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Department of
Agriculture

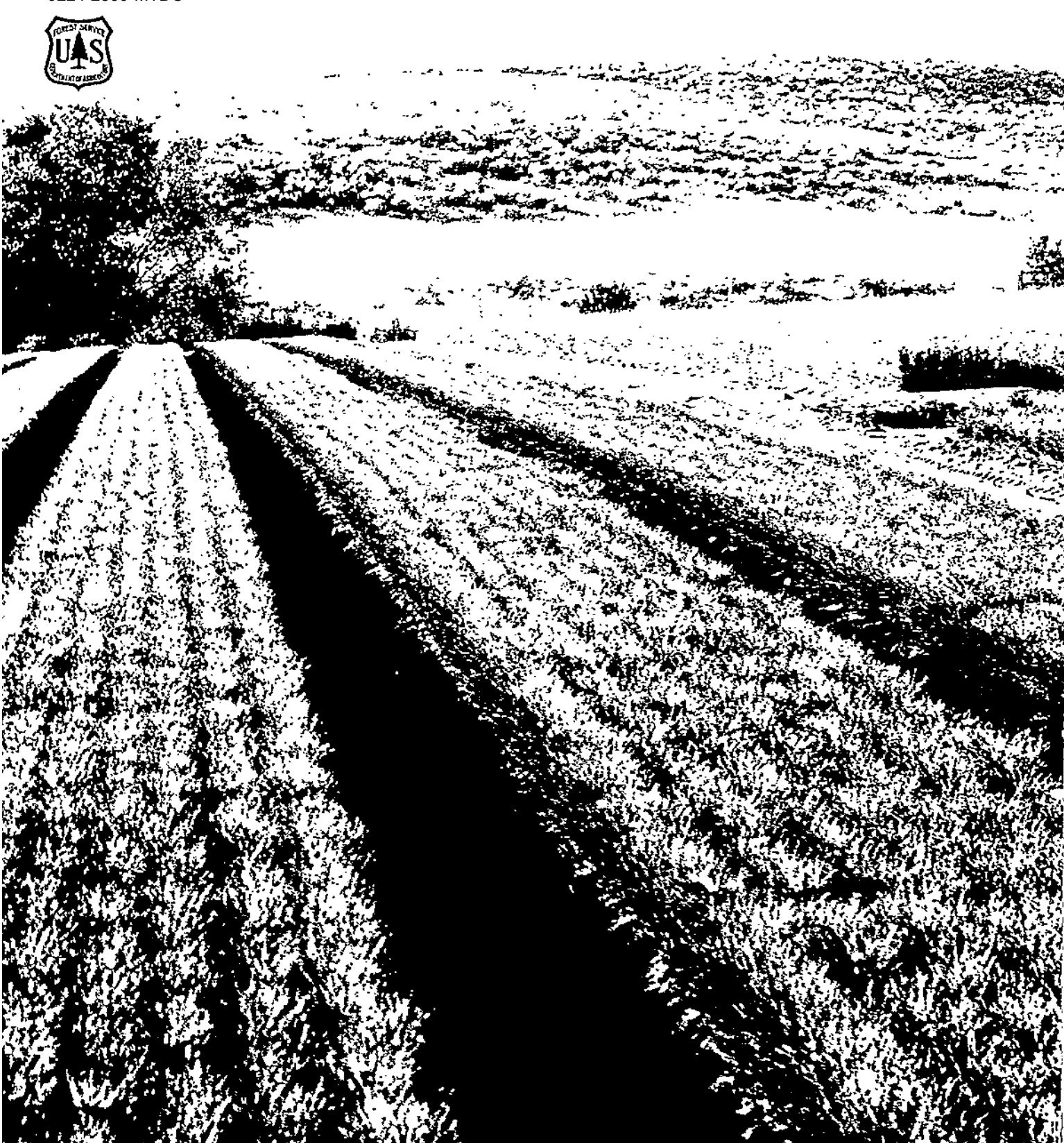
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Development
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Bareroot Nursery Equipment Catalog



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Abstract

The *Bareroot Nursery Equipment Catalog* contains information about equipment and supplies needed to collect and process seed and grow seedlings in a bareroot nursery. It is organized into eight chapters that present basic concepts and terminology, followed by a description of the types of equipment that are commercially available and a listing of suppliers. Numerous photographs and technical drawings illustrate the various pieces of equipment and their accessories.

Bareroot Nursery Equipment Catalog



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TE02E12
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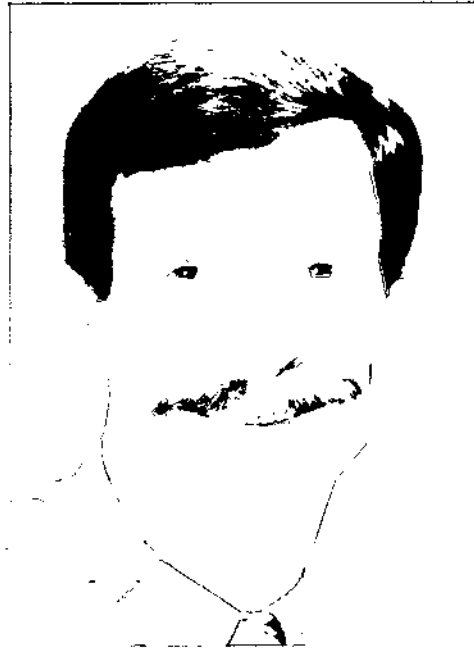
September 1992

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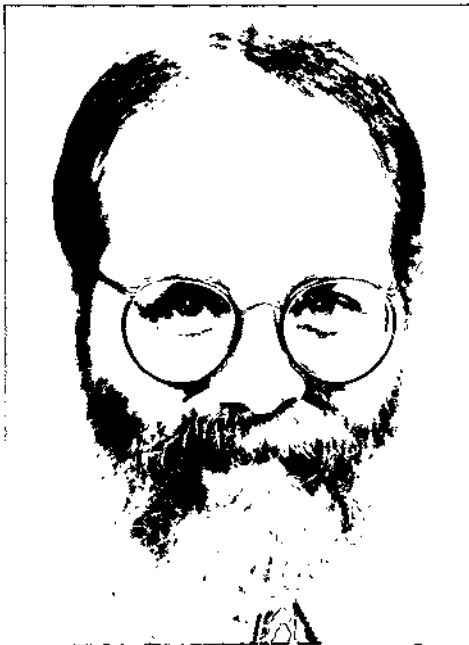
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Introduction

Growing bareroot seedlings is a highly technical enterprise that requires a wide variety of sophisticated and specialized equipment. Staying abreast of the many developments in equipment is difficult for nursery managers. This catalog was developed to help meet this need. The *Bareroot Nursery Equipment Catalog* contains information about equipment and supplies needed to collect and process seed and grow seedlings in a bareroot nursery. It is organized into eight chapters that present basic concepts and terminology, followed by a description of the types of equipment that are commercially available and a listing of suppliers. Numerous photographs and technical drawings illustrate the various pieces of equipment and their accessories.

The *Bareroot Nursery Equipment Catalog* replaces the original Missoula Technology and Development Center (MTDC) *Nursery Equipment Catalog*, which was written by Ben J. Lowman and Jan McLaren in 1976. Information on equipment is quickly outdated, so this book will be revised in a few years. If you note mistakes or omissions, please contact the senior author.

1.0 Cone Harvesting



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Cones are collected for their seed, which is both fragile and perishable. Therefore, cone harvesting must be carefully planned and executed to insure high quality seed. Harvesting methods generally are dictated by tree species, terrain, and timing. During the entire harvesting process, it is imperative to insure that individual seed lots are properly identified.

Several methods are used for cone harvesting. Cones may be gathered manually or with cone collection equipment after they have fallen or have been dislodged from trees and before the cones have opened. Cones may be dislodged with poles, pole saws, hooks, and tree shakers. Catching frames may be used to facilitate cone gathering.

Cones may be picked directly from the tree. Tree climbing equipment such as climbing irons (spurs), ladders, and tree bicycles are commonly used. Lifting devices such as mobile aerial towers and ladders are also used when economically and physically expedient.

Trees may be felled and the cones gathered manually. Seeds that have already dispersed from the trees may be gathered directly from the ground with a vacuum seed harvester or with a net retrieval system. These specialized methods are used in seed orchards on certain species.

Once harvested, cones must be treated carefully. The main consideration during cone handling and storage is to insure that cones do not become over-heated. Cones should be placed in porous sacks or other containers that leave enough room for expansion. A good rule of thumb is to only place 1 bushel of cones in a 2-bushel capacity sack. The use of forklifts or conveyers speeds up the handling process at the extractory.

Loose cones or sacks of cones are usually stored on trays or racks, both before and after delivery to an extractory. Cones should be kept cool and dry with ample air movement; if cones are stored in a poorly ventilated area, the use of fans to expedite air movement is recommended. The main consideration is to insure that cones do not heat. Cones that are moist provide an ideal environment for damaging mold. So, cool, dry, well-ventilated storage is essential.

1.1 Cone Collection



Manual cone collection generally requires the collector to get up to the top one third of the crown of the tree. This may be done with a variety of devices— ladders, tree grippers, and various types of tree climbing gear. Once in the tree top, the collectors will need equipment such as poles, polesaws, and hooks to safely assist in the removal of the cones from the tree.

On relatively flat ground and in seed orchards, aerial lifting equipment is often utilized. Ground collection systems are also used in seed orchard collection schemes.

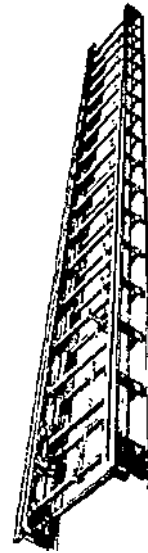
Climbing Equipment

Climbing equipment is used by individuals to scale trees and pick cones. The equipment includes ladders, grippers, steps, irons, and various other support systems. Poles, saws, and hooks are carried by climbers to dislodge cones. Climbing equipment is most frequently used in wildland seed harvesting.

Ladders

Both one-piece and extension ladders may be used in harvesting cones. Some ladders have siderails and top shelves, others can be converted from a one-piece to an extension ladder. Ladders are generally made of aluminum or a lightweight alloy. Weight-to-height ratios limit their use to short trees.

Ladders are locally available at hardware and paint stores or can be ordered from general forestry suppliers.



