PRODUCTION SEED PROCESSING AT PINE RIDGE FOREST NURSERY [1]

D. Altmann, P. N. Au and L. Lafleur[2]

ABSTRACT

Pine Ridge Forest Nursery processes seed from cones collected by The Alberta Forest Service and forest industry in Alberta. The seed program involves cone storage and the extraction, cleaning, grading, storage and testing of predominantly white spruce and lodgepole pine seed.

INTRODUCTION

Pine Ridge Forest Nursery processes cones collected by the Alberta Forest Service and forest industry in Alberta. Extracted seed is used for production of bareroot or container seedlings at the nursery, seeding of harvested areas, or seedling production by forest industry.

The seed program at Pine Ridge Forest Nursery involves cone storage and extraction, cleaning, grading, storage and testing of seed. Seedlots are kept separate by provenance from cone collection to seed storage.

CONE STORAGE

Cones are collected off felled trees or from squirrel caches, and shipped to the nursery in two bushel (0.70 hectolitre) burlap bags. Each bag is tagged with two identity tags, specifying name of shipper, species, area and year of collection, e.g. DG 64-5-6-74 Sw. Each shipment of cones is accompanied by a prescribed document containing detailed information about the cone collecting area.

Cones are stored in three steel-frame sheds with large, wire-screened sliding doors and asphalt floors. Each shed can hold approximately 6000 bushels (2200 hectolitres) of white spruce cones or 18,000 bushels (6500 hectolitres) of lodgepole pine cones. Pine cones are stored in their burlap bags, about eight bags high.
Spruce cones are stored loosed on burlap lined self-stacking pallets, about 11 bushels per pallet; this allows for air circulation to dry the cones and discourages molding. A bumper crop of spruce cones in 1979 forced utilization of twenty container seedling greenhouses as additional space for air-drying: cones were spread out on the floor and periodically stirred.

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[2]Respectively Research Forester, Production Forester, and Seed Program Supervisor at Pine Ridge Forest Nursery, Smoky Lake, Alberta.

SEED EXTRACTION

The seed extraction facility, based on a design of the Saskatchewan Forest Service, was built in 1978. It is capable of processing 50,000 bushels (18,000 hectolitres) of spruce and pine cones per year, on a one shift per day basis.

Seed extraction (and seed cleaning) are usually only carried out from November until March, on a twenty-four hours a day, five days a week schedule. This conserves energy and provides continuous employment. It also develops a versatile labour force because personnel is employed in seedling production during the remaining part of the year. The plant employs four people per eight hour shift to process cones and six people per shift to extract spruce cones. The weekly production is 3,300 bushels.

Spruce and pine cones are treated differently because scales of lodgepole pine cones are kept closed by a resinous bond.

Lodgepole Pine

Bagged cones are moved on pallets from the cone storage sheds into the building by forklift. Cones are brought in from the cold a minimum of 16 hours before processing to ensure uniform cone temperature prior to scorching.

A hopper is filled with 30 bushels of cones by means of a conveyor, and the pones are slowly funneled through a revolving cone-shaped screen to remove needles and loose dirt. Subsequently they pass through a scorching unit, consisting of a 4-step vibrating pan and 6 gas-fired radiant heaters. This subjects the cones to a temperature of 210 - 230°C during 1.25 – 1.5 minutes, and breaks the resin bond.

Cones are transported from the scorcher by means of a conveyor belt to four preheat bins. These bins utilize the exhaust heat from the kilns to precondition the cones before going into the kilns. This saves energy and time. The cones are fed into the preheat bins through a pivot-mounted auger. Water can be applied to the cones while they pass through the auger. Cones can remain for up to two hours in the preheat bins.

A batch cart on rails is filled from the bottom of a preheat bin and positioned over one of eight revolving drums in four individually controlled kilns to discharge the cones through a chute in the floor. The screened kiln drums are hexagonal in shape. Both the inside temperature of the kiln and the drum rotation speed can be varied to suit the species and seedlot being extracted. It is also possible to raise the humidity in the kiln by steam injection.

Pine cones remain in the 30 bushel capacity kiln drums for up to eight hours at a temperature of 60°C. During this time they are rotated at 3 RPM for various periods of time. Seed falling through the rotating screens is periodically conveyed by vibration into wooden catch bins outside the kiln. This step provides continuous visual evidence of the progress of the extraction process, as well as the effects of varying the rate of rotation and tumbling schedule. Removing the seed from the kiln soon after release from the cone minimizes the time that the exposed seed is subjected to heat.

Winged seed is collected from the catch bins, bagged and put in cold storage until it can be cleaned.

Spent cones are removed after the extraction cycle is completed by reversing the direction of rotation of a drum, vibrating the cones through a chute in the floor and conducting them by means of a vacuum system into a large elevated hopper outside the building. Spent pine cones are sold to contractors for use in landscaping.

White Spruce

White spruce cones open partly during the drying process in storage. They are transferred from the pallets into open carts; one cart load contains 15 bushels of "green" cones or 30 bushels fully dried cones. Cones are conveyed directly from the cart by a vacuum system to a holding bin on the floor above the kilns; dust is collected in large canvas filter bags.

