Development of a Mechanical Seeder for Sowing Small-Seeded Oak Species

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Abstract

This article describes a mechanical seeder designed at Indiana's Vallonia State Tree Nursery to achieve target sowing rates for small-seeded acorns. This seeder can also be used for other hardwood species with similar-sized seeds. Using the seeder has helped achieve desired seedbed densities, thereby reducing cull percentages.

Introduction

The Indiana Division of Forestry's Vallonia State Tree Nursery, located about 80 mi (130 km) south of Indianapolis, grows bareroot seedlings for reforestation, mine reclamation, and wildlife enhancement for citizens of Indiana to purchase at low cost (Hawkins and O'Connor 2011). We grow a selection of 35 to 40 native hardwood species well adapted to Indiana's climates. Seed size varies significantly among these species. This size variation makes it difficult for a single mechanical seeder to effectively sow seeds for every hardwood species at the seeding rates necessary to reach our target seedbed densities.

The most difficult seeds for us to control sowing densities when using our mechanical seeders are the small-sized acorns such as pin oak (*Quercus palustris* Münchh.), cherrybark oak (*Q. pagoda* Raf.), shingle oak (*Q. imbricaria* Michx.), black oak (*Q. velutina* Lam.), and chinkapin oak (*Q. muehlenbergii* Engelm.). There are few affordable hardwood seeders on the market that can handle a variety of seeds of this size. Several options exist for small tree and shrub seeders. Because the bareroot nursery industry is small, however, production of these machines is limited, making them very expensive to produce or purchase. Therefore, individuals from within the Vallonia Tree Nursery workforce designed and assembled a new, in-house seeder (figure 1) to help us achieve our desired sowing rates for small-sized acorns. The cost to build this seeder was approximately $5,500 (2005 pricing). This cost covered all parts, steel, and materials but did not include any labor expenses used in building the seeder.

Figure 1. Seeder developed at Indiana's Vallonia State Tree Nursery to achieve target sowing rates for small-seeded acorns and other species with similar-sized seeds. (Photos by Bob Hawkins, 2016)

Mechanical Seeder for Small-Sized Acorns

We designed our new seeder based on a multitude of ideas from other seeders used or developed by the nursery, as well as planters used in crop production. A roller, mounted at the front of the seeder, rolls over the formed bed and levels it as much as possible (figure 2). We wanted each seed to be picked up and dropped in the soil, much like corn or soybeans when they are sown. We modified finger pick-up units (P/N AA60535, John Deere Company, Moline, IL)(figure 3) to pick up small acorns individually from seed boxes (P/N BA28955, John Deere Company, Moline, IL) filled with seed (figure 4). Using these adapted finger pick-up units results in good density control by enabling each seed to be placed in the seedbed individually instead of 4 to 5 seeds at a time, which causes a clumping effect.

Floating double disk openers (P/N 121-782L, Great Plains Manufacturing, Salina, KS) open the soil in the seedbeds to the desired sowing depth (figure 5). Various pressure adjustments on the disk openers can be made to sow seed to the target depths. An individual riding the seeder and monitoring the seeding operation can make these adjustments during sowing (figure 6). The more pressure adjusted to these openers, the deeper the trench made for the seed. As seed is sown, a press wheel follows to

Figure 2. Roller mounted on front of seeder to assist with leveling the seedbed. (Photo by Bob Hawkins, 2016)

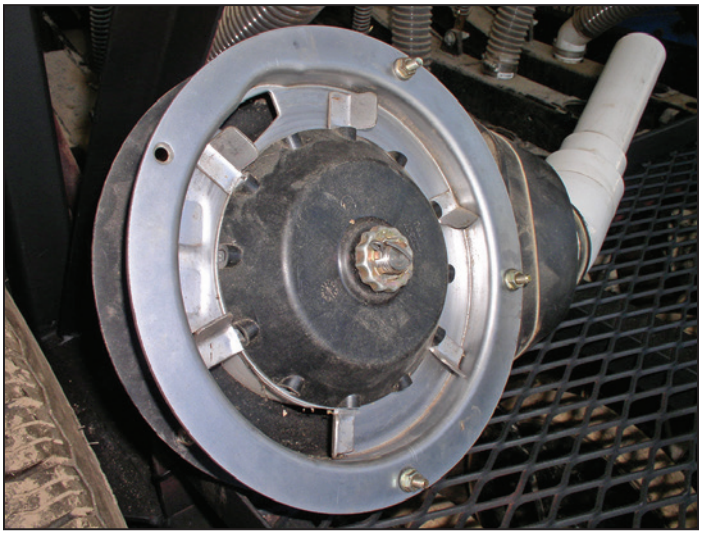

Figure 3. Modified finger pickup units used to grab individual seeds for placement in the seedbed. (Photo by Jeannie Redicker, 2012)