Ladders:

Aluminum Ladder Co.
P.O. Box 5329, Dept. LS
Florence, SC 29502
(803) 662-2595

A.M. Leonard, Inc.
P.O. Box 816
6665 Spiker Rd.
Piqua, OH 45356-0816
(513) 773-2694

Bishop Ladder Co., Inc.
1400 Park St.
Hartford, CT 06106
(203) 951-3246

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

Louisville Ladder Co.
1163 Algonquin Parkway
Louisville, KY 40208
(502) 636-2811

Patent Scaffolding Co.
One Bridge Plaza
Dept. TR
Fort Lee, NJ 07024
(201) 461-8700

R.D. Werner Co., Inc.
P. O. Box 580
Greenville, PA 16125
(412) 588-8600

Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

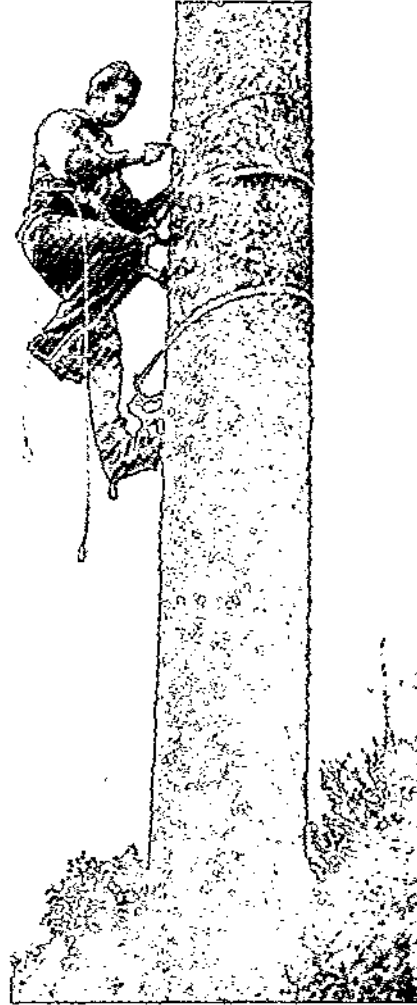
Tree Climbing Ladders

Sectional tree climbing ladders consist of 10-foot aluminum ladder sections that lock together and are chained against the tree. Any heights may be climbed if enough ladder sections are available. Sections shorter or longer than the standard 10-foot sections can be custom made.



Swiss Tree Grippers (Tree Bicycles)

A tree bicycle (Swiss tree gripper) is an apparatus that allows a climber to walk up or down a tree with both hands free. It consists of a foot pad, stirrups, and steel bands that wrap around a tree and it is effective for climbing trees up to 26 inches in diameter. The bicycle may be removed while the climber is in the tree and is effective in all terrain.



Tree Climbing Ladders:

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

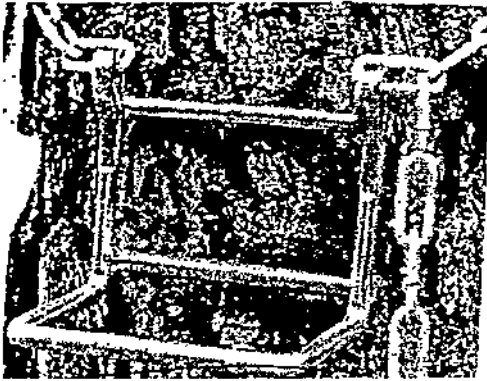
Swiss Tree Grippers:

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

Tree Steps

Individual steps may be chained to a tree without damaging the bark. The first step is placed 6 feet from the ground, with successive steps placed 2 feet apart. Steps are tested at more than 1,000 lbs, with a load rating of 440 lbs. A safety belt should be used with the steps.



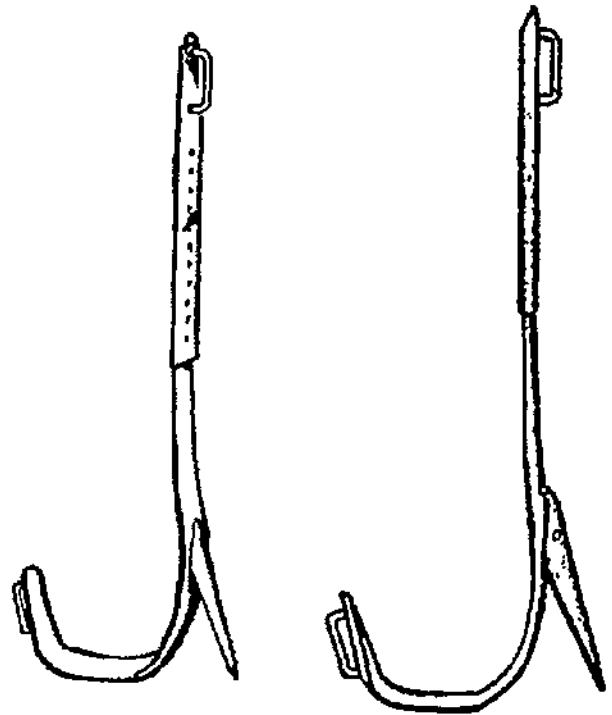
Tree Steps:

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

General Supply Corp.
P.O. Box 9347
303 Commerce Park Dr.
Jackson, MS 39286-9347
(601) 981-3882

Tree Climbing Irons

Tree climbing irons (spurs) are metal stirrups welded to gaffs, long enough for a secure grip in the bark, without causing excessive bark damage. Gaffs 1 to 3 inches long are available for rough bark. The length of leg shanks is adjustable for fit, from 15 inches to 19 inches. Leather harnesses circle the leg at the ankle and leg, with leg padding available on special order. Trees of all sizes in all types of terrain may be scaled with climbing irons. A belt with safety straps is recommended.



Tree Climbing Irons:

Bartlett Mfg. Co.
3003 E Grand Blvd.
Detroit, MI 48202
(313) 873-7300

A.M. Leonard, Inc.
P.O. Box 816
6665 Spiker Rd.
Piqua, OH 45356-0816
(513) 773-2694

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Nasco
901 Janesville Ave.
Fort Atkinson, WI 58538
(414) 563-2446

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

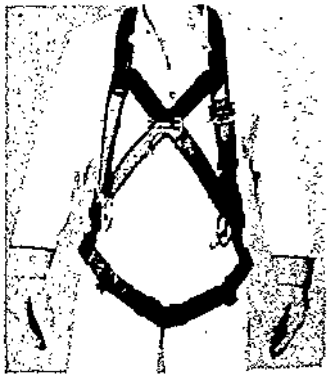
Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Tree Climbing Support

Safety saddles for climbing consist of belts of strong cotton or nylon strapping, normally 1-3/4 to 3 inches wide, with some belts up to 5 inches wide. The belts are reinforced with web padding or leather straps. For support, "D" rings are attached to the belt. Two "D" rings allow suspension by an overhead line, while four rings allow an additional safety strap around a tree. These are useful when topping trees or finding temporary anchorage. The "D" rings are made of drop-forged steel. Most belts provide a positioning belt (slope belt) for support, while others use leg loops. For extra support, some belts have both. Some saddles also have extra-wide belts for back support. Belts are fastened with tongue buckles that have holes reinforced with brass grommets. Some belts come with a tool belt snap and "O" rings for tools. Saddles come in small, medium, and large. Whole or partial-body harnesses are attached to the overhead line by back waist "D" rings.

Belts are similar to saddle belts in construction and width. Belts have two "O" rings for support.

Nylon suspension ropes with snap-hooks are available. Lanyards are available in 6-foot lengths.



Sky Genie Tree Climber System

This integrated system is used for precision-controlled descent needed when working away from the tree's bole. The climber controls descent by providing friction to the mechanism. The unit comes with nylon line and permanent loops, descent control mechanism, tree climber harness, one crotch lanyard, one snap ring, and carrying case with instructions. Kits are available for trees from 75 feet to 175 feet.



Tree Climbing Support:

Bartlett Mfg. Co.
3003 E Grand Blvd.
Detroit, MI 48202
(313) 873-7300

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

A.M. Leonard, Inc.
P.O. Box 816
6665 Spiker Rd.
Piqua, OH 45356-0816
(513) 773-2694

Sanderson Safety Supply Co.
800 SE Hawthorne Blvd.
Portland, OR 97214
(503) 238-5700

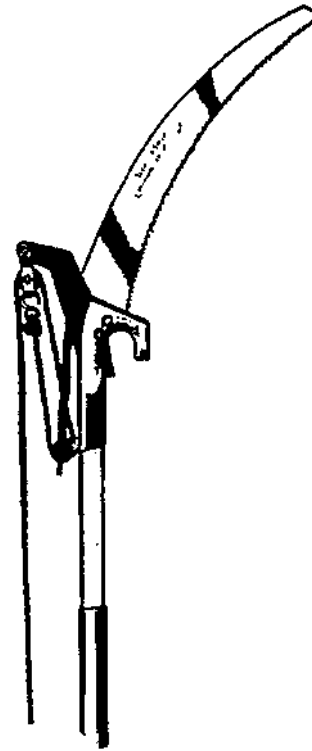
Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Sky Genie Tree Climber System:

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

Poles, Pole Saws, and Hooks

Lightweight, rigid poles with pruners, saws, or hooks may be used to dislodge cones from trees. Most poles are made of aluminum, plastic, fiberglass, or lightweight alloy. They are available in many lengths, but are difficult to use on tall trees and fatiguing to use for extended periods.



