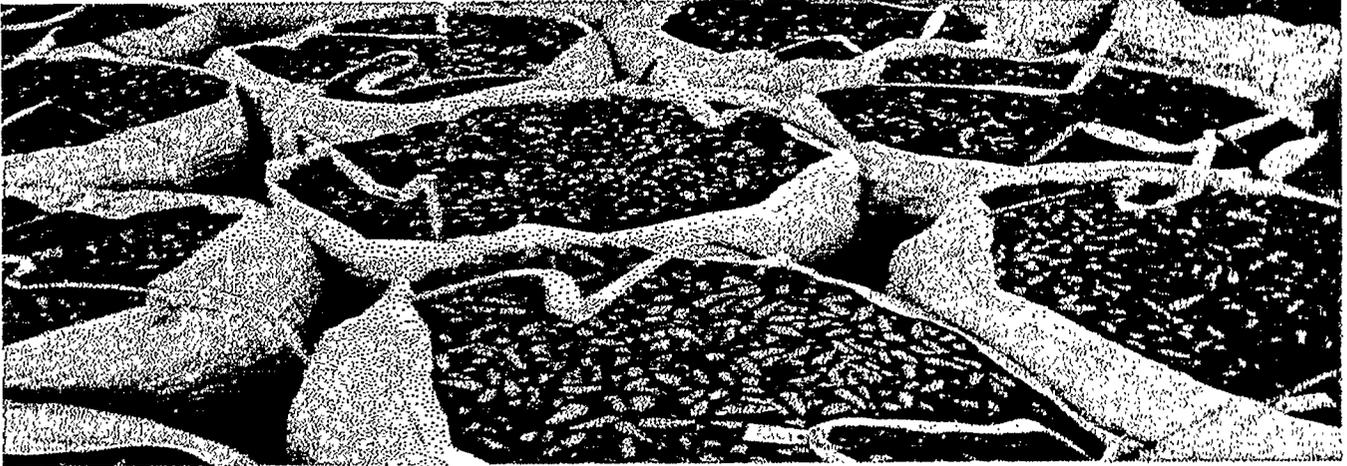
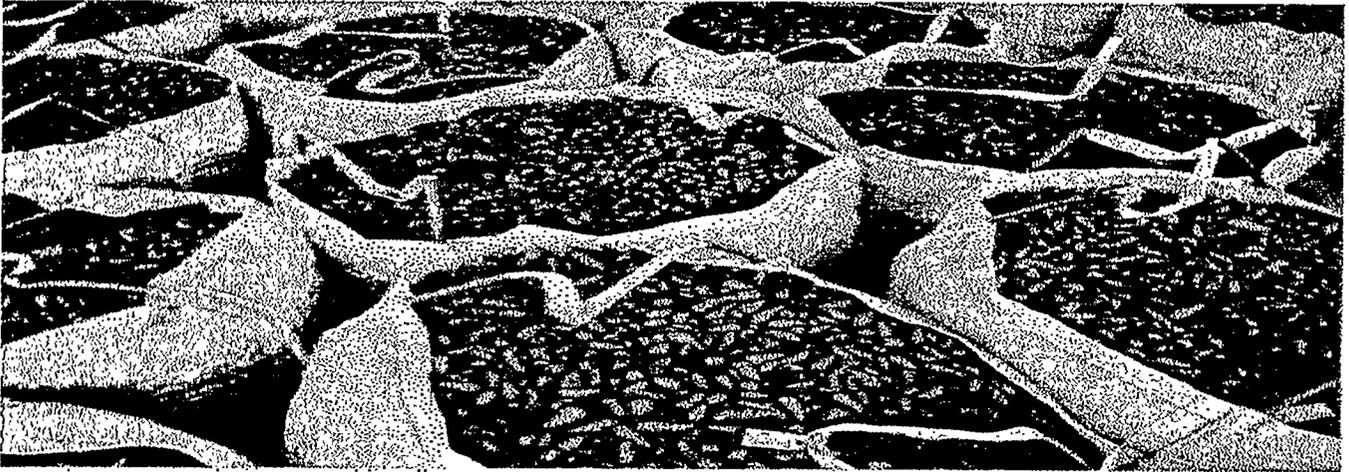


2.0 Seed Processing



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2.0 Seed Processing



Seed processing can be defined as the methods and techniques used to obtain clean, high quality seed. There are two schools of thought in the establishment of a work sequence for seed processing: **batch processing** and **continuous flow processing**.

Batch processing provides the flexibility to vary the type and sequence of seed processing steps to meet the individual needs of different species and seedlots. Personnel are able to monitor the seed at each step in the extraction process, and adjustments and recleaning are easily accomplished. Equipment may be changed and updated as appropriate. The batch system is generally favored, especially for smaller seedlots.

In a **continuous flow system**, cones and seeds move through an interconnected sequence of processing steps. This allows fewer personnel to be involved in the seed cleaning process. However, if there is any equipment failure, the entire processing system shuts down. Because of the required conveying equipment, the possibility for seedlot contamination is increased. It is also much more difficult to determine the specific cause of seed damage in a continuous flow system. The continuous flow system is more common in extractories where large seedlots are processed.

The first step in the extraction process is to open the cones by drying. After removal from sacks or bins, cones are dried in a kiln. There are many types of kilns, each needs to be evaluated for its application at a specific nursery. Seed extraction, removing seed from cones, is similar for all conifer seed. Cones are placed in a tumbler where seeds are shaken free from the cones.

Seed scalping, seed dewinging, and seed cleaning are all specialized techniques to remove the wings, debris, and empty seeds. Various specialized pieces of equipment, many of which have been adapted from agricultural seed cleaning equipment, facilitate this process.

Once cleaned, seed is stored for future use. Tree seed must be dried to a specific moisture content, generally 5 to 9 percent, for long-term storage; this may require an additional drying step. Seed is further prepared for storage by counting, testing, and packaging. Careful recordkeeping is of the utmost importance in seed processing. Seed counting and testing may be contracted to a commercial laboratory.

2.1 - Cone Drying



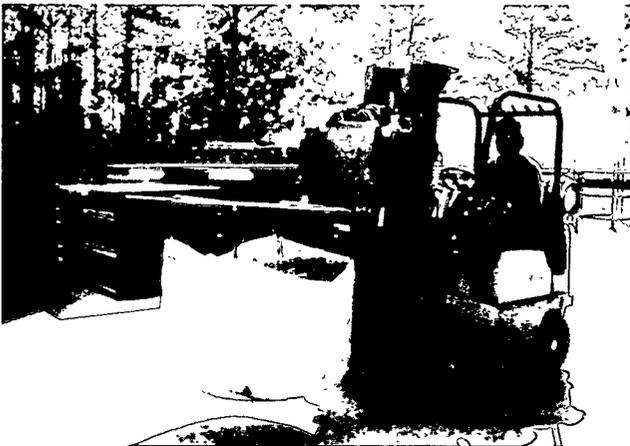
Complete opening of cones for seed release requires cone moisture content to reach a level of 10 percent or lower. Some air drying occurs before the cones are placed in a kiln. Under some conditions, cones are airdried and do not need to be placed in a kiln for further drying. However, most cones are in the range of 30 to 60 percent moisture content when initially placed into the kilns. Cone drying rates are controlled by regulating air temperature and relative humidity.

