼ to ½ open 3. Air Separator at 220 highest speed
<p>Gaillardia multiceps</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Sieve through box screen B to remove large stems/plant materials.



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	<ol style="list-style-type: none"> Use Brass sieve #10 to remove smaller plant materials; seeds will not fall through.
Gaillardia pinnatifida	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Used seed boat to break apart plant material into smaller pieces for sifting out. Sifted with Z silver sieve, then with Brass sieve #10.
Gaillardia pulchella	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Sift through 'J' aluminum sieve. #10 brass sieve Hand-pick out large stems and debris. <p><u>Notes:</u> Written for a small collection</p>
Geum macrophyllum	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Brush Machine: #16 or #20 mantle; 0.5mm brush Air separator <p><u>Notes:</u> Seeds are covered in tiny hairs that are irritating when stuck in skin. Wear long sleeves and gloves if possible and make sure the room is well ventilated and vacuum is on while using the brush machine. In brush machine and air separator small hairs clump together and are hard to remove completely from clean seed.</p>
Glandularia bipinnatifida	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Brush Machine: #12 mantle at slow speed, front door open $\frac{1}{3}$ of the way, seed comes out both front and bottom. Clipper: Bottom screen 30x30 wire, Top screen 1/12 round, air flow medium Air separator around 200 Silver sieve U to remove any remaining plant material.
Glandularia goodingii	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Brush Machine: #12 mantle at slow speed with front door open about $\frac{1}{2}$ inch (note: seed will come out the front and the bottom). Clipper: Bottom screen 30x30 wire, Top screen 1/12 round, one fan open approximately halfway. Additional screening with either silver sieve or clipper screen by hand.
Grindelia squarrosa	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Rub through brass sieve # 10 Air separator: Highest speed used 325-335



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<p>Heliomeris longifolia</p>	<p><u>Cleaning Process:</u> (small collection)</p> <ol style="list-style-type: none"> 1. Brass sieve #18: mash seed heads into the sieve with your hands to break them up. 2. Air separator: highest speed used - 110 (may need to run through several times). 3. Additional sieving if desired. <p><u>Notes:</u> This species is tricky to clean to a high level. The seeds are very small and you will end up with a lot of small flower parts of a similar size and weight as the seed. Just do your best :)</p>
<p>Hesperostipa comata</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use 0.9mm brush, mantle #8 and feed through multiple times. 2. Air separator: Run through multiple times between 200-300 speed. <p><u>Notes:</u> Need to take your time feeding seed through machines so they don't get tangled into a mass and stuck.</p>
<p>Hymenoxys hoopesii</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: 0.5mm brush, slow speed, #16 mantle, door $\frac{1}{3}$ open. <ol style="list-style-type: none"> a. Most seeds come out the front, run bottom output through multiple times. 2. Air Separator max speed 240 <ol style="list-style-type: none"> a. Good seeds come down the bottom, run the top output through more times if good seeds are coming out that way.
<p>Ipomopsis aggregata</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Silver sieve C to separate out the loose seed. 2. Use seed boat to crush pods. 3. Air separator around 220 <ol style="list-style-type: none"> a. Run through sieve again to help separate remaining plant material.
<p>Ipomopsis longiflora</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brass sieve #10, crush pods through or use seed boat for a large number of pods. 2. Air Separator: Highest speed used 280. 3. If there is a lot of remaining chaff, use clipper with screens 1/14 round on top and 30x30 wire on bottom, air flow medium.



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	Notes: cleaning process written for a small collection, could be scaled up using brush machine mantle #10.
Ipomopsis multiflora	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Use seed boat to crush pods. 2. Brass sieve #10 to separate out loose seed. 3. Air separator at 280
Iris missouriensis	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Break open seed pods and dump them into bag, toss any seed pods in the chaff bin. 2. Pick out any large stems or additional debris from the bag. 3. Air separator: Highest setting used 525; May need to run the seed through multiple times. <p>Notes: Seed is heavy, cleans easily through Air Separator.</p>
Lotus wrightii	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush machine: Use #12 mantle, run through at slow speed with vent all the way closed. Open vent after 5 minutes or so to allow pods and seeds to come out. Some seeds will also come out the bottom. 2. Run seed from both collection bins through silver sieve C. 3. Inspect pods that get filtered out and run them through brush machine again if they still have seeds stuck in them. 4. Air separator: Run seed through at 290.
Machaeranthera pinnatifida	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Dump seed bag out over wooden box screen A with wooden base underneath it. 2. Lightly fluff seed and move it around so debris falls to the bottom. 3. Pick out any stems, or remaining flower parts and dump them in the chaff bin. <ol style="list-style-type: none"> a. If there is a lot of large debris, collections can be dumped over box screen B. Seeds will fall through and debris can be dumped off the screen. <p><u>Notes:</u> For smaller collections, this process can be done using the silver sieves.</p>
Machaeranthera tanacetifolia	Cleaning Process: See Machaeranthera pinnatifida
Muhlenbergia montana	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Cut material into small pieces with scissors.