<p>Poles, Pole Saws, and Hooks:</p>	<p>Corona Clipper Co. P.O. Box 1388 1540 E Sixth St. Corona, CA 91718-1388 (714) 737-6515</p>	<p>Hickok, Inc. P.O. Box 2091 Wenatchee, WA 98807 (509) 662-6065</p>	<p>Stanley Hydraulic Tools 3810 SE Naef Rd. Milwaukee, OR 97222 (503) 659-5660</p>
<p>American Standard Co. P.O. Box 325 Plantsville, CT 06479 (203) 628-9643</p>	<p>Fairmont Hydraulics 415 N Main Fairmont, MN 56031 (507) 238-4357</p>	<p>Lannen Tehtaat Oy Plant Systems Div. SF-27820 Iso-Vimma (Sakyla) Finland (938) 70-300</p>	<p>Timm Enterprises, Ltd. P.O. Box 157 5204 Trafalgar Rd. Oakville, Ontario, Canada L6J 4Z5 (416) 878-4244</p>
<p>Azel Corp. 2121 S. Susan St. E Santa Anna, CA 92704 (714) 557-6426</p>	<p>Forestry Suppliers, Inc. P.O. Box 8397 205 W Rankin St. Jackson, MS 39284-8397 (800) 647-5368</p>	<p>Nasco 901 Janesville Ave. Ft. Atkinson, WI 58538 (414) 563-2446</p>	<p>True Temper Hardware Div. Emhart Consumer Group P.O. Box 3500 465 Railroad Ave. Shiremanstown, PA 17011</p>
<p>Bartlett Mfg. Co. 3005-T E Grand Blvd. Detroit, MI 48202 (313) 873-7300</p>	<p>General Supply Corp. P.O. Box 9347 303 Commerce Park Dr. Jackson, MS 39286-9347 (601) 981-3382</p>	<p>Porter-Ferguson, Inc. 321 Newbury St. Danvers, MA 01923 (508) 774-1629</p>	<p>Uittokalusto Oy Fredrikinkatu 61, PL 455 00101 Helsinki, Finland (90) 694-2400</p>
<p>Ben Meadows Co. P.O. Box 80549 Atlanta (Chamblee), GA 30366 (800) 241-6401</p>	<p>Gilmour American Std. Co. P.O. Box 325 Plantsville, CT 06479 (203) 628-9643</p>	<p>Sauze Technical Products Corp. 212 Oak St. Ext. Plattsburgh, NY 12901 (518) 561-6440</p>	<p>Zip-Penn P.O. Box 1779 2008 E 33rd St. Erie, PA 16512 (814) 898-2008</p>
<p>Canadian Forestry Equipment, Ltd. 90 E. Boul. Brunswick Blvd. D.D.O., Quebec Canada H9B 2T5 (403) 484-2447</p>	<p>Gilmour American Std. Co. P.O. Box 325 Plantsville, CT 06479 (203) 628-9643</p>	<p>Seymour Smith & Son, Inc. 900 Main St. Oakville, CT 06779 (203) 274-2558</p>	<p>Zip-Penn P.O. Box 1779 2008 E 33rd St. Erie, PA 16512 (814) 898-2008</p>

Collection Equipment

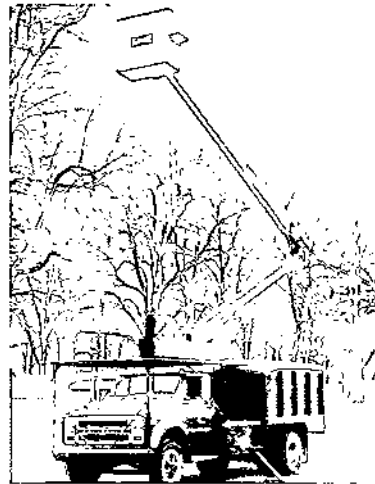
Mechanical systems such as aerial lifts, seed tree shakers, nut harvesters, and cone rakes are also used extensively to collect tree seed. These systems are normally used on easy terrain such as seed orchards.



Mobile Aerial Lifts

Aerial lifts provide flexibility in cone harvesting or pruning on fairly level ground. An operator in the basket controls the movement. Baskets can be ordered to hold one or more operators and some baskets are insulated against electric shock. Controls are protected from accidental activation. Hydraulic outlets allow pruning loppers, chain saws, or other tools to be used on some lifts and a wide variety of hydraulic attachments are available.

Large aerial lifts are generally designed for utility work. They are mounted on trailers or trucks. Booms can rotate 360 degrees and working height ranges from 35 to 85 feet. Manufacturers offer a wide selection of models and accessories. Foot controls are offered on some models. Attachable bags can hold harvested cones, which an operator can then dump into a bin carried on the trailer.



Aerial Lifts:

Edwards Equipment Co.
4312 Main St.
Yakima, WA 98903
(509) 248-1770

Elliot Equipment Corp.
2600 Florence Blvd.
Omaha, NE 68110
(402) 341-1004

Fairmont Hydraulics
415 N Main
Fairmont, MN 56031
(507) 238-4357

Friday Tractor Co., Inc.
69226 CR 687
Hartford, MI 49057
(616) 621-3318

Gilmour
American Standard Co.
P.O. Box 325
Plantsville, CT 06479
(203) 628-9643

Hickok, Inc.
P.O. Box 2091
Wenatchee, WA 98807
(509) 662-6065

Porter-Ferguson, Inc.
321 Newbury St.
Danvers, MA 01923
(508) 774-1629

H.C. Ranger, Inc.
P.O. Box 177
NW 22610 Bluemound Rd.
Waukesha, WI 53187-0177
(414) 547-1000

Reynolds Televator Corp.
1005 W Laketon Ave.
Muskegon, MI 49441
(616) 722-3698

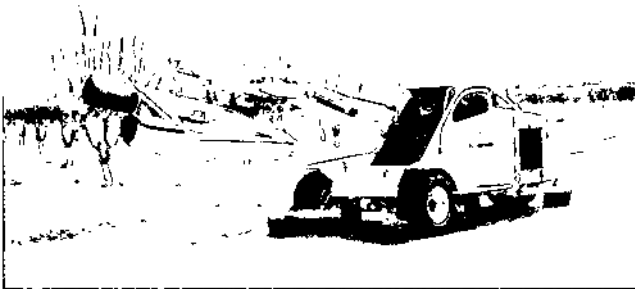
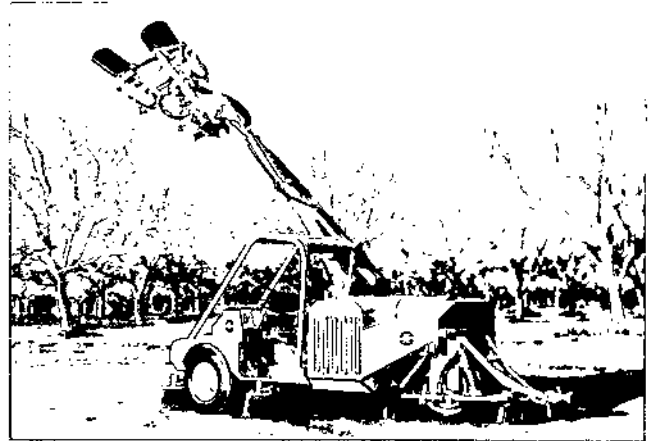
Snorkel Economy
P.O. Box 65
Stockyards Station
St. Joseph, MO 64504
(913) 989-4481

Tree Shakers

Tree shakers can collect cones quickly in areas accessible to vehicles and can operate on trucks up to 30 inches in diameter. If the bole is too large, the shaker can shake limbs. Cones on the ground are picked up by hand or some other means. The shaker boom reaches up to 18 feet, with some manufacturers providing booms to 21 feet on request. The boom is operated by a single control. Operators can choose between 3- and 4-wheel models. For uneven terrain, 4-wheel models are recommended.

During operation, the hydraulic boom lifts the shaker head to the correct height. To grasp the bole, the boom can rotate to the side or can tilt up or down. The shaker head grasps the tree firmly and pads on the shaker head prevent slippage or damage to bark. Some manufacturers, like Orchard Machine Corporation, make heads that shake the tree in specific patterns. Forest Service tests have found the shakers to work best by grasping the trunk high, starting to shake slowly, and then increasing shaking intensity to a sharp burst at the end.

A modified shaker for use in wildlands was developed by the Missoula Technology and Development Center. A complete description of the project can be found in the report *Wildland Cone and Seed Harvesting: Road Side Shakers*, April 1987, USDA Forest Service, Missoula Technology and Development Center, Building 1, Fort Missoula, Missoula, MT 59801, (406) 329-3900.



Tree Shakers:

Albany Tractor Co.
1709A S Stappey Blvd.
Albany, GA 31701
(912) 432-7468

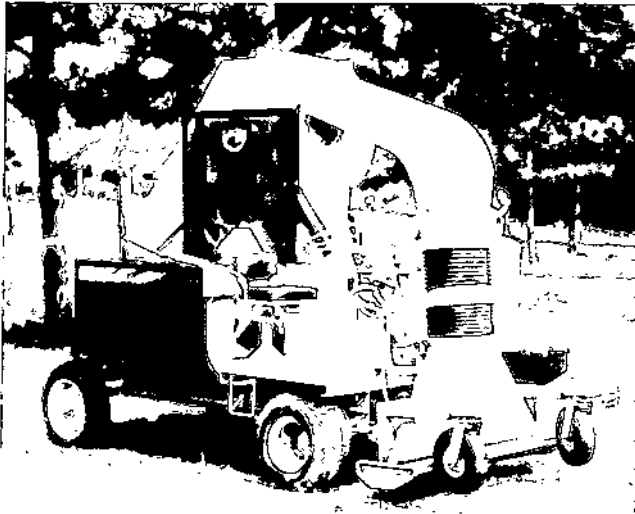
Northern Michigan Equipment Co.
P.O. Box 1270
Traverse City, MI 49685
(616) 943-3700

E.D. Kilby Mfg., Co.
286 W Evans-Reimer Rd.
Gridley, CA 95948
(916) 846-5625

Orchard Machinery Corp.
2700 Colusa Highway
Yuba City, CA 95991
(916) 673-2822

Vacuum Seed Collector

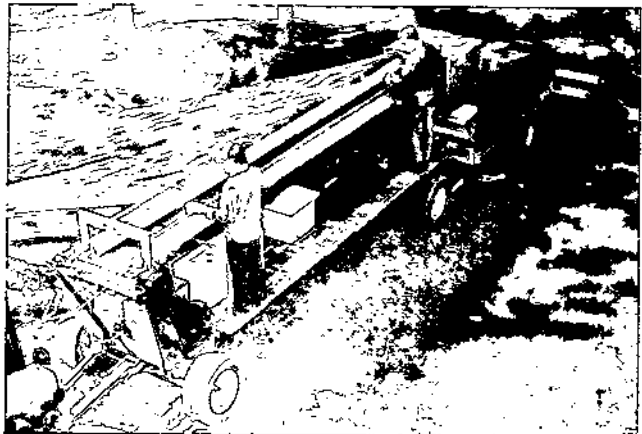
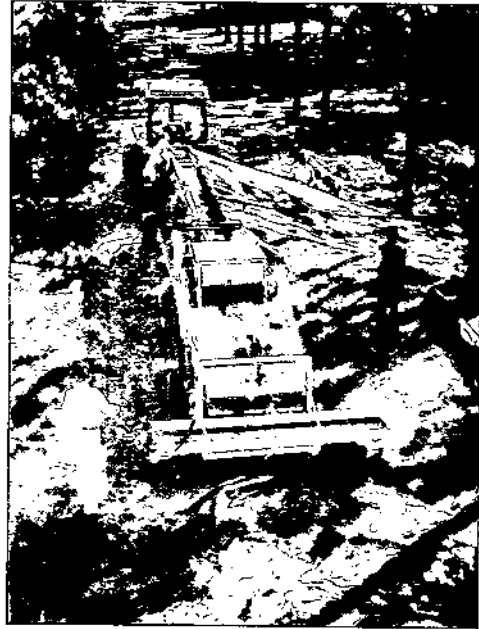
A vacuum seed collector was used in seed orchards in the South to collect Loblolly seeds. This vacuum seed collector was developed by Bowie Industries of Texas for the North Carolina State Industry Tree Improvement Cooperative. This machine has a large vacuum head that sucks up pine straw, fine dust, and seeds and drops this material into a separator system. The separator separates the tree seed and seed-sized material from the pine straw and pine dust.