Relative humidity within kilns normally is regulated in the 15 to 45 percent range. This depends on species and the drying rate desired. Average operating temperatures of kilns range from 90°F to 110°F.

Cone Hoppers

In large processing operations, cone hoppers aid in transferring cones. They serve as an intermediate step between the storage container and the kiln, or between the kiln and the tumbler.

These hoppers are used to fill cone trays or are combined with conveyors to transfer cones from trays to a tumbler.



Cone Hoppers:

International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5749

Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

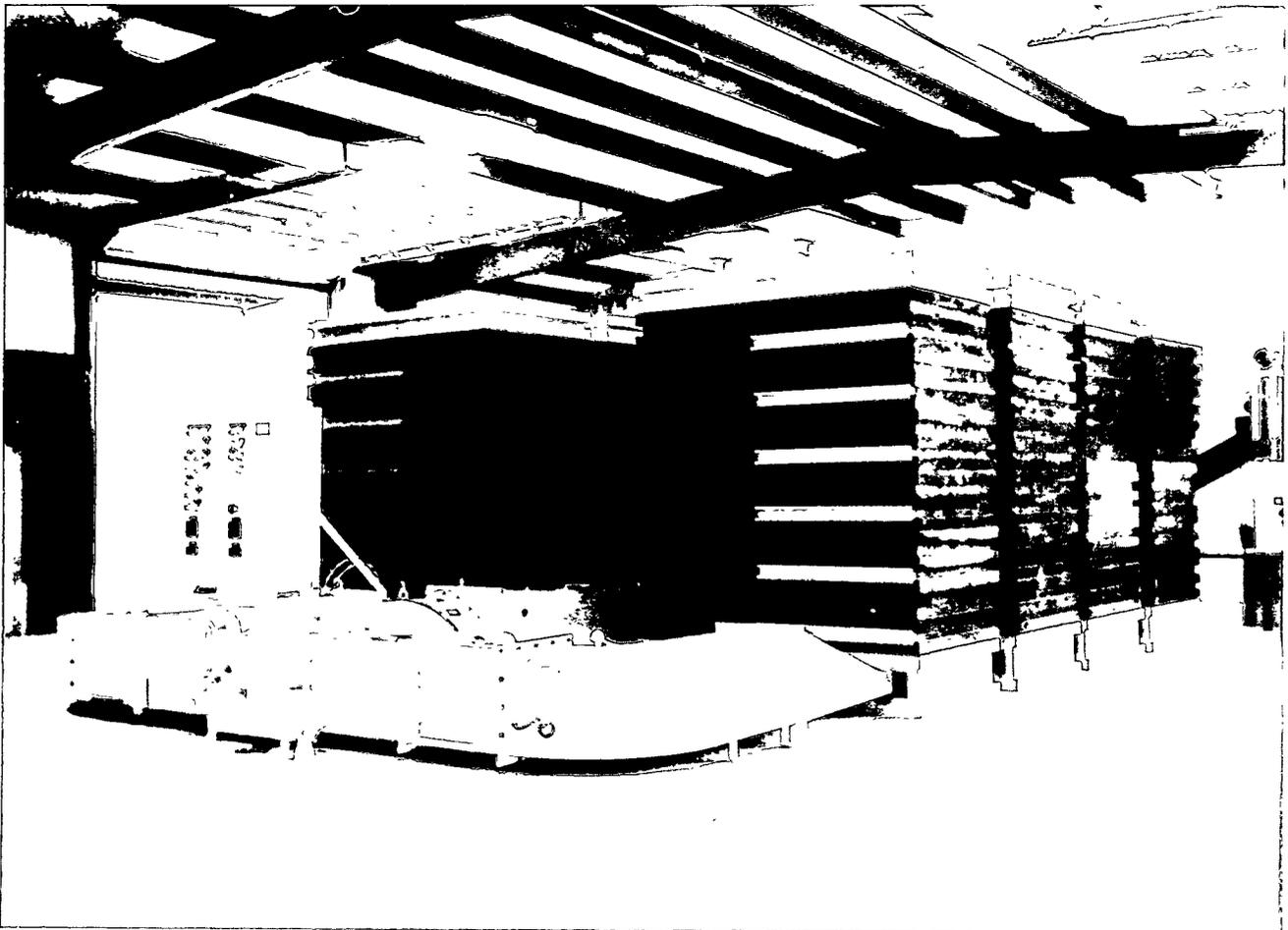
Kilns

Kilns are generally of two types: rotary drum kilns and stationary kilns.

Rotary drum kilns are made of a perforated metal drum that rotates on a horizontal axis and includes a heater and a fan. Cones are placed in the rotating drum with warm air circulating through it. As the cones open, the seeds fall through the drum perforations where they can be gathered. This operation combines the kiln and tumbler into one unit. Generally, the kiln has both humidity and temperature controls.

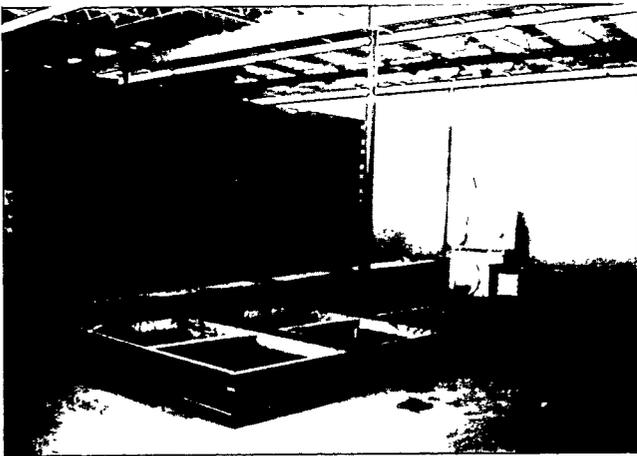
Stationary kilns are large heated rooms, cabinets, or tray systems with temperature and humidity controls. Cones are placed on trays or racks, and are exposed to warm, dry airflow. When properly opened, the cones are transferred from the kiln to tumblers. Stationary kilns are the most commonly used. The major advantage of these kilns is the flexibility to dry many different seedlots simultaneously.

The most popular type of stationary kiln is the tray system kiln. Cones are placed into trays (flats). The trays are stacked on each other. Warm air from the heating system is blown through the trays. In several modern kilns low-humidity air is recirculated through the trays to reduce energy consumption. Temperature and humidity is controlled and these kilns have automatic air exchange louvers. The system is composed of a base, trays, covers for the top trays, a heating system, air ducts, and various tray system components. Various models allow many small seed lots to be dried simultaneously. Some tray kiln systems require the use of a forklift with a rotating clamp head attachment for loading and unloading.