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	<ol style="list-style-type: none"> 2. Brush machine: Use #12 mantle, ran through 2-3 times. 3. Crumbled seed over wooden box screen A or silver sieve multiple times to remove larger stems. 4. Air separator 125, to remove small chaff. <p><u>Notes:</u> Material wads up inside brush machine so needs to be taken apart between feeds and fed slowly to try and prevent as much wadding as possible.</p>
Muhlenbergia porteri	<p><u>Notes:</u> Very small seed at the end of the panicles. Sent to researcher to have her technicians clean. If it needs to be done in house see M. torreyi for directions.</p>
Muhlenbergia torreyi	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush machine #12 mantle; keep the end open to allow stems to escape. 2. Processed through Z silver sieve about 4 times until all large stemmy material is removed. 3. Air Separator 65, feed in slowly. <p><u>Notes:</u> The seed is very small and the chaff if hard to remove, use air separator at the low speed to not risk losing seed. Just do the best you can, this is a hard one to clean.</p>
Oenothera villosa	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 5. Break pods apart manually or with seed boat. 6. Filter through silver 'U' sieve. <p><u>Notes:</u> Air separator would be a good option as well.</p>
Packera multilobata	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Run material through silver sieve U, or brass sieve #18 (multiple times). 2. Air Separator: highest speed 180
Panicum obtusum	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Used Wooden box screen A or Silver sieve J to filter out large material. 2. Air Separator: Highest speed used 200, feeder slow on 5-6
Penstemon barbatus	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Silver sieve C to filter out loose seed. 2. Run pods through brush machine* with #12 mantle at slow speed with door almost completely closed. 3. Run brushed material through silver sieve C. 4. Run all seed through air separator at 130 (up to 300).



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	<p>5. Run through silver sieve to get out remaining large chaff. *Can use seed boat instead of brush machine for small collections.</p>
Penstemon neomexicanus	<p><u>Cleaning Process</u></p> <ol style="list-style-type: none"> For small collections: run through silver sieve U and C.
Pericome caudata	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Brass sieve #10 to get out large chaff. Brass sieve #35 to get out small chaff. Air separator at 155 <p><u>Notes:</u> This was written for a small batch, better methods could be written for large batch.</p>
Piptochaetium pringlei	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Brush Machine: <ol style="list-style-type: none"> 0.5mm brush and mantle #16 or #20. Low speed, air vents ~$\frac{1}{4}$ open. Air separator at ~240.
Plantago patagonica	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Brush Machine: 0.5mm brush and mantle #12. Air separator
Polanisia dodecandra	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Pour bag out over silver sieve C on top of base round silver sieve or big square sieve depending on quantity of seed collection. Crush any pods with a hand tool until all seed is released and falls to the bottom. Use seed boat if necessary. Air Separator: Run seed through multiple times, highest setting used ~300.
Ratibida columnifera	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Dump bag out over Z silver sieve with base sieve below it. Break apart any whole seed heads and shake through to base sieve. Air Separator: Max speed used ~220. <ol style="list-style-type: none"> 130-140 is a better start for separating unfilled from filled seed.
Ratibida tagetes	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> Hand crush seed heads through C silver sieve. Clipper: top screen- 7 round, Bottom screen- 1/14 round <ol style="list-style-type: none"> Air flow medium. Run any mixed output through again.



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Rudbeckia laciniata	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Clipper: top screen 1/16 x ¼ slot; Bottom 1/18x ¼ slot <ol style="list-style-type: none"> a. Silver sieve Z works for small collections. 2. Air Separator: highest speed used 200.
Scabrethia scabra	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Rub seed heads through wooden box sieve 'B'. 2. Clipper: top screen ½ x ½ slot; bottom screen 6 round 3. Air Separator: highest speed used 300. <p><u>Notes:</u> Very time consuming, might be a better way to clean seed. A lot of empty/ non-viable seed that gets blown off in air separator</p>
Schizachyrium scoparium	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: #20 mantle at slow speed with front door about ¼ open (most seeds should come out the front). 2. Run material from bottom of brush machine through silver sieve to remove fluff. 3. Air Separator: run material from bottom of brush machine through at around 170 (slowly, might take multiple passes). 4. Screen all seeds to remove any large stems remaining. <p><u>2024 Notes for mass production:</u></p> <ol style="list-style-type: none"> 1. Start with box screen B to sieve out biggest stems. 2. Brush Machine: #20 mantle at medium-high speed, vent nearly closed (open periodically at high speed to flush seeds out) to remove fluff. Most seeds come out the front but collect those from the bottom too. 3. From front of brush machine: Clipper 10 round top screen and solid bottom screen to remove fluff and stems - take from bottom drawer, some unsheathed seeds may come out the front shoot. <ol style="list-style-type: none"> a. Put material from bottom of brush machine through clipper at same settings, this will take longer and more chaff is mixed in with the seed. 4. Air Separator 170-190 or adjust as needed, watch for clogs.
Senecio flaccidus	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine #12 mantle 2. Sift through silver sieve C 3. Air separator: highest speed used 160
Setaria leucopila	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Silver sieve: C 2. Clipper: top screen 6 round, bottom screen 6x22 round 3. Silver sieve C again