Orchard Seed Harvester

A net retrieval system for retrieving plastic netting from seed orchard floors after seeds fall and separating the seeds from the majority of the pine straw and trash was developed by MTDC engineers. This system has been used very successfully in Loblolly pine seed orchards in the southern United States.

Although, at the present time, there is no commercial source for this equipment, drawings are available. With these drawings, a local job shop can custom-build this equipment. Request drawing number MTDC-851, Orchard Seed Harvester from the Missoula Technology and Development Center, Building 1, Fort Missoula, Missoula, MT 59801.

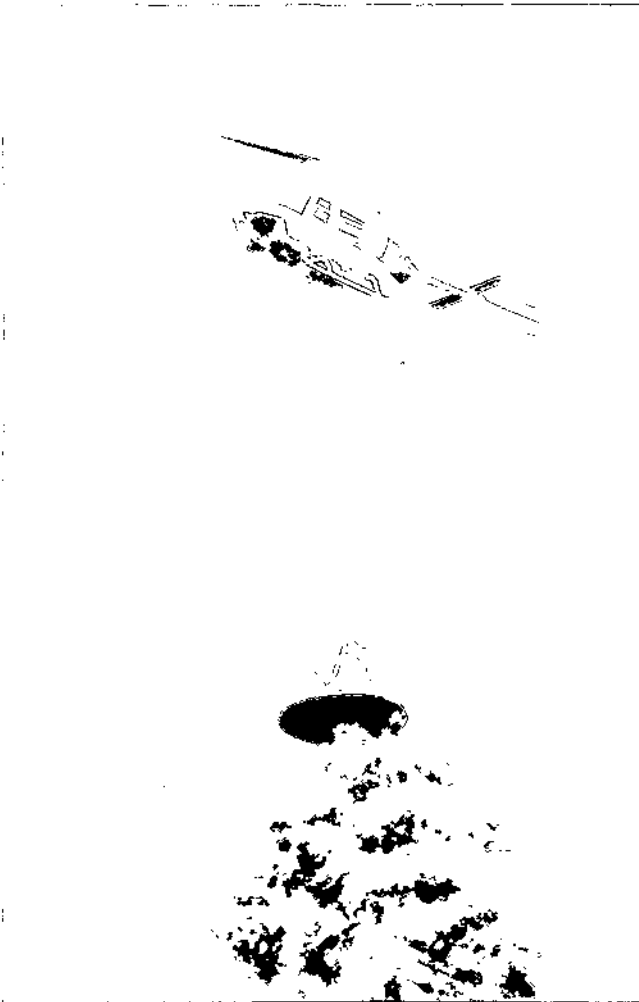


Vacuum Seed Collector:

Bowie Industries, Inc.
P.O. Box 931-T
Bowie, Texas 76230
(817) 872-1108

Cone Rakes

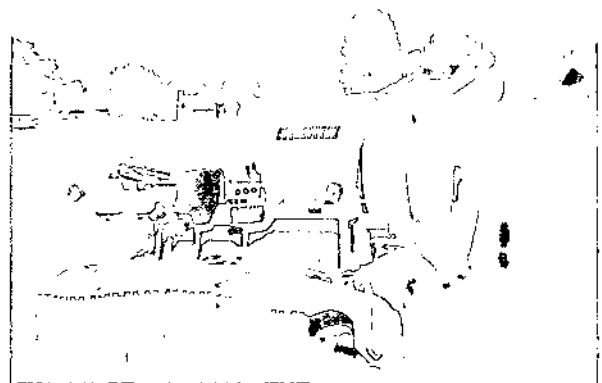
Cones may also be gathered with cone rakes. These are circular devices that are suspended from helicopters, lowered onto trees, then raised. These devices dislodge the cones, which fall to the ground to be collected by hand. They were originally developed in British Columbia. Currently, they are being used on the West Coast of the United States. Several helicopter companies contract this service. Contact Dick Hallman, Missoula Technology and Development Center, Building 1, Fort Missoula, Missoula, MT (406) 329-3946, for more information.



Nut Harvesters

Nut harvesters have been adapted to the problems of collecting cones in tree orchards. This equipment gathers large numbers of cones in a short time, but is limited to use in cultivated tree orchards. Most nut harvesters consist of a paddle wheel in the pickup head, conveyors, air-stream cleaning devices, and a cone container. Sticks and heavy objects are not removed.

Equipment efficiency is improved by mowing the grass in the orchard a few days before harvest so that cones aren't hidden. Then the cone harvester is driven around the trees in a spiral pattern. The pickup head floats to small contour changes, but will not collect cones in depressions. The remaining cones are picked up by hand. One manufacturer reported that their harvester picked up to 20 bushels of Loblolly cones in 25 minutes.



Nut Harvesters:

Flory Industries
P.O. Box 908
4737 Tomes Rd.
Salida, CA 95368
(209) 545-1167

Ramacher Mfg., Co.
P.O. Box 506
Linden, CA 95236
(209) 887-3815

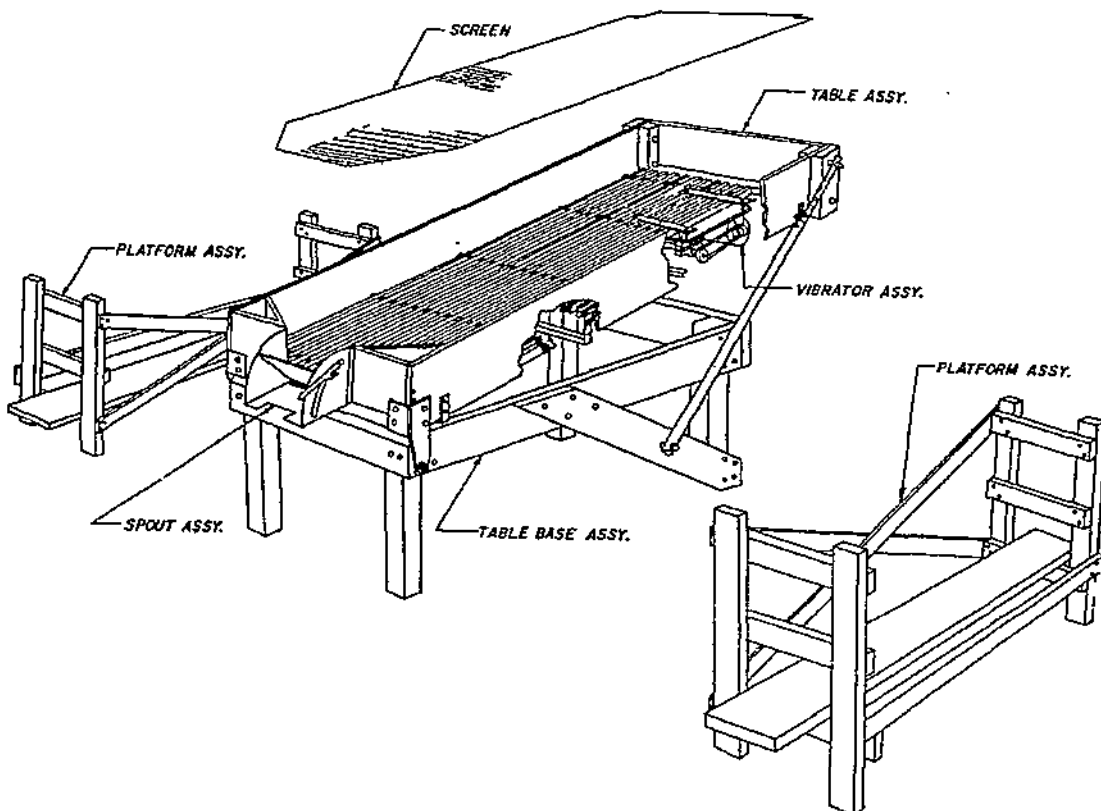
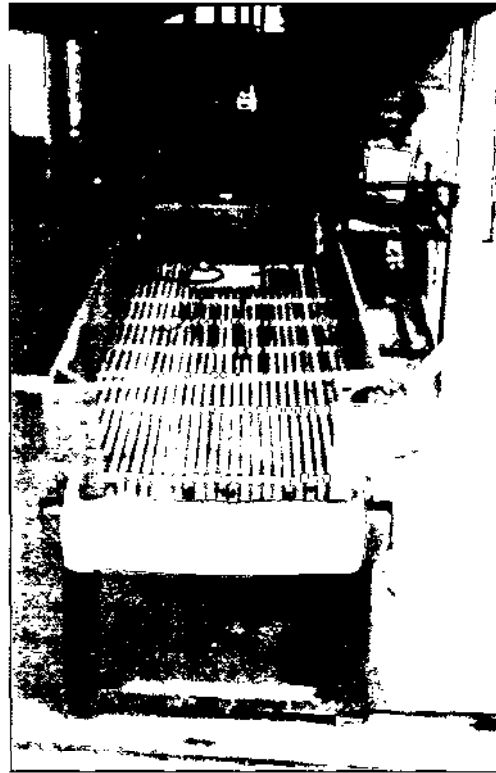
Weiss-McNair, Inc.
531 Country Dr.
Chico, CA 95926
(916) 891-6214

Cone Inspection Table

Drawings are available upon request to construct an inexpensive table used to inspect and clean cones as they are received at collection points. Two or three people are required for efficient operation. One person dumps the cones onto the table; a second person examines the cones and removes any litter too large to go through the slats; and a third person measures and sacks the cones.