Southpine Tray Dry Kiln

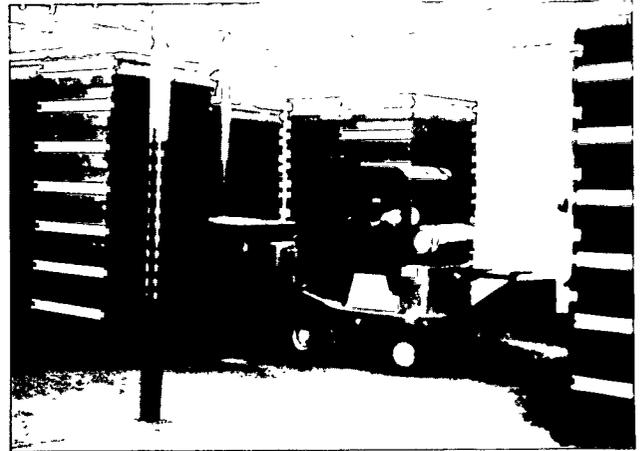
The Southpine Tray Dry Kiln is designed to dry up to 300 bushels of pine cones per charge. It has 48 cone drying trays with perforated metal bottoms. The trays have metal receptacles to permit pickup and emptying with a forklift. Several lots of cones may be dried at the same time without any contamination or delay in processing. The Southpine Tray Dry Kiln is equipped with a propane or natural gas-fired recirculating heating system. The control panel includes a programmable digital temperature controller and humidity controller to initiate the discharge of high humidity air. Additional temperature and humidity controllers may be programmed to automatically shut down the dry kiln when the cones have finished drying. It has water injection to help open case-hardened cones, and all of the kiln's functions may be monitored or recorded on a personal computer. The control panel controls are fully integrated into a factory prewired electrical enclosure. The dry kiln is also equipped with all necessary fail safe safety controls.



Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

International Forest Dry Kiln

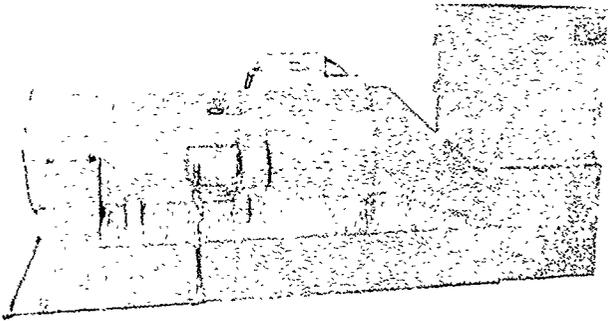
This dry kiln with a 288-bushel capacity is made of stacks of wooden flats holding cones. Warm air is forced through the flats by a heating system that can be designed to use fuel oil, natural gas, or propane. Low-humidity air is recycled through the flats to reduce energy consumption. Temperature and humidity may be controlled and the metal air ducts have automatic air exchange louvers. The system is composed of eight base trays, eight cover trays, metal protector cleats, air ducts, and various tray system components. The flats hold 6 bushels each and are usually made 4 feet x 8 feet x 16 inches. The design, however, can be altered. It is similar to the South Pine Tray Dry Kiln system.



International Forest Tree Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5749

McPherson Cone Dryer

This dryer uses a fan to draw air in and blow it past a heater. The warmed air enters a large chamber where the air velocity is slowed. The warm air slowly circulates through the cells containing cones, allowing the air to pick up moisture. The air is discharged through the ends of the cells. The warmed air that did not pass through the cells is recirculated back in front of the fan, where it is mixed with fresh air. The exhaust vents can be adjusted to provide even drying for cones with different drying abilities and different amounts of cones in the cells. To form a larger dryer, additional cells and a recirculation chamber can be added to the end of the current cells and chamber. The standard model comes with 12 cells. The cells come in 1, 2, 3, or 8 bushel sizes.



A.W. McPherson and Assoc., Inc.
P.O. Box 5011
1406 Howell Dr.
Monroe, LA 71203
(318) 343-5957

Peerless Cone Drying System

Peerless Manufacturing Company has a portable pine cone drying system. They load 100 bushels of cones onto trays in a wagon. The wagon plugs into a kiln powered by LP natural gas. Once the cones have opened, they unload the trays into rotary drum extractors.

Peerless Mfg. Co., Inc.
U.S. Highway 82 E
Shellman, GA 31787
(912) 679-5353

Kilns:

International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5749

A.W. McPherson and Assoc., Inc.
P.O. Box 5011
1406 Howell Dr.
Monroe, LA 71203
(318) 343-5957

Peerless Mfg. Co., Inc.
U.S. Highway 82 E
Shellman, GA 31787
(912) 679-5353

Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

Serrotinous Cones

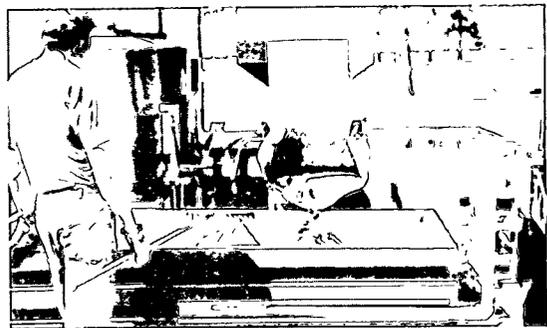
Serrotinous cones require special treatment because the cone scales are fused with resin. Before the normal drying step, a brief heat treatment using air, water, or steam is required to break the resin bond.

Traditionally, serrotinous cones in burlap bags were dipped in scalding water for a brief period to melt the cone's exterior resin.



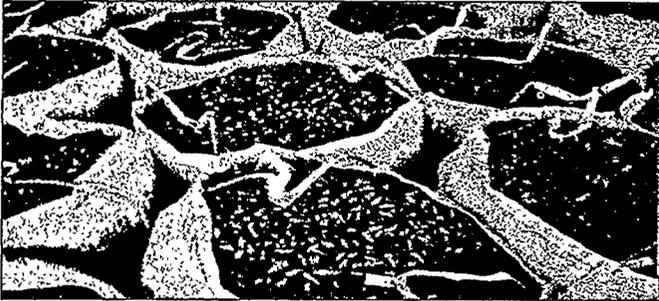
Sand Pine Cone Processor

A sand pine cone processor is commercially available. This processor melts the cone resin by a direct steam application to the cone exterior and consists of four primary components: Steam generator, wire mesh belt conveyor, steam chamber, and feed hopper. Cones are placed into a 25-bushel capacity hopper that has an adjustable discharge gate and provides a constant cone depth on the belt. The belt transfers the cones through the steam chamber where they are pressure steam-treated and then discharged at the end of the belt. This system is used at the USDA Forest Service W.W. Ashe Nursery in Brooklyn, Mississippi.