A batch cart on rails is filled from the holding bin and the cones are discharged in the kiln drums, where they remain at a temperature of 40°C for varying lengths of time and are tumbled for short periods at 8 RPM. Cones of high moisture content take somewhat longer to open before releasing the seed. The average extraction cycle takes four hours.

SEED CLEANING AND GRADING

The seed cleaning and grading equipment was designed by the Hilleshog Company in Sweden, and has operated for one season. The system consists of two scalpers, a wet dewinger, a liquid separator, a seed drier, a seed sizer and four gravity separators. The objective of this process is to obtain seed of high purity and viability and a seed moisture content of 5 to 8 percent.

Scalping

Winged seed is shaken out of bags into a vibrating hopper on rails and passes through one of two scalping units, i.e. a vibrating step-sieve for lodgepole pine seed or a vibrating screen for white spruce seed, to remove cone scales, needles, dust and other debris. The vibrating screen is used for seed of both tree species until modifications of the step-sieve are completed.

Dewinging

Winged seed is transferred to a wet dewinger. This is a 130 cm diameter rotating drum, open on one end, capable of holding about 400 litres of winged seed. The drum rotates at various speeds depending on the load size and species being dewinged. A full load of approximately 340 litres of winged seed is tumbled for 40 to 45 minutes. Water is added for 4_2' minutes after the drum is filled. Air is blown continuously along the side of the drum to facilitate tumbling of the seed and to prevent sticking of the wi-ged seed against the sides of the drum. The moisture causes the wings to expand and the seed drops off. The wings and some empty seeds are blown from the drum by the continuous stream of air and fall into a chute below the drum for disposal.

Liquid Separator

Seed is removed by tipping the drum and discharging the seed onto a shaking screen which removes much of the small debris. The seed passes through a small hopper and is fed by a vibrator into a cup-shaped receptacle. Here it is mixed with running water and drops through a spout about 50 cm deep into a liquid separator which contains lukewarm water. The water removes resin, fungal spores, cracked seed and fine dirt. The seed floats up to the surface and seed and water flow into a feeding device for distribution over screened trays fastened to an endless variable speed conveyor. The speed is regulated to cover the screens with seed to a depth of 2 cm.

Drier

These screens pass through three connected drying units (each unit has room for five trays) against the direction of forced air flow, i.e. the air is cool and moist at the entry of the first drying unit and warm (32oC) and dry (2-4! RH) at the exit
of the last unit. The seed dries in one to one and a half hours. The drying process is monitored by periodic testing of seed moisture content at the end of the drying cycle by means of a grain moisture tester. A moisture content between 5 and 8 percent is considered satisfactory.

Seed Sizer

Dried seed falls into a hopper and is conveyed through a suction hose to a seed sizer, which consists of a series of shaking screens of various mesh sizes. Foreign matter and seed of four sizes are separated into five fractions.

Gravity Separators

The final step of seed cleaning is accomplished by means of specific gravity separators. Each seed size if funneled into its individual separator unti. Air flowing through a separator divides the seed by weight into three fractions, i.e. filled seed, empty seeds plus wing remnants, and poorly developed seed plus misc-ellaneous foreign matter. The air flow can be regulated to minimize loss of good seed. Each fraction is collected in plastic bins, but only the filled seed fraction is retained and packed in clear plastic bags, separately for grade A (largest two fractions), B and C (smallest fraction).

Packing

Seed is weighed in 10 kilogram lots, an identity tag is enclosed and the bag is double-sealed by heat. Sealed bags are packed in waxed cardboard boxes that can hold 10 or 20 kilograms of seed, waxed cardboard covers of similar size are slipped over the boxes, and relevant information is written on the side of each box cover (seedlot, species, seed grade and amount of seed). Samples for laboratory testing are taken for each seed grade before packing the seed. The seed is now ready for storage.

The whole operation is run by a crew of three per shift. The average production per eight hour shift is 140 kilograms of seed.

SEED STORAGE

The final production phase of the seed program is cold storage of seed at -18^{0}C (0 F) and 50 percent relative humidity. A separate fire-proof concrete building has been designed to store 50,000 kilograms of seed within four freezer compartments, each with its own environment controls. It is built 1.80 metres below ground level in the side of a small hill. This results in conservation of energy and a more closely controlled environment. An important safety factor is that conditions will remain fairly stable for at least 72 hours in case of a power failure.

SEED TESTING

The seed testing laboratory is located on the second floor of the seed extraction building. It is equipped with four germination cabinets, a drying oven, an X-ray machine, precision balances and other apparatus.

Random samples of seed are taken from each of the three seed grades of every extracted seedlot and tested for purity, moisture content, germination rate and weight of 1000 seeds. X-rays are taken to detect damaged and empty seeds. Seed in cold storage is retested every second year for germination rate and moisture content.

Testing procedures are based upon the rules of the International Seed Testing Association (ISTA). A recent modification is that our germination rates are based only on the top four vigour classes according to a classification of Mr. Wang of the Petawawa National Forest Institute of the Canadian Forestry Service. This gives a better correlation with germination in the greenhouse.

Laboratory staff also stratifies seed for container seeding at the nursery.