Request Drawing No. MEDC- 303 from:

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



1.2 Cone Handling and Storage



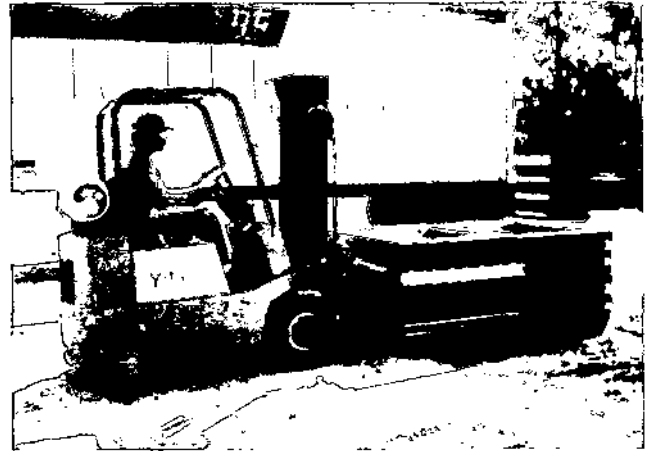
Careful handling and storage of cones is critical to obtain high quality seed.

Conveyors must be selected so the cones or seeds are not damaged. During storage, cones need large amounts of air circulation and cool, dry conditions. Cones are generally stored for brief periods of time prior to the extraction process because of the volume of cones delivered to seed extractories. While cones are in interim storage, further maturing of the seed often occurs. Cones are most vulnerable to overheating and mold during this storage period.

Trays or sacks in combination with racks are best utilized to prevent mold formation because they allow the cones to be spread out and allow air to circulate around and through the cones. Wire bins function in much the same way.

Cone Trays

Some nurseries store cones on trays that are commercially available or trays can be made to order. Most trays are manufactured from wood, metal, polyethylene, fiberglass, or cellulose fiber and are available in a range of sizes.



Cone Trays:

C.R. Daniels, Inc.
3451 Ellicott Ctr. Dr.
Ellicott City, MD 21043-4191
(301) 461-2100

Flexcon Products Corp.
673-T Morris Ave.
Springfield, NJ 07081
(201) 467-3323

T.R. Miller Mill Co.
P.O. Box 708
Brewton, AL 36427
(205) 867-4331

NVF Co.
P.O. Box 68-T
Haley Dr.
Yorklyn, DE 19736
(302) 239-5281

Panel Controls Corp.
1000 Mt. Elliott Ave.
Detroit, MI 48207
(313) 568-2400

Plastech International, Inc.
P.O. Box C-5050
John Fitch Industrial Park
Warminster, PA 18974
(215) 441-5200

Regal Plastic Co.
440 E 11th St.
Kansas City, MO 64127
(816) 483-3040

Snow Corp.
P.O. Box 12067
4350 McKinley St.
Omaha, NE 68112
(402) 453-2200

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

Toteline
Molded Fiberglass Tray Co.
1000 E Erie St.
Linesville, PA 16424
(814) 683-4500

Tri-State, Inc.
P.O. Box 337
505 Fourth St.
Henderson, KY 42420-0337
(502) 826-8361

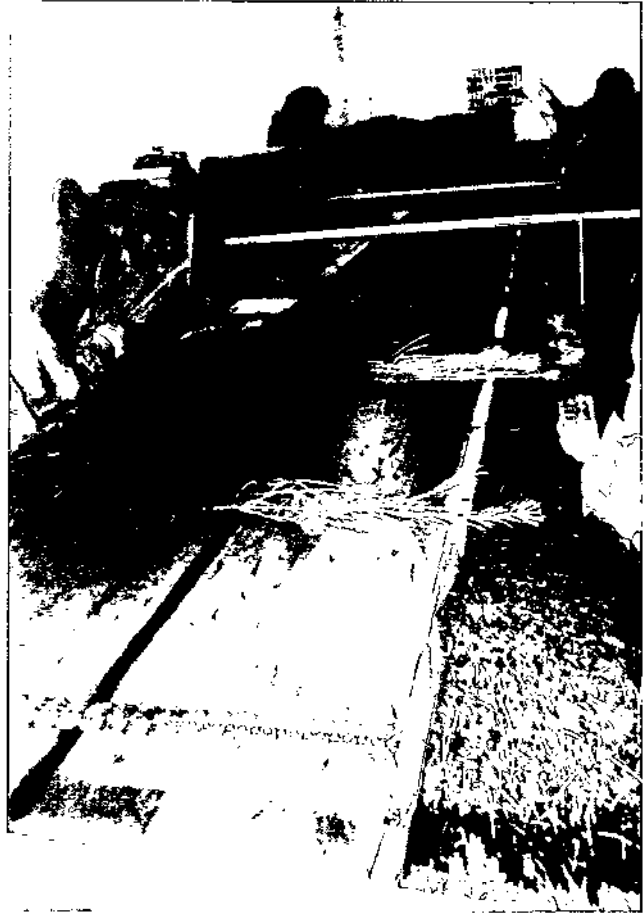
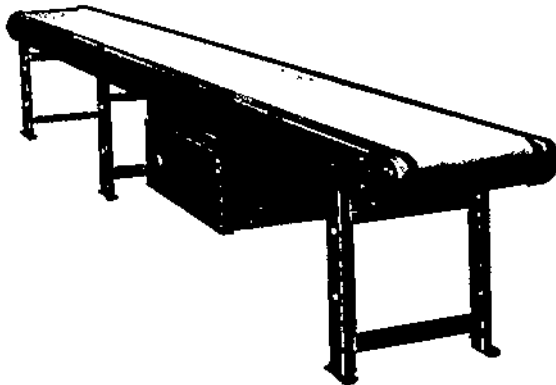
Conveyors

Conveyors are used in the nursery for moving loose cones and seedlings as well as containers. Many nurseries use them when grading seedlings. Manufacturers will help nurseries design conveyor systems with the correct size and speed.

Conveyors come in various types, including belt, roller, chain, bucket, and vibratory. They can be obtained in different lengths or widths and can be designed with curves, spirals, angles, and can be built vertically like an elevator.

Belt conveyors are generally powered by electric motors. Some conveyors are built expressly for loose material with walled sides and dividers on the belt to prevent material from rolling backwards. Portable conveyors can be used in the field. Some conveyors are enclosed for dust control. Screw

conveyors with covers are used to transport free-flowing bulk materials. Belts may be treated to resist water, chemicals, and fertilizers. Belt surface friction can be selected to provide a smoother flow of materials.



Conveyors:

AAR Brooks and Perkins
Handling Technology Div.
P.O. Box 1227
Aberdeen, NC 28315
(919) 944-2167

Ace Supply, Inc.
P.O. Box 1098
315 N Kit Ave.
Caldwell, ID 83606-1098
(208) 459-0731

AEC Machinery, Ltd.
143 Brockley Dr.
Hamilton, Ontario
Canada L&E 3C4

Aeroil Products Co., Inc.
Wesley St.
South Hackensack, NJ 07606
(201) 343-5200

Andec Corp.
2310 E Logan St.
Decatur, IL 62526
(217) 428-4365

Baker Material Handling Corp.
P.O. Box 2400
2450 W 5th North St.
Summerville, SC 29484
(803) 875-8000

Bulk Handling Sys., Inc.
1040 Arrowsmith
Eugene, OR 97402
(503) 485-0999

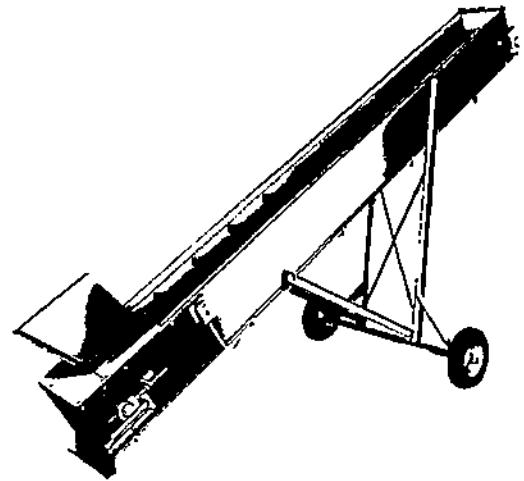
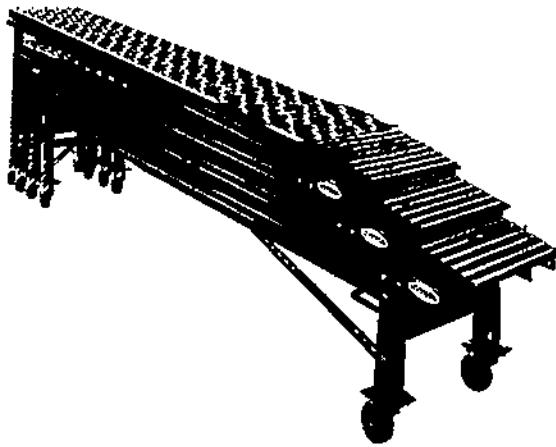
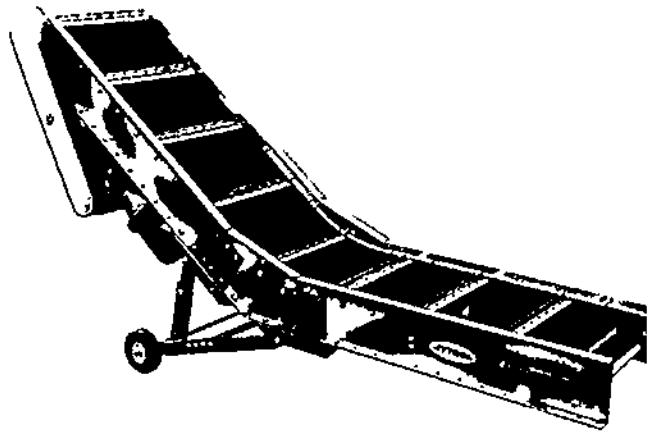
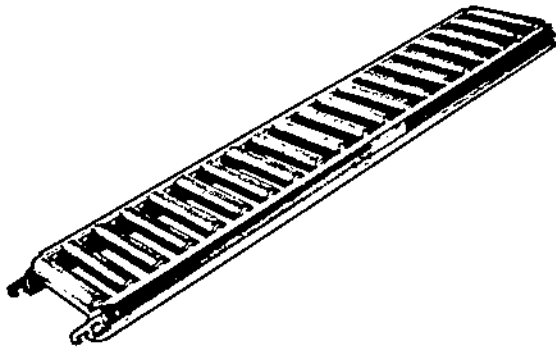
Canadian Forestry Equipment, Ltd.
90 E. Boul., Brunswick Blvd.
D.D.O., Quebec
Canada H9B 2T5
(403) 484-2447