Dixie Products
2080 Atlanta Rd
Smyrna, GA 30080
(404) 432-0626

2.2 Seed Extraction

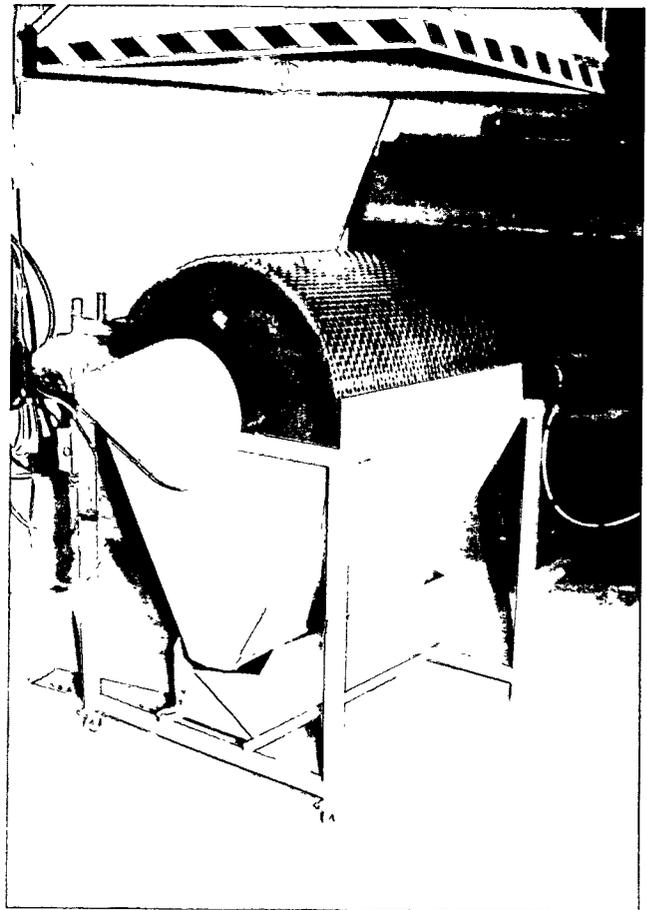


After the cones have opened properly, seeds are separated from the cones. This separation process is normally accomplished by placing the cones into a rotating mesh tumbler. Seeds are jarred loose from the cones and fall through the mesh. The empty cones are removed from the tumbler at the opposite end. Many cone tumblers are homemade or adapted from existing agricultural seed cleaning equipment such as spiral grain or corn cleaners.

Tumblers

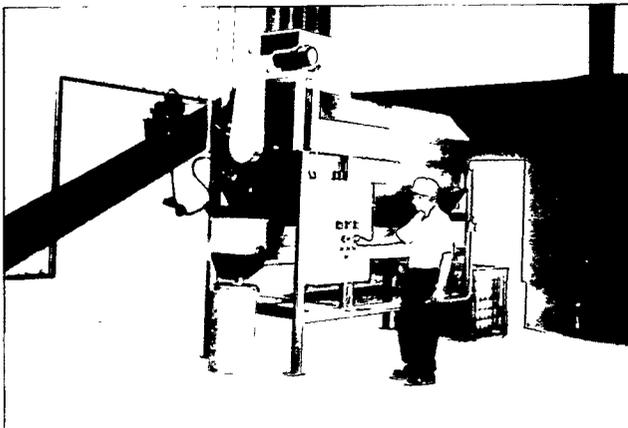
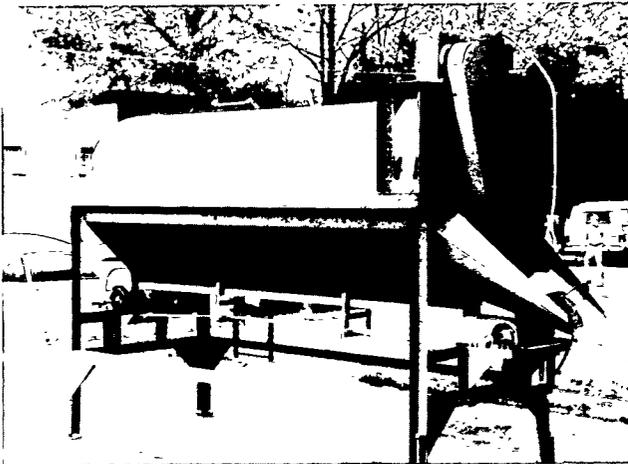
Cones need to be fully dried and opened prior to insertion into the tumbler for proper seed extraction. The tumblers rotate at relatively low speeds, which allows the seed to fall from the cones. The wire mesh allows the seed to be immediately removed from the tumbler to prevent damage.

Small seed lot extractors, like the cone tumbler built at the USDA Forest Service Coeur d'Alene Nursery, extract seed for very small lots of cones (1 to 2 bushels). Plans (CDN-8) are available from the Missoula Technology and Development Center, Building 1, Fort Missoula, Missoula, MT 59801.



Southpine Batch Tumbler

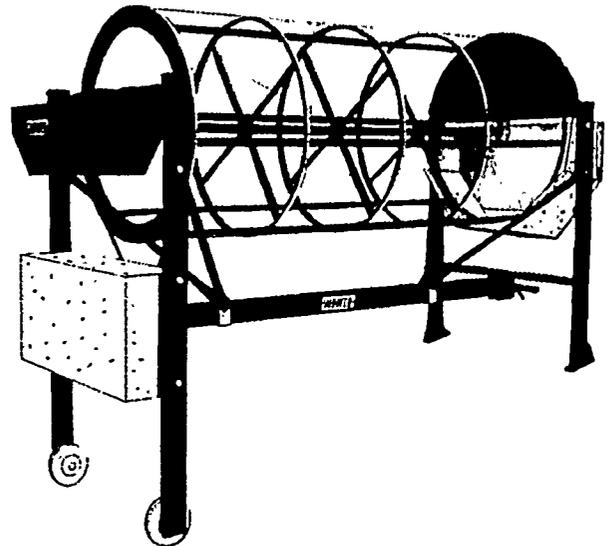
The Southpine Batch Tumbler is designed to extract seed from pine cones. It is equipped with three programmable time controls that operate the tumbler automatically. The first controller stops the tumbler for loading, the second controls the time cones are tumbled, and the third reverses directions of tumbler and discharge conveyor to empty out the cones. The tumbler is programmed for continuous running after a sample batch has been manually run to establish the exact time for totally extracting the seed from that individual lot.



Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

Fabricated Tumbler

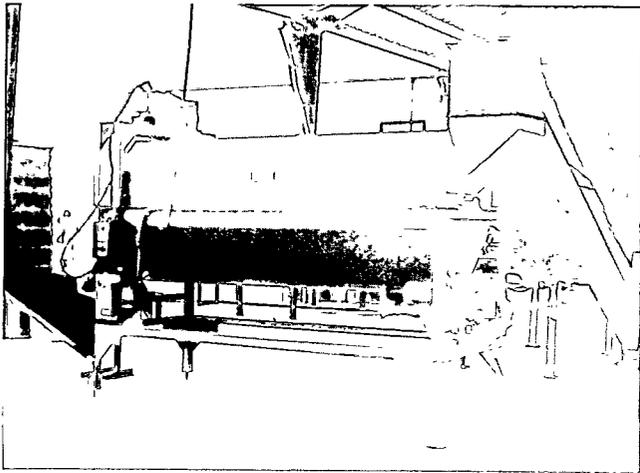
Several extractories have custom built their own tumblers by modifying rotating grain cleaners. The drums are 70 inches in length and either 30 or 36 inches in diameter with interchangeable screens.



Snow Corp.
4350 McKinley
Omaha, NE 68112
(402) 453-2200

International Forest Seed Tumbler

International Forest Seed Company offers a cone tumbler with a variable speed control 3 hp main motor. The tumbler capacity is approximately 72 bushels per hour. Loading conveyors are available as options.



International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5726

Batch Tumblers:

International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5726

A.W. McPherson and Assoc.
P.O. Box 5011
1406 Howell Dr.
Monroe, LA 71203
(318) 343-5957

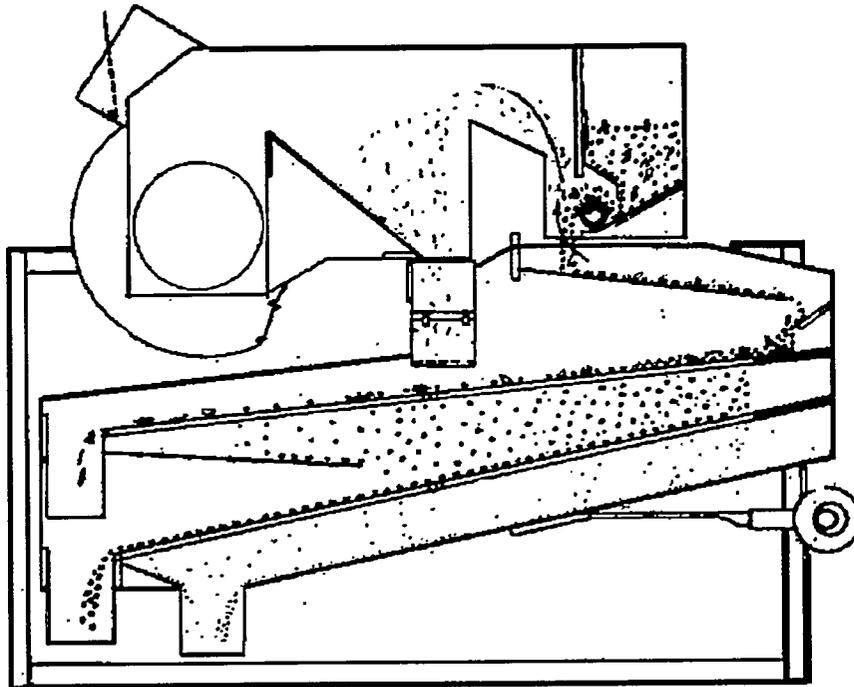
Snow Corp.
4350 McKinley
Omaha, NB 68112
(402) 453-2200

Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

2.3 Seed Scalping



Before tree seed is dewinged, it is cleaned to remove the largest trash that otherwise could injure seeds. This pre-cleaning operation is called scalping. Many seed processors use scalpers with two screens that make three separations. The top screen removes large debris such as cone scales and needles; seeds and light litter fall through the holes onto a second screen. The seed remains on the second screen and is discharged into a hopper, and the light litter falls through the holes and is swept away by an air draft (See Section 2.5 Seed Cleaning).



Seed Scalpers:

B.A.I.C.
Bluffton Agri/Industrial Corp.
P.O. Box 256
805 S Decker Dr.
Bluffton, IN 46714

Crippen Mfg. Co., Inc.
700 W End St.
Alma, MI 48801
(517) 463-2119

Forsbergs, Inc.
P.O. Box 510
Thief River Falls, MN 56701
(218) 681-1927

Hance Corp.
235 E Broadway
Westerville, OH 43081
(614) 882-7400

Ideal Grain and Seed
Cleaner Co.
85 Second Ave. SE
New Brighton, MN 55112
(612) 636-7323

Oliver Mfg. Co., Inc.
P.O. Box 512
Rocky Ford, CO 81067
(303) 254-6371

Seedburo Equipment Co.
1022 W Jackson Blvd.
Chicago, IL 60607-2990
(312) 738-3700

Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

Triple/S Dynamics
1031 S Haskell Ave.
Dallas, TX 75223
(214) 828-8600

2.4 Seed Dewinging



Dewinging, removing wing material from the seed, is one of the most important steps in tree seed processing because this is when the seed is most often damaged. Winged seed causes problems when sowing. The wing portion is usually removed from the seed by a rubbing action.

Dewinging may be dry or wet. Some tree species have wings that are an integral part of the seed coat; other species have wings that surround the seed and can be easily removed when moistened. Wetting the seed with small amounts of water may help release the wing from the seed. However, this moisture must be removed by further drying before long-term seed storage.

Dewingers

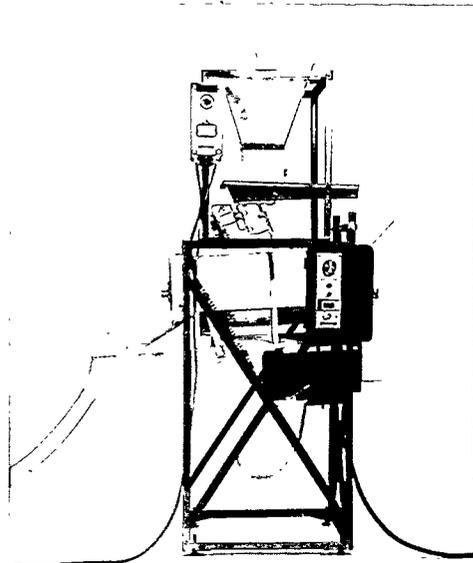
Most machine dewingers are rotating devices that dewing seed by rubbing the seed with paddles between two surfaces, or against the walls of the dewinger chamber. Chamber walls are made of wire, wood, or are lined with canvas or rubber. The paddles and brushes are made of wood, rubber, or metal. Seed may be easily damaged by excessive agitation. Successful dewinging depends on paying close attention to paddle rotation speed, the amount of clearance between agitator and cylinder walls, and the rate of feed into the dewinger.

MEDC Tree Seed Dewinger

This dewinger has a processing capacity of up to 50 lbs/hr. It is designed to operate continuously, so it does not require specific amounts of seed. Pre-cleaning or scalping of seed before dewinging is desired.

