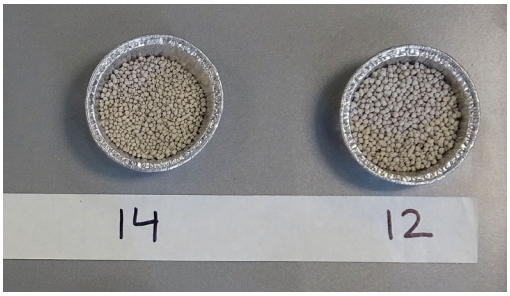
CENTRE FOR BOREAL RESEARCH
TECHNICAL NOTE #27
PLANT AND SEED TECHNOLOGIES - APRIL 2019

Native Boreal Seed Enhancement: Seed Pelleting



INTRODUCTION

Improving seed emergence and survival is one of the largest potential benefits for native boreal seed enhancement. Seed pelleting can increase seed size by multiple orders of magnitude, resulting in improved ease of direct seeding and the likelihood of seeds landing in protected microsites. Seed pelleting encases seeds with solid particles (e.g. clay powder) together with an adhesive solution (e.g. 5% Elmer's multi-purpose glue and water). The agricultural industry pellets seeds for better flow through seeding equipment, resulting in seed application at a consistent rate, faster production and higher yields.

Seed pelleting has the potential for enhancing boreal reclamation, however, the materials, tools and techniques for pelleting native boreal seeds of different sizes and shapes are not well documented. This technical note outlines the procedure tested by the Centre for Boreal Research and collaborators, and provides recommendations for seed pelleting in boreal reclamation.

MAIN CHALLENGES

Harvesting, processing and establishing native boreal seeds for reclamation is time consuming, labor intensive and expensive:

- The timing of seed collection is critical and is usually done by hand.
- There is minimal available information for improving germination rates, and some species are difficult to propagate.
- Efforts in seed extraction vary between species; some seeds are time consuming and difficult to extract.
- There are a variety of different seed sizes and shapes, complicating direct seeding efforts: trembling aspen (*Populus tremuloides*) has approximately 9,000 seeds per gram and fireweed (*Chamerion angustifolium*) has approximately 16,000 seeds per gram (Figure 1). Their small size makes them difficult to evenly disperse across a site.
- Seeds are susceptible to dessication, predation and displacement following direct seeding.

Figure 1. Fireweed (*Chamerion angustifolium*) un-pelleted seeds (left) and pelleted seeds (right, No. 10 (2 mm) sieve).

SEED PELLETING MATERIALS

SEEDS

Pre-trial pelleting tests were conducted on relatively inexpensive seeds:

- **Chamomile** (*Matricaria chamomilla*)
- **Flax** (*Linum usitatissimum*)
- **Alfalfa** (*Medicago sativa*)

Native boreal seeds used in the trials:

- **Fireweed** (*Chamerion angustifolium*)
- **Balsam poplar** (*Populus balsamifera*)
- **Trembling aspen** (*Populus tremuloides*)
- **Bebb's willow** (*Salix bebbiana*)
- **Goldenrod** (*Solidago canadensis*)
- **Lodgepole pine** (*Pinus contorta*)

Species were selected for trials as a representative sample of the various seed sizes and shapes commonly found in Alberta boreal forests.

EQUIPMENT

- U.S.A standard test sieves of desired mesh sizes. No. 18 (1 mm), 16 (1.8 mm), 14 (1.4 mm), 12 (1.7 mm), 10 (2 mm), 8 (2.36 mm) and 5 (4 mm) were used to separate seed pellets (Figure 2). Smaller sieves (No. 18, 16, 14 and 12) were only used for particularly small seeds such as fireweed (*Chamerion angustifolium*).
- Fine-meshed kitchen sieve and kitchen tablespoon (Figure 3)
- Half-face respirator
- Air compressor (Mastercraft 10 gallon shop air compressor)
- Fine sawdust (optional to slow initial adhesive solution application rate)
- Heavy duty vacuum (Shop-Vac)
- Seed pelleting machine (SATEC) (Figure 4)
- Wiley Mill (Thomas Scientific Mini Mill) (if peat and alfalfa pellets are used as solid particles)

ADHESIVE SOLUTIONS

Two different adhesive solutions were trialed:

- Elmer's multi-purpose glue (5, 10, 25 and 50%) and water
- SATEC's Sticker WWL (5 and 10 %) and water

SOLID PARTICLES

- Clay powder
- Ground peat (Wiley Mill No. 60 screen)
- Ground alfalfa pellets (Wiley Mill No. 60 screen)
- 25% SATEC's Sticker WWL and water
- 25% SeedWorks Stix Lite liquid glue and water
- 50% SeedWorks Stix Lite liquid glue and water

Figure 2. Sieves for sorting seed pellets by size.

