# NEW DEVELOPMENTS IN SEED PROCESSING

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Abstract.--The steps in processing forest tree seeds are extracting, dewinging/depulping, cleaning, upgrading, and treating. All could probably be improved to some degree in most operations, but the best opportunities for further research and development lie in (1) refining kiln schedules, (2) improving the upgrading of lots with specialized equipment, and (3) investigating possible benefits of pelletting tree seeds.

Additional keywords: Pinus spp., cone kilns, seed separating equipment.

Processing of forest tree seeds generally refers to the steps of extracting, dewinging or depulping, cleaning, upgrading, and treating. By upgrading, we mean the improvement of the potential performance of a seed lot by removal of empty, damaged, weak, immature, or odd-sized seeds. The treating step could include treatment with repellents, pesticides, or peleting materials.

Most techniques for carrying out these steps are proven and well known. Is there room for improvement, then? Are there new developments or equipment that show promise in the field of tree seed processing? To answer these questions, let's look at each step of processing.

## EXTRACTING

If I wanted the biologically safest procedure for opening multi-seeded fruits and cones to extract the seeds, then I would choose air-drying. The sheer size of regeneration programs with southern pines (*Pinus* spp.), however, dictates the use of cone kilns with these species. Kilns can be the progressive types, in which cones are slowly moved through a "tunnel" of progressively higher temperatures and lower humidities; or they may be the batch type, in which a group of cones is placed in a heated compartment, separate from other groups.

The increasing harvest from Southern seed orchards has favored a trend to batch kilns, which can handle small lots of expensive seed (see McConnel 1973). Some companies are even collecting and processing seed from individual clones separately. In this way, kiln temperatures and schedules can be custom-fitted to cone conditions and clonal characteristics. With orchard seed valued at $1,000 and up per pound, this additional care in extraction is apparently well justified. I believe we will see more of this type of extraction, and I believe it will pay off.

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What improvements can be made? In batch extracting we need more information on proper kiln temperatures and humidities. We need to be sure that we aren't losing seed quality in this step of processing because once lost, seed quality cannot be regained. I believe that it's time for some new basic research on cone drying and its effect on seed quality.

## DEWINGING AND DEPULPING

Dry dewinging was one of the worst things that ever happened to conifer seeds; it was potentially the most dangerous step of processing. Wet dewinging has apparently solved this problem. Any number of techniques can be used to dampen the seed quickly and then supply a gentle rubbing or mixing action to knock off the hygroscopic wing before the seeds take up any water (Loman 19751. Small cement mixers are good, as is the old standby Dybvig macerator. 2/ Small lots can be rubbed by hand, stirred by vacuum, or stirred in a kitchen blender full of water.

For certain hardwoods, dewinging must be dry. Yellow-poplar (*Liriodendron tulipifera* L.) can be dewinged in grain debearders or in Dybvig macerators (smaller lots), but moisture in the carpel wings will prevent complete removal of that tough appendage (Bonner and Switzer 1971).

Depulping of drupes, such as the tupelos (*Nyssa* spp.), black cherry (*Prunus serotina* Ehrh.), or dogwood (*Cornus florida* L.), can easily be done with the Dybvig or other macerators. The presence of water helps to keep the risk of injury to a minimum.

There are no pressing needs for new dewinging or depulping techniques at this time. We apparently can do a good job on those species that need dewinging.

## CLEANING

The basic cleaning machine for almost all seeds--those of crops and trees--remains the air-screen cleaner. This machine can separate seeds by three physical properties: size, shape, and density. Air-screen cleaners can be regulated by changing screen pattern, feed rate, airflow, screen oscillation, and screen pitch (in some models). The three cleaning elements are:

- *scalping* - good seeds drop through screen openings, and large material rides over screen;

- *grading* - good seeds ride over screen openings, and smaller particles drop through;

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2/ Mention of trade names is only to identify materials or equipment used and does not imply endorsement by the U. S. Department of Agriculture.

aspiration - light material is removed from the seed mass.

I know of no tree seed now being collected that cannot be cleaned on an air-screen cleaner, except those large seeds--walnuts (*Juglans* spp.), hickories (*Carya* spp.), etc.--for which no suitable screen sizes are available. In the cleaning phase of processing, no crucial research and development problems are evident.