Conveyor Matic, Inc.
31475 Utica Rd.
Fraser, MI 48026
(313) 296-0200

Conveyor Systems, Inc.
6453 Main St.
Morton Grove, IL 60053
(312) 966-7700

Conveyors, Inc.
2735 S Highway 55
Eagan, MN 55121
(612) 456-9225

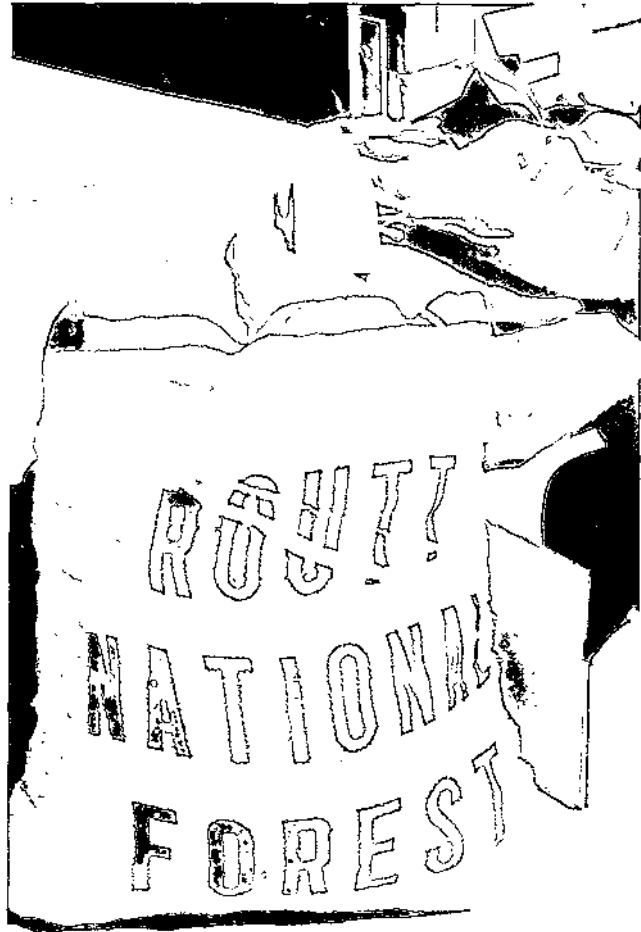
Corn States Metal Fabricators, Inc.
P.O. Box 65635
1323-T Maple St.
West Des Moines, IA 50265
(515) 225-7961



<p>Conveyors:</p> <p>H.D. Davis Sons Mfg. Co., Inc. P.O. Box 395 Bonner Springs, KS 66012 (913) 422-3000</p> <p>The Duplex Mill & Mfg. Co. P.O. Box 1266 415 Sigler St. Springfield, OH 45501 (513) 325-5555</p> <p>Forsbergs, Inc. P.O. Box 510 Thief River Falls, MN 56701 (218) 681-1927</p> <p>General Kinematics Corp. 777 Lake Zurich Rd. Barrington, IL 60010 (312) 381-2240</p>	<p>Hohl Machine and Conveyor Co. 1580 Niagara St. Buffalo, NY 14213 (716) 882-7210</p> <p>S. Howes Co., Inc. 1974 Miller St. Silver Creek, NY 14136 (716) 934-2611</p> <p>Hytrol Conveyor Co., Inc. 2020 Hytrol Dr. Jonesboro, AR 72401 (501) 935-3700</p> <p>Litton Industrial Automation Unit Handling Systems Litton Lane Hebron, KY 41048 (606) 334-2500</p> <p>Oliver Mfg. Co., Inc. P.O. Box 512 Rocky Ford, CO 81067 (303) 254-6371</p>	<p>Rapistan Corp. 507 Plymouth Ave. NE Grand Rapids, MI 49505 (616) 451-6200</p> <p>Sauze Technical Products Corp. 212 Oak St. Ext. Plattsburgh, NY 12901 (518) 561-6440</p> <p>Stewart-Glapat Corp. P.O. Box 2486 1637 Moxahala Ave. Zonesville, OH 43702 (614) 452-3601</p> <p>Triple/S Dynamics 1031 S Haskell Ave. Dallas, TX 75223 (214) 828-8600</p>	<p>Tri-State Metal Fabricators, Inc. Building 8 Spokane Industrial Park Spokane, WA 99216 (509) 926-7165</p> <p>Union Iron Works, Inc. P.O. Box 1069 1102 N 18th St. Decatur, IL 62525 (217) 429-5148</p> <p>Versa Ferguson Conveyor P.O. Box 152-T Mt. Sterling, OH 43143 (614) 869-2738</p> <p>White Bag Co., Inc. P.O. Box 607 Warehouse Row & Campbell Dr. Jacksonville, AK 72076 (501) 982-9551</p>
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Sacks

Cones are collected and stored in sacks. Burlap sacks have been traditionally used because they are porous and aid in wicking moisture from the cones. Plastic mesh sacks are an alternative to burlap. Sacks can be manufactured in various sizes.



Sacks:

Acro Plastics
Div. of Lowry Mfg., Inc.
8630 Airport Highway
Holland, OH 43528
(419) 865-0258

Alabama Bag and Burlap Co.
P.O. Box 320797
4330 Powell Ave. S
Birmingham, AL 35232-0797
(205) 595-6116

Armin Plastics Corp.
841 S Norbury
Lombard, IL 60148
(312) 916-8277

Bemis Paper Bag Div.
P.O. Box 171821
Memphis, TN 38187-1821
(208) 523-0546

Canton Canvas Products
336 6th St. NE
Canton, OH 44702
(216) 453-2525

C.R. Daniels, Inc.
3451 Ellicott Center Dr.
Ellicott City, MD 21043-4191
(301) 461-2100

Dowling Bag Co..
P.O. Box 1768
Valdosta, GA 31601
(912) 244-0133

Friedman Bag Co., Inc.
P.O. Box 3067 Annex
801 E Commercial St.
Los Angeles, CA 90051
(213) 595-6116

Halsted Corp.
P.O. Box 4068, Bergen Strn.
78-94 Halladay St.
Jersey City, NJ 07304
(201) 433-3323

Humphry's Textile Products Co.
1243 Carpenter St.
Philadelphia, PA 19147
(800) 523-4503

More Plastic Bags
801 Suite G
Mahler St.
Burlingame, CA 94010
(415) 692-8018

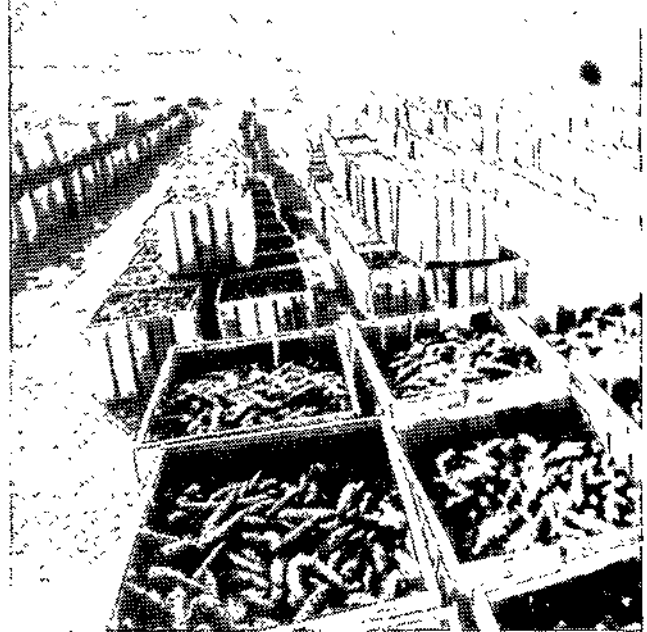
Protective Lining Corp.
603 39th St.
Brooklyn, NY 11232
(800) 221-9712

Troy Sunshade Co.
607 Riffle Ave.
Greenville, OH 45331
(800) 833-8769

Western Kraft Paper
5800 SW Western Ave.
Beaverton, OR 97705
(503) 641-4455

Storage Bins

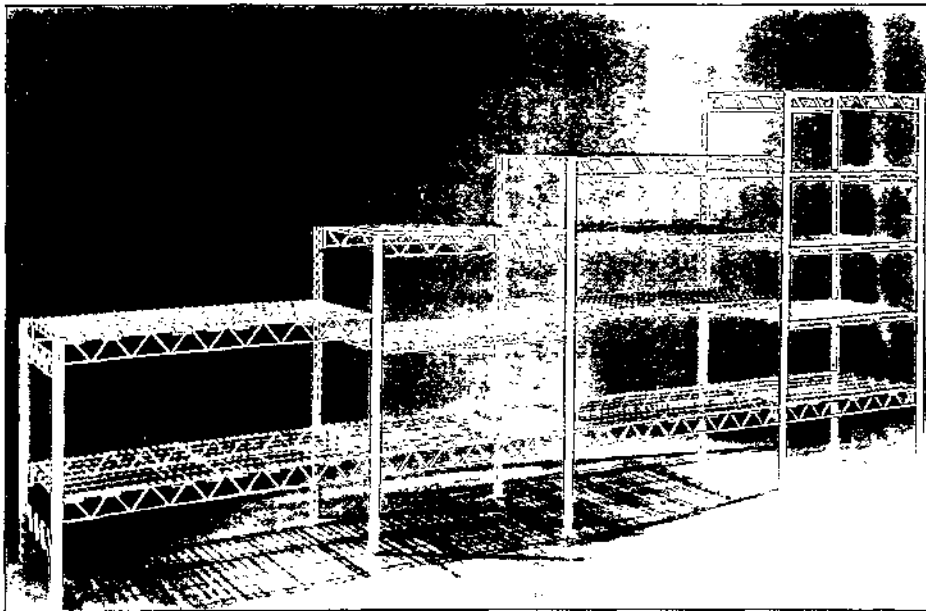
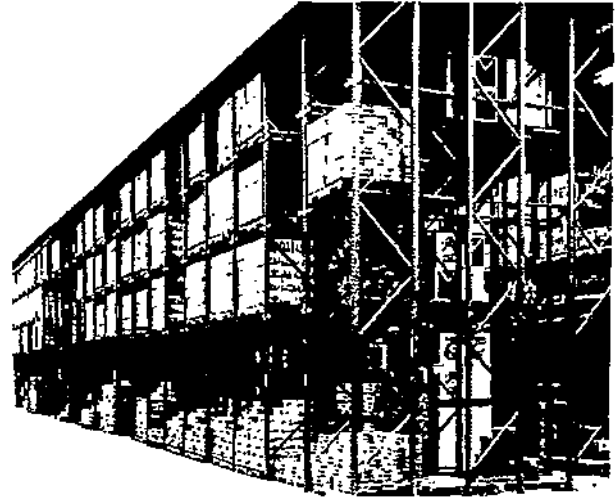
Bins can be used to store large numbers of cones and can be made of plastic, wood, or steel mesh. They come in a wide variety of sizes, shapes, and styles, and may be made to custom order. Some models can be collapsed or stacked to minimize storage space in the off-season. Mesh bins allow drying and ventilation. Most bins must be handled by a forklift, although some are available with wheels.