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<p>Solidago simplex Solidago velutina</p>	<p><u>Cleaning Process: (for collections with whole plants/seed heads)</u></p> <ol style="list-style-type: none"> 1. Rub seeds across wooden box screen A to separate out large stems and seed heads. <p>Note: Many other plant parts can be present in these collections which are not easily separated out</p>
<p>Sphaeralcea fendleri</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use #12 mantle, .5mm brush (may work with .9mm), speed up to 10, and close the vent completely on the front panel. 2. Use silver sieve U to sieve off large chaff. 3. Air Separator highest speed 250
<p>Sporobolus airoides</p>	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush machine: #12 mantle and 0.5mm brush. Leave vent all the way open so large stems can escape. 2. Silver sieve U to separate out larger material. 3. Air Separator: highest speed used 180 <p><u>Notes:</u> Can also use wooden box screen B instead of brush machine. Can also use Clipper instead of silver sieve, used top screen 1/12 round, bottom screen- 1/14 round.</p>
<p>Sporobolus contractus</p>	<p><u>Cleaning Process:</u> See Sporobolus airoides</p>
<p>Sporobolus cryptandrus</p>	<p><u>Cleaning Process: (for collection with clipped stems)</u></p> <ol style="list-style-type: none"> 1. Cut large stems into about 1" sections 2. Feed cut stems through brush machine at max speed with #8 mantle and .5mm brush with front door all the way open. 3. Use silver sieve U or wooden box screen to separate out large material. 4. Clipper: bottom screen 60x60 wire, top screen 1/16 round 5. Air separator: 150 max speed 6. Silver sieve K
<p>Sporobolus flexuosus</p>	<p><u>Cleaning Process:</u> See Sporobolus airoides</p>
<p>Sporobolus wrightii</p>	<p><u>Cleaning Process:</u> See Sporobolus airoides</p> <ol style="list-style-type: none"> 1. Air separator: highest speed 160
<p>Symphiotricum falcatum</p>	<p><u>Cleaning Process: (for collections with whole plants/seed heads)</u></p> <ol style="list-style-type: none"> 1. Rub seeds across wooden box screen A to separate out large stems and seed heads.



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	Note: Many other plant parts can be present in these collections which are not easily separated out.
Thelesperma megapotamicum	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use any roughness of brush and Size #8 mantle. Run seed through brush machine 1-2 times to get chaff off seed. 2. Air Separator: Run through multiple times at 250
Thermopsis montana	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: Use any roughness of brush and Size #8 mantle 2. Air Separator: Try starting around 220 and go from there
Thymophylla pentachaeta	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Sieve through Brass sieve #18 to remove large debris. 2. Air separator 110-115; small chaff is often this part may be skipped if not effective.
Verbena macdougallii	<p><u>Cleaning Process:</u></p> <p>From severed seedhead:</p> <ol style="list-style-type: none"> 1. Break up inflorescences by hand or with wooden box screen A or B. <p>Without seedhead:</p> <ol style="list-style-type: none"> 2. Run through Clipper, with 1/20 round screen on top and solid screen on bottom, air flow medium to low. Run any mixed outputs through at least once more, if not twice. <ol style="list-style-type: none"> a. May substitute silver sieve for small collections.
Verbesina encelioides	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Brush Machine: use #16 or #20 mantle and 0.5mm brush. <ol style="list-style-type: none"> a. Open vent on front panel $\frac{1}{4}$ of the way. 2. Clipper: top screen 15 round, bottom 5.5 round <ol style="list-style-type: none"> a. Open air vent $\frac{1}{8}$ of the way. 3. Air Separator: Highest speed 235
Xanthisma spinulosum	See Machaeranthera pinnatifida
Yucca baileyi	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Break apart pods manually or with seed boat. 2. Air separator: Highest speed 200 3. Pick out any remaining debris.
Zinnia grandifolia	<p><u>Cleaning Process:</u></p> <ol style="list-style-type: none"> 1. Rub over wooden box screen A.



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	<p>2. Air separator at 150</p> <p><u>Notes:</u> this was written for a small collection.</p>
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