Figure 4. Seed boxes loaded with oak seed. (Photo by Jeannie Redicker, 2012)

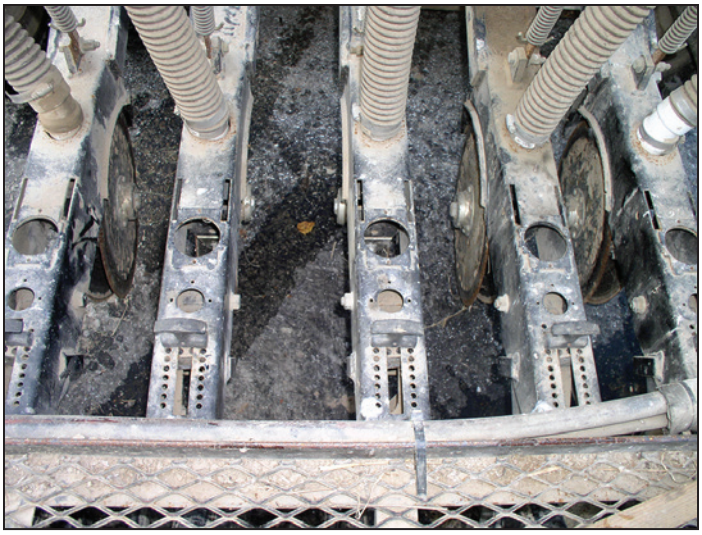

Figure 5. Double disk openers used to open soil in seedbed. Various pressure adjustments can be made as to the depth of the trench desired for the seed. (Photo by Bob Hawkins, 2016)

Figure 7. Press wheels used to secure seed into seedbed while covering seed with soil. (Photo by Jeannie Redicker, 2012))

Figure 6. An operator riding on the seeder can monitor and adjust speed and density. (Photo by Jeannie Redicker, 2012)

Figure 8. Speed-O-Meter used to control the speed of the seed pickup. (Photo by Bob Hawkins, 2016))

secure seed into the depressed seedbed (figure 7). Once seed is sown, a heavy drag pulled over the top of the seedbed drags soil on top of the seed and fills the trench. In most cases, seed flows well from the seed boxes. Occasionally, however, a wooden stick is needed to poke seed down in the box and assure proper flow and disbursement.

A chain-driven system turns the finger pick-up units. A Speed-O-Meter (P/N 01010, Micro-Trak Systems Inc., Eagle Lake, MN) is used to control how fast these units turn and how quickly seed is picked up and dropped in the seedbed (figure 8). The speed of the chain can be altered by adjusting a hydraulic flow line to allow more revolutions (increased seed drop) or fewer revolutions (decreased seed drop).

The individual riding the seeder and monitoring the operation can adjust the hydraulic fluid flow using a lever on the seeder. We reach our target sowing density by adjusting the chain speed and the speed of the tractor. All sowing calibrations are made based on a tractor speed of 1 MPH in the field. Seed is collected for 1-minute increments and weighed to determine necessary adjustments for achieving target sowing rates for each hardwood species.

We have also used this seeder design to sow other species with similar seed sizes, including American plum (*Prunus americana* Marshall), persimmon (*Diospyros* virginiana L.), hazelnut (*Corylus americana* Walter), and de-winged seeds of sugar maple (*Acer saccharum* Marshall). We have had very good success

calibrating and using this seeder to obtain the desired densities and germination rates for all these species. This seeder has greatly helped reach our desired seedbed densities (figure 9), thereby reducing the number of cull seedlings when grading and processing these seedlings for sale. The importance of seedbed density cannot be understated. By controlling seedbed densities, a more uniform, higher quality seedling will be produced for outplanting (figure 10).

Figure 9. Typical seedling spacing reached from use of this seeder. (Photo by Bob Hawkins, 2016))

Figure 10. One-year-old oak seedbeds planted with this seeder. (Photo by Bob Hawkins, 2016)

REFERENCES

Hawkins, B.; O'Connor, P. 2011. Tree planting in Indiana. Tree Planters' Notes. 54(1): 10–14.