Storage Bins:	A.M. Leonard, Inc. P.O. Box 816 6665 Spiker Rd. Piqua, OH 45356-0816 (513) 773-2694	Plastech International, Inc. John Fitch Industrial Park P.O. Box C-5050 Warminster, PA 18974 (215) 441-5200	Summit Products Co. P.O. Box 909 146 S Beeson Ave. Uniontown, PA 15401 (412) 437-7251
BMC Mfg., Inc. 100-T S Mill St. Plymouth, MI 48170 (313) 453-5400	T.R. Miller Mill Co. P.O. Box 708 Brewton, AL 36427 (205) 867-4331	Portage Industries Corp. 1325 Adams St. Portage, WI 53901 (608) 742-7123	Tri-State Metal Fab, Inc. Bldg. 8 Spokane Industrial Park Spokane, WA 99216 (509) 926-7155
C.R. Daniels, Inc. 3451 Ellicott Center Dr. Ellicott City, MD 21043-4191 (301) 461-2100	Pacific Wire Works 14615 Anson Ave. Santa Fe Springs, CA 90670 (213) 921-7925	Rubbermaid Commercial Products, Inc. 3124 Valley Ave. Winchester, VA 22601 (703) 667-8700	Union Steel Products, Inc. P.O. Box 60 509 N. Albion St. Albion, MI 49224 (517) 629-2181
InterMetro Industries Corp. 653 N Washington St. Wilkes-Barre, PA 18705 (717) 825-2741			

Rack Storage

Loose cones, sacks, or containers filled with cones may be stored on racks. Some nurseries hang cone sacks on custom-built racks. Racks, which may have adjustable or removable shelves, can be constructed of metal or wood and some models can be disassembled when not in use. Many brands are commercially available or they may be made to order.



Rack Storage:

Acme Steel Co.
13500 S Perry Ave.
Riverdale, IL 60627-1182
(312)849-2500

Bernard Franklin Co.
4055-T Torresdale Ave.
Philadelphia, PA 19124
(215) 744-9300

BMC Mfg. Inc.
100-T S Mill St.
Plymouth, MI 48170
(313) 453-5400

Equipto
225 S Highland Ave.
Aurora, IL 60507
(312) 859-1000

Frazier Industrial Co.
P.O. Box F
Fairview Ave.
Long Valley, NJ 07853
(201) 876-3001

InterMetro Industries Corp.
653 N Washington St.
Wilkes-Barre, PA 18705
(717) 825-2741

Modern Equipment Co., Inc.
2011 Cumming St.
Omaha, NE 68102
(402) 341-4939

Paltier Corp.
1701 Kentucky St.
Michigan City, IN 46360
(219) 872-7238

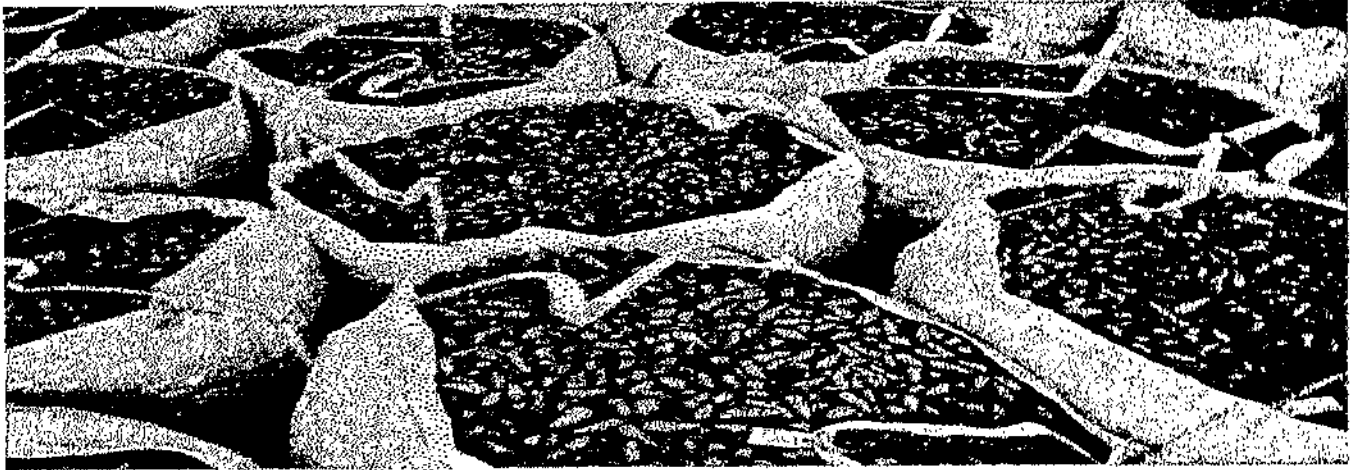
Penco Products, Inc.
200 Brower Ave.
Oaks, PA 19456
(215) 666-0500

Pucel Enterprises, Inc.
1440-T E 36th St, Dept. TR
Cleveland, OH 44114
(216) 881-4604

Ridg-U-Rak, Inc.
120-T S Lake St.
North East, PA 16428
(814) 725-8751

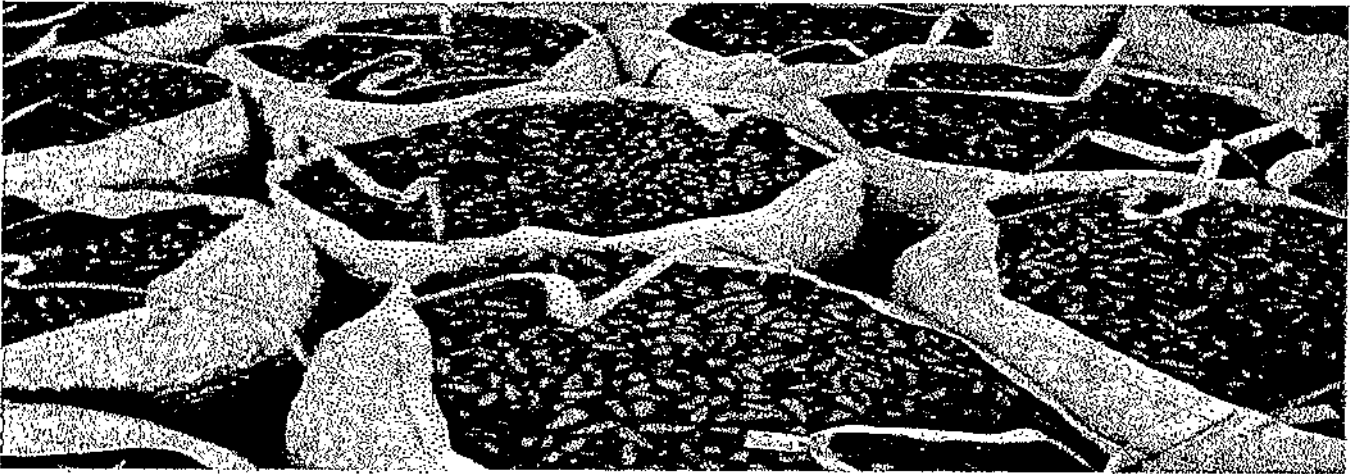
Tier-Rack Corp.
818 Olive St., Dept. B
St. Louis, MO 63101
(314) 241-5451

2.0 Seed Processing



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Cone Hoppers	20	Crippen Tree Seed Cleaner/Sizer	
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Southpine Tray Dry Kiln		Air (Terminal Velocity) Separators	40
International Forest Dry Kiln		Southpine Seed Aspirator	
McPherson Cone Dryer		International Forest Seed Aspirator	
Peerless Cone Drying System		Bates Laboratory Aspirator	
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2.2 Seed Extraction	25	Barnes Tree Seed Separator	
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Southpine Batch Tumbler		Reverse Separation Modification	
Fabricated Tumbler		McPherson Gravity Separator	
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MEDC Tree Seed Dewinger		McPherson Seed Dryer	
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International Forest Seed Sizer/Scalper			
Southpine Flat Screen Cleaner/Sizer			
Damas Vibram Solo			