A small vibrating feeder funnels seed into a rubber-lined cylinder. Here, gum rubber flaps attach to a central shaft rotates to dewing the seed. The dewinging time is controlled by the speed of the central shaft and the tilt of the cylinder; the steeper the tilt, the shorter the dewinging time. The dewinged seed drops into an exit chamber at the bottom of the drum. As the seed drops, a vacuum system aspirates the chaff. Plans and an operators manual are available from:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801



Wet Dewinger

This dewinger handles up to 100 pounds of seed in a batch and can clean two batches in an hour. The dewinger may be adjusted for speed, tilt, and the amount of water and compressed air. The dewinger has a built-in operator's platform and holds two carts for cleaned seed.



McPherson Small Lot Dewinger

This small dewinger handles lots of 3 to 10 pounds of seed either in batches or as a continuous flow. It can be used either for dry or wet use.

Wet Dewinger:

International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5749

McPherson Small Lot Dewinger:

A.W. McPherson and Assoc., Inc.
P.O. Box 5011
1406 Howell Dr.
Monroe, LA 71203
(318) 343-5957

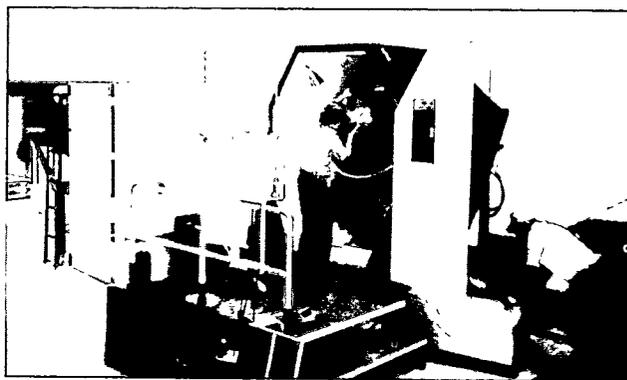
Southpine Paddle Dry Dewinger

The Southpine paddle dry dewinger consists of a drum with mounted paddles. The paddles rotate, breaking off the wings. The dewinger may be operated wet or dry. When used wet, water is sprayed directly on the seed after loading.



Southpine Wet Dewinger

The Southpine Wet Dewinger is a rotating drum. Seeds are placed in the drum, where water mist is applied to loosen the wings. As the drum rotates, compressed air is blown on the seed. As the wings dry out, they detach from the seed and blow into a plastic bag. When the wing bag is removed, the drum is tilted down to gather the seed into a tray.



Dry Dewinger:

Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

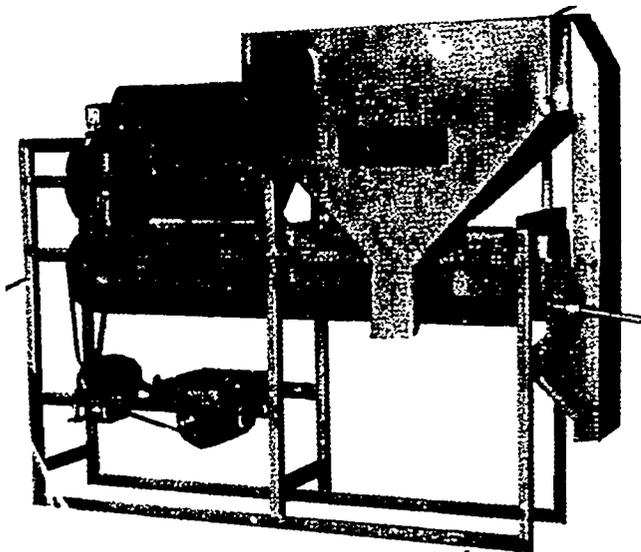
Wet Dewinger:

Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

Crippen Dewinger (Dry and Wet)

In the dry model, a feeding chamber regulates the amount of seed entering the dewinging chamber. The chamber is a cylinder where paddles rotate on a shaft. After sufficient dewinging, the contents enter an aspirator. The airstream lifts out wings and light trash. The seeds then pass through a check chamber where the heavy trash settles out and is discarded. Remaining light trash is blown away by an aspirator fan. A plexiglass cover allows operations to be inspected at all times. The Crippen Dry Dewinger may be used alone or teamed with the Crippen Wet Dewinger. The dry dewinger comes in two models that treat 12- and 2-cubic feet of seeds in each batch. Dewinging seed falls into a container below a discharge chute.

The Crippen Wet Dewinger is composed of five parts. First a feed hopper drops a metered amount of seed onto a conveyor. Then, the seed is fed into a seed weighing chamber. The seed falls onto a weighpan. When a certain amount of seed collects, the weighpan drops the seed into a dewinging chamber. The weighpan movement starts a timer that controls the dewinging time. The timer also triggers a jet that hits the seed as it drops into the dewinging chamber. Paddles churn the seeds while at the same time moving them toward the discharge door. As the dewinged seeds drop into a flute, suction aspirates the wings and light trash.

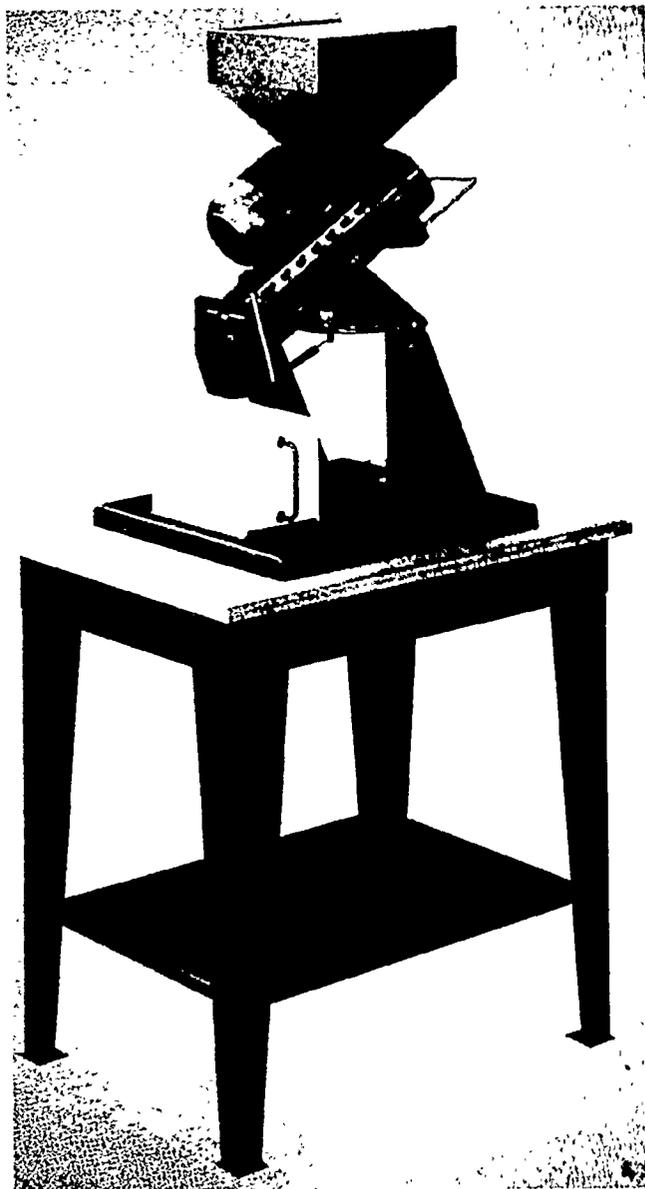


Dewinger:

Crippen Mfg., Co.
700 W End St.
Alma, MI 48801
(517) 463-2119

Kamas Laboratory Dewinger

This dewinger can be used in the laboratory or for small seed lots. It is comprised of a steel cylinder and rotor. A hopper feeds seeds in at the top. A number of fixed pegs on the cylinder wall obstruct the flow from the rotor, which causes a turbulence that dewings the seed.