Figure 3. Kitchen tablespoon and kitchen sieve for clay powder application.

SEED PELLETING STEPS

1. Extract and clean harvested seeds (see technical notes #14, #16 and #22).
2. Put on half-face respirator and other required safety equipment. Attach air compressor to seed pelleting machine. Turn on air compressor (recommended settings: tank 105 psi, tool 70 psi).
3. Add seeds into the seed pelleting machine and add two spoonful of sieved sawdust.
4. Set speed (recommended settings: speed motor 2.5, spinning disk (SPIDI) speed 10) and turn seed pelleting machine on.
5. Open valve between seed pelleting machine and adhesive solution compartment. To ensure a fine mist of adhesive solution (and avoid clumping) only open the valve a small amount. Use the back of the tablespoon to test adhesive solution flow rates.
6. Fill fine-meshed kitchen sieve with clay powder. Tap the kitchen sieve with the tablespoon, so a fine dusting of clay falls into the machine and onto the freshly coated seeds. Continue to tap the kitchen sieve with the tablespoon at a slow and steady rate to uniformly increase seed pellet size.
7. As the seed pellet size grows, slowly increase the adhesive solution valve opening and increase the rate of clay powder application by quickening spoon tapping while maintaining consistency.
8. Stop the machine and remove seeds through the chute as required to removed clay build up. Use the Shop-Vac to clean excess clay from the machine, and use U.S.A standard test sieves to remove any chunks of clay from the seeds.
9. Remove seed pellets of desired size using soil sieves, return smaller seed pellets to the machine and continue the process (steps 2 to 9) until the targeted size is obtained.
10. Once the targeted seed pellet size is acquired, close the adhesive solution compartment valve, add one more tap of clay powder for a dry coating, remove the seed pellets through the chute and turn off the machine and air compressor.
11. Pour the final seed pellets into U.S.A standard test sieves to separate by size and remove the loose clay.
12. Air dry the seed pellets.
13. Seed pellets are now ready to deploy.

Figure 4. Seed pelleting machine. Numbers indicate selected steps in above list.

PRELIMINARY OBSERVATIONS - QUALITY OF PELLETS

SIZE

The seed pelleting process was successful for increasing all seeds to the trial standard sizes (No. 10, 8 and 5), including the smallest sized seeds (Figure 5).

SHAPE

Seed pelleting was successful for creating smooth and round pellets for all trialed seed sizes and shapes (e.g. irregular goldenrod (*Solidago canadensis*) seeds). The challenge was consistently creating smooth and round seed pellets, as adding clay powder too quickly or adding adhesive solution too slowly resulted in bumpy and uneven asteroid-shaped seed pellets (Figure 6). The original seed size and shape did not affect asteroid-shape outcomes.

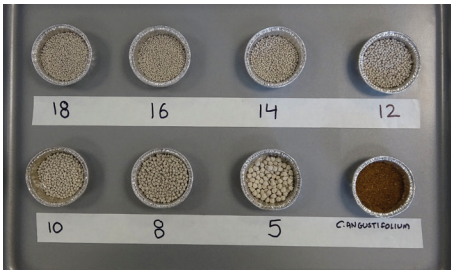


Figure 5. Seven samples of pelleted fireweed (*Chamerion angustifolium*) seeds sorted by size (sieves No. 18 to 5) and one sample of un-pelleted seeds (bottom right).

Figure 6. Asteroid-shaped seed pellets.

LESSONS TO DATE

- Clay powder showed the most promise in improving seed pellet quality. Ground peat and alfalfa pellets were trialed on non-native seeds with little initial success. Further trials are required.
- The seed pellet fill rate was dependent on the species and purity of the seed lot. Generally, around 90% of pellets had seeds in them. Less than 0.5% of seed pellets contained more than one seed per pellet. Thorough seed cleaning prior to pelleting greatly increased the quality of the seed pellet.
- Sawdust was useful to start the pelleting process, as it prevented seeds from sticking to the sides of the machine and reduced excess adhesive solution coating the seeds.
- The tested equipment would be effective for working on small-scale reclamation projects. However, field trials will be conducted before concluding the benefits of this technique for establishing native boreal plant species.

NEXT STEPS

- Further lab experiments (e.g. compression tests, fine tuning processes for consistent pellet quality, ground peat and alfalfa seed pellets)
- Production trials (e.g. greenhouse production of seed pellets under various water treatments and direct seeding)

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