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



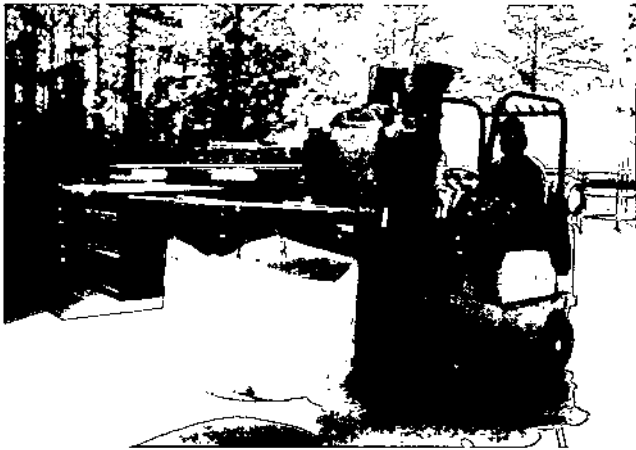
Complete opening of cones for seed release requires cone moisture content to reach a level of 10 percent or lower. Some air drying occurs before the cones are placed in a kiln. Under some conditions, cones are air-dried and do not need to be placed in a kiln for further drying. However, most cones are 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
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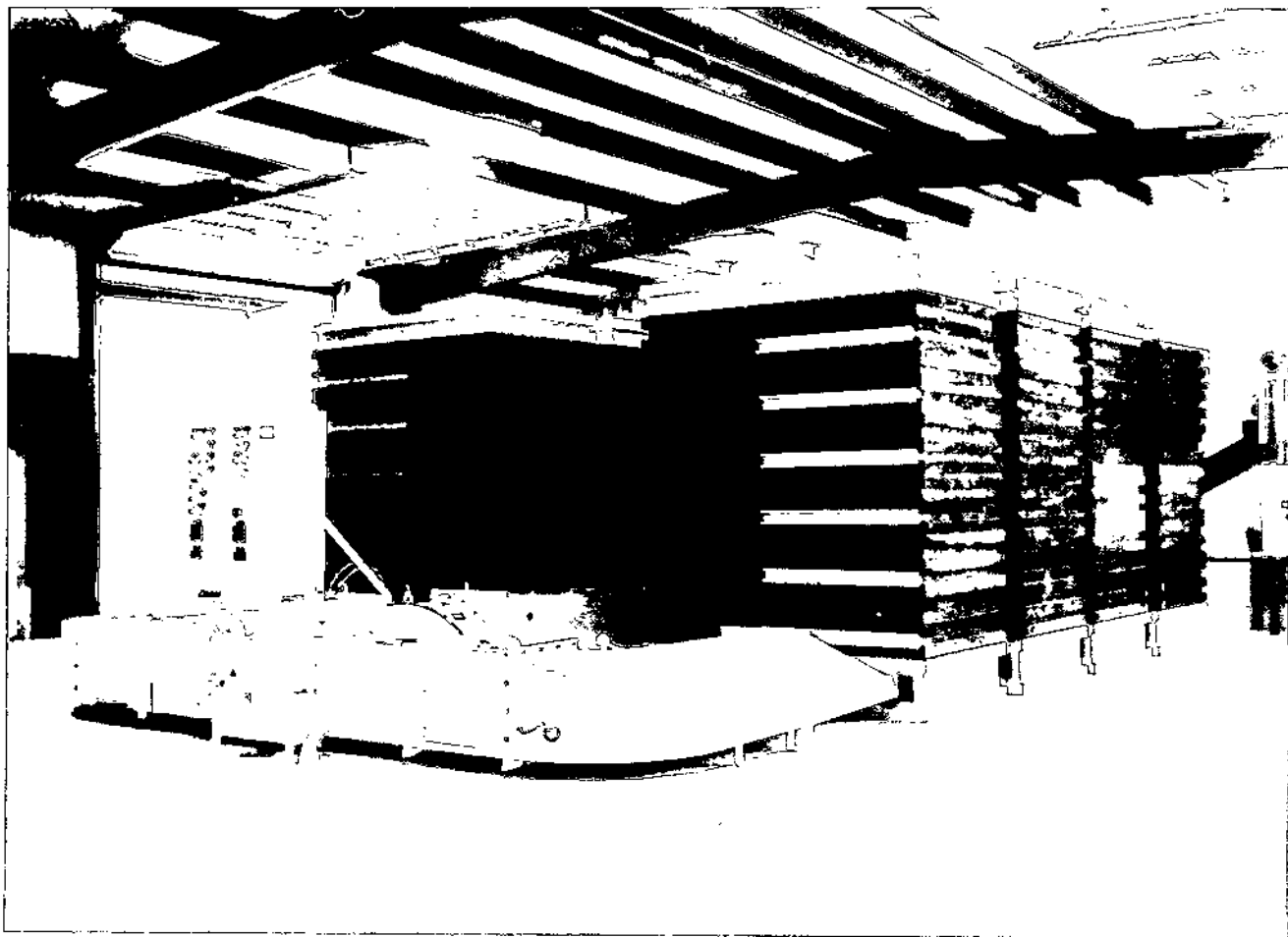
Kilns

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.

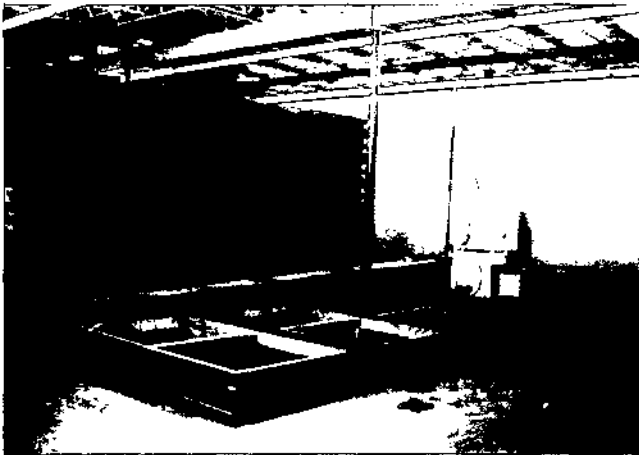
Stationary kilns are large heated rooms, cabinets, or tray systems with temperature and humidity controls. Cones are placed on trays or racks, and are exposed to warm, dry airflow. When properly opened, the cones are transferred from the kiln to tumblers. Stationary kilns are the most commonly used. 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

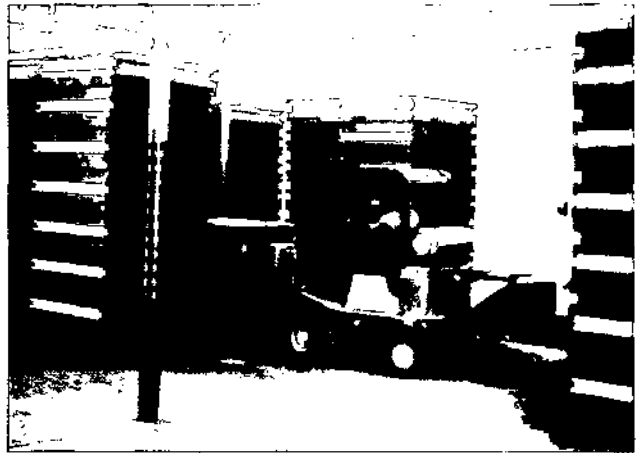
The Southpine Tray Dry Kiln is designed to dry up to 300 bushels of pine cones per charge. It has 48 cone drying trays with perforated metal bottoms. The trays have metal receptacles to permit pickup and emptying with a forklift. Several lots of cones may be dried at the same time without any contamination 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

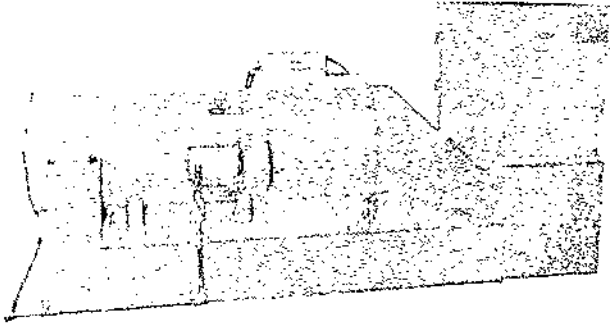
This dry kiln with a 288-bushel capacity is made of stacks of wooden flats holding cones. Warm air is forced through the flats by a heating system that can be designed to use fuel oil, natural gas, or propane. Low-humidity air is recycled through the flats to reduce energy consumption. Temperature and 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

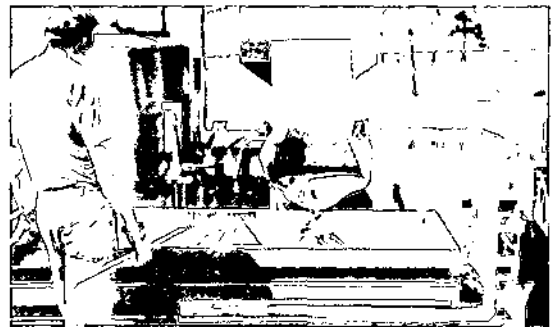
Serrotinous cones require special treatment because the cone scales are fused with resin. Before the normal drying step, a brief heat treatment using air, water, or steam is required to break the resin bond.

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

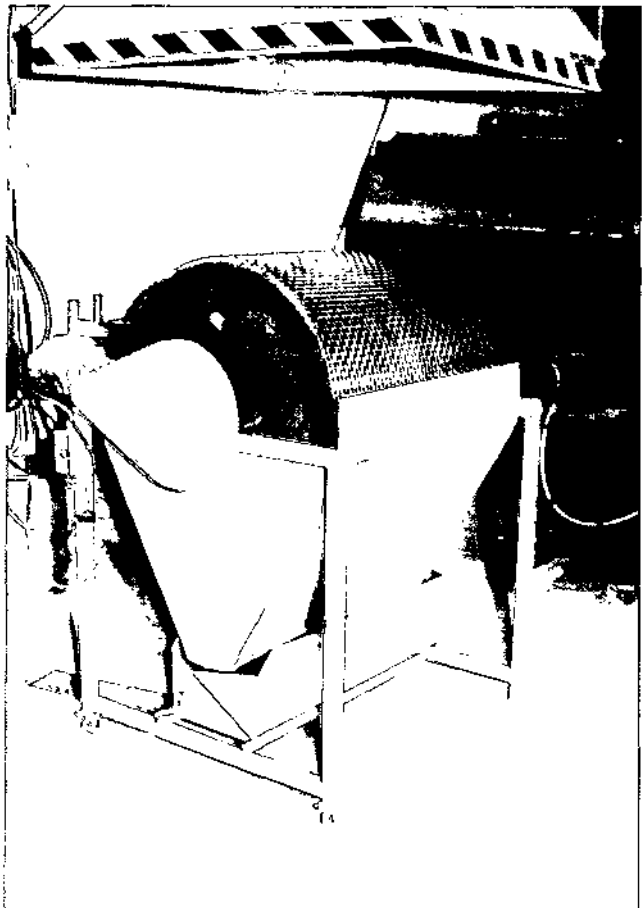


After the cones have opened properly, seeds are separated from the cones. This separation process is normally accomplished by placing the cones into a rotating mesh tumbler. Seeds are jarred loose from the cones and fall through the mesh. The empty cones are removed from the tumbler at the opposite end.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

Tumblers

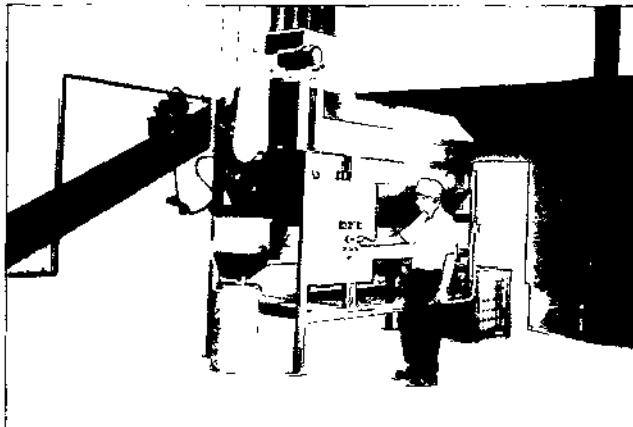
Cones need to be fully dried and opened prior to insertion into the tumbler for proper seed extraction. The tumblers rotate at relatively low speeds, which allows the seed to fall from the cones. The wire mesh allows the seed to be immediately removed from the tumbler to prevent damage.

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