Dewinger:

Damas A/S
Industrivej 2
Vester Aaby
DK-5600 Faaborg
Danmark

Kamas-Westrup
P.O. Box 27
DK-4200 Slagelse
Denmark
(0) 3 522564

MAT-OSU Laboratory Debearder

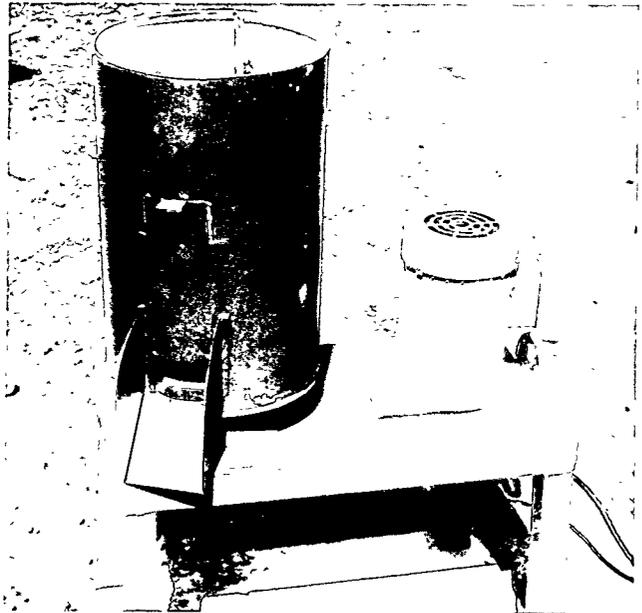
This debearder can be used to dewing small seed lots such as tree improvement seed. It consists of a vibrator feeder and an agitator that rubs seeds against each other and the agitator pods. A variable speed drive gives the agitator infinite speed control from 0 to 100 rpm.



Dybvig Seed Cleaner

The Dybvig Seed Cleaner was originally designed for depulping berry and fruit seeds. It has a hopper, a cleaning plate, an electric motor with "V" belt, and variable speed sheaves. The cleaning plate is adjustable for various sizes of seeds. Seeds rub against each other, which removes the pulp. The addition of a stream of water washes away the pulp.

This machine has been used in dewinging small lots of coniferous seeds. No water is used for dewinging. Care is required to avoid seed damage.



MAT-OSU Debearder:

Mater International, Inc.
101 SW Western Blvd.
Corvallis, Oregon 97333
(503) 753-7335

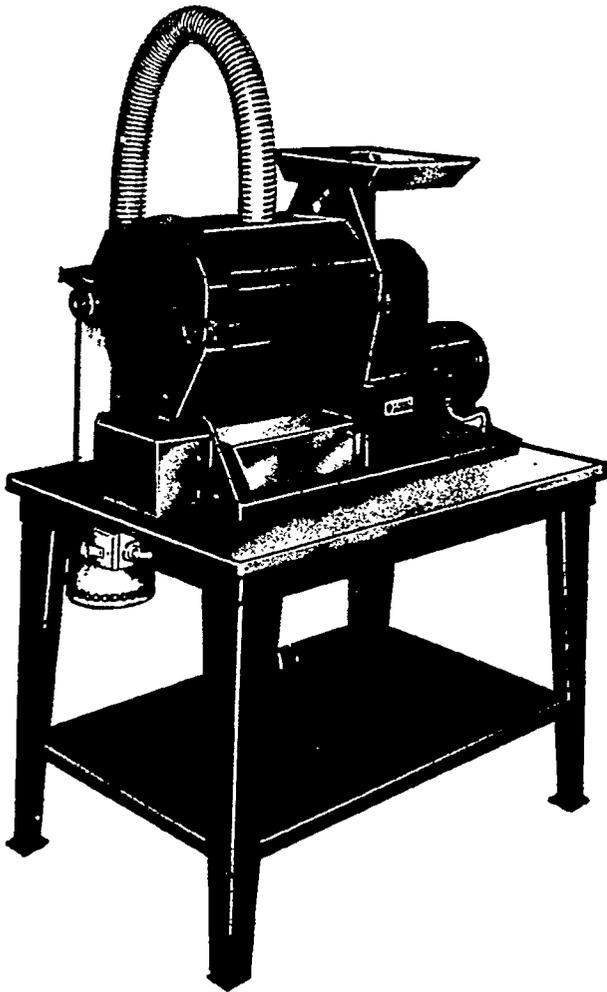
Dybvig Seed Cleaner:

Bouldin-Lawson, Inc.
P.O. Box 208
Rt 10
McMinnville, TN 37110
(615) 668-4090

Melvin R. Dybvig
4025 Rio Vista
Milwaukee, OR 97222
(503) 659-0718

Kamas Dewinger Scarifier

The Kamas Dewinger Scarifier consists of a drum cylinder, brushes mounted on a rotating shaft, a vacuum dust remover, and an electric motor. The wings are removed from seeds by a rubbing action between the brushes and cylinder jacket. Cloth, wire mesh, or perforated steel jackets are available. The brush may be adjusted for different sizes of seeds. The apparatus is readily disassembled.