## UPGRADING

The upgrading step of tree seed processing probably offers the most potential for improvement. Some upgrading can be accomplished on air-screen cleaners by removal of sub-sized seeds with the fan, as in sweetgum (*Liquidambar styraciflua* L.) and sycamore (*Platanus occidentalis* L.) (Bonner and Switzer 1974), or by sizing with a second or third run over screens. Much better upgrading for many species, including the southern pines, can be done on the gravity separator. Originally built to remove ore from clay and dirt, these machines have been adapted successfully to seed processing. A gravity separator can separate seeds of different sizes but the same density or seeds of different densities but the same size; it cannot handle a mix of both sizes and densities. The feed rate, air stream through the deck, deck pitch (side and end), and shaking speed can all be regulated. Most southern extractories have gravity separators for processing southern pine seed, but they don't use them enough. Don't stop with southern pine; upgrade sycamore, dewinged yellow-poplar, and probably other seeds. It is worth the effort, if you want high-quality seedlings.

Are there new developments in upgrading? The answer is yes. The equipment isn't new, but its possible use with tree seeds is. The magnetic separator, for example, can pull out rough-coated or cracked seeds (Vaughan et al. 1968). Seeds are sprayed with water, then mixed with fine iron powder. The powder sticks to moist surfaces, as in cracks or rough spots, and enables these seeds to be attracted to a turning, magnetic drum. Smooth, undamaged seeds do not retain the powder and thus fall from the drum well before the "magnetized" seeds are swept off. These machines were first tried on seeds in England some 40 years ago, but they were not successful. Several machines have since been designed for seed separations by firms in the U. S. and Europe, but I know of no routine use with tree seeds.

Another machine, called an electrostatic separator, utilizes differences in a seed's ability to hold or conduct an electrical charge (Vaughan et al. 1968). Basically, an electrode sprays a high-intensity charge onto the seed on a moving belt. Poor conductors absorb and hold the charge, and are thus carried to a discharge sprout. Good conductors lose their charge easily and drop off before the other seeds. Electrostatic separators have had limited use in the seed industry and should still be considered as experimental machines. One such device is being used to sort *Picea abies* (L.) Karst. seeds of differing germination capacities in Rumania (Chiru 1968). This technique deserves some attention in tree seed research.

In recent years another electronic sorting machine has appeared on the market, and the developers claim that it can sort seeds into categories of germination and vigor potential. A low current is passed through individual seeds, and selection is apparently made according to the amount of current conducted through the seeds. High current is equated with low vigor and yield; low current means high vigor and yield (Levengood et al, 1975). A high-speed, automated device has been designed to do this separation on an operational basis. To my knowledge, the machine has not been tested on tree seeds.

There is also a high-speed electronic device available which sorts seeds by seed coat color (Vaughan et al. 1968). A sensing device compares each seed with an electronic pattern or a specific color background. Seeds that do not fit into the acceptable range of color are diverted from the feed "stream" by compressed air or other means. Color separators are quite expensive, but their use might be justified for valuable seed orchard seed if seed color and seed quality are related. Such a relationship has been suggested for some pine species in the past (Kuo 1965), but I know of no definite research on U. S. species. At least one commercial tree seed company in Europe has a color sorter.

## TREATING

Treating is usually the last step in processing crop seeds, but for most tree seed operations treating with repellants and fungicides usually is associated with planting. Treating at this stage may be in many types of vats and containers, but commercial treating machines are available. One can treat with slurries, dusts, or liquids as the occasion demands.

Pelletting of seeds may also be put into the treating category. Pelletting is becoming common with some seeds, especially vegetable seeds, and work has been done with pelletting of forest tree seeds. Some European firms are selling pelletized tree seeds, and I think this trend will continue. Small seeds, even *Eucalyptus*, can be pelletted to aid in sowing operations. With the additional advantage of supplying beneficial chemicals through the coating to the seeds, pelletting seeds appears to be a technique that foresters can not afford to ignore. It is another area where research is needed.

## ADDITIONAL INFORMATION

For those who would like more details on equipment and its capabilities, there are several sources of information. In addition to the references cited in this paper, I recommend Chapter V of Agriculture Handbook 450, *Seeds of Woody Plants in the United States*, by Stein, Slabaugh, and Plummer, and Agriculture Handbook 354, *Mechanical Seed Cleaning and Handling*, by Harmond, Brandenburg, and Klein.

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