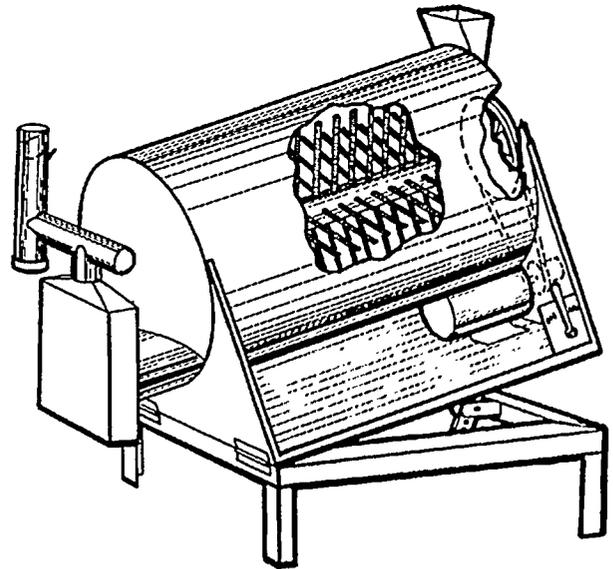
Coeur d'Alene Dewinger

The Coeur d'Alene Dewinger has rubber fingers mounted on a shaft that rotates inside a metal cylinder. The complete apparatus may be tilted. An electric motor with variable speed sheaves is used to provide varying degrees of dewinging action. A vacuum hose may be attached to the discharge end to remove dust. Plans are available from:

USDA Forest Service
Coeur d'Alene Nursery
P.O. Box 245
Coeur d'Alene, Id 83814

or

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801



Dewinger:

Kamas
Kvarnmaskiner AB
Fack S-200 42
Malmo 7, Sweden

2.5 Seed Cleaning



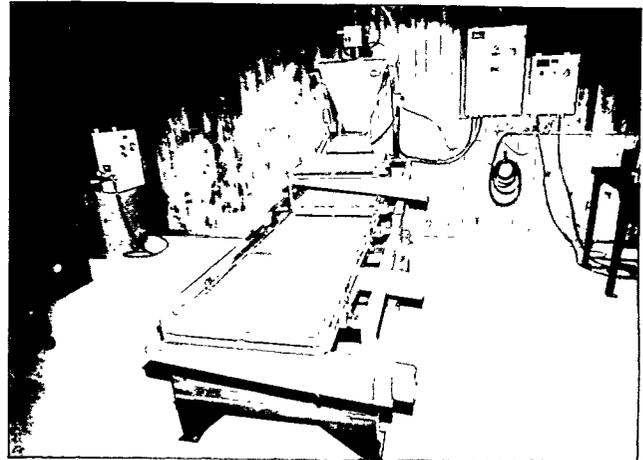
The most common principles of tree seed cleaning are: screening, air separation, and specific gravity separation. These principles are used separately or in combination to separate seed, usually into relatively pure fractions. All equipment in this section is a modification or adaptation of agricultural seed processing equipment.

Screen Separators

Perforated metal screens can be effective in separating seeds by length and width. Each screen has channels or grooves that up-end the seed so it presents itself to the perforation correctly. (See *Air-Screen Separators* in this section.)

International Forest Seed Sizer/Scalper

This unit has numerous screens in different sizes. It comes with a vibratory feeder and control panel.

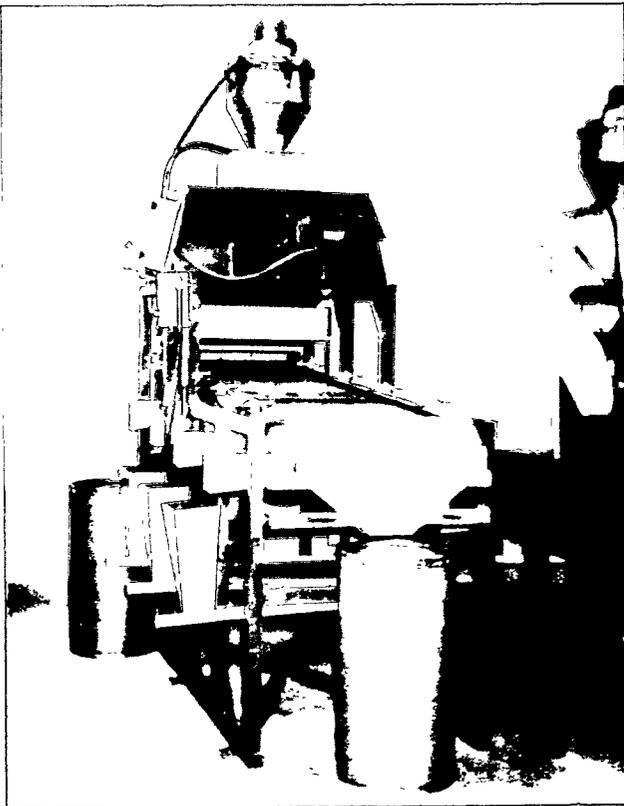


International Forest Seed Sizer/Scalper:

International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5726

Southpine Flat Screen Cleaner/Sizer

The Southpine Flat Screen Cleaner/Sizer is designed for cleaning and sizing forest tree seed. It has five screens and makes six separations. This model can be set up to scalp, or clean, or separate seed into sizes. It can perform any one or all of the operations simultaneously. The cleaner has a variable speed shaker and vibrating ball racks under the screens. The seeds on the screen racks are always visible.

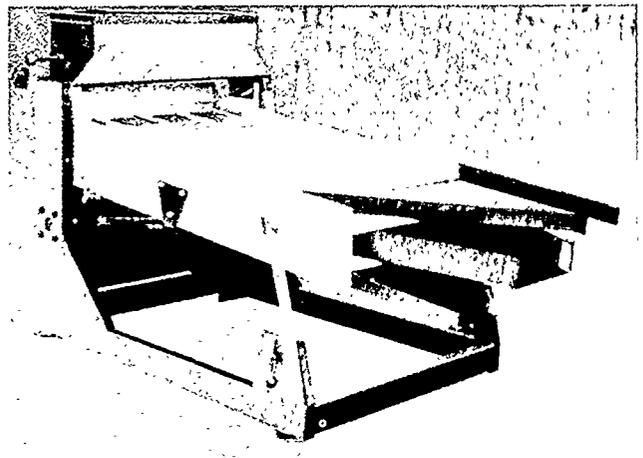


Southpine Cleaner/Sizer:

Southpine, Inc.
P.O. Box 530127
Birmingham, AL 35253
(205) 879-1099

Damas Vibram Solo

This general purpose two-screen cleaner performs small cleaning and grading tasks. It uses aspiration before and after screening. The small machine processes up to 3 tons/hour. The larger model processes up to 5 tons/hour.



Damas Cleaner:

Damas A/S
Industrivej 2
Vester Aaby
DK-5600 Faaborg
Danmark

Air Screen Separators

This type of separator combines the principles of screen and air separation. This combination of principles separates the heavy and fine debris from the seed. The **screen separation** part of the machine separates material based on differences in size and shape. The **air separation** is based upon the terminal velocity difference of material. Manufacturers offer a wide range of screen hole shapes and sizes. This type of equipment was called a fanning mill in the past.

For example, in a two-screen separator, seeds and trash pass over a strong air jet. Fine particles are lifted away. The mixture then passes over the first screen, where the seeds and any remaining light debris drop through the holes. The large and long trash is not able to enter the holes and is discharged. The seeds are retained by the second screen, but the light debris falls through and is lifted away by a jet of air. The seeds will pass through one more air separation to insure all light trash has been removed. Many separators use vibrating ball racks to keep screens clear.

Air screen cleaners are available in a range of sizes and vary from small two-screen models to large eight-screen models with four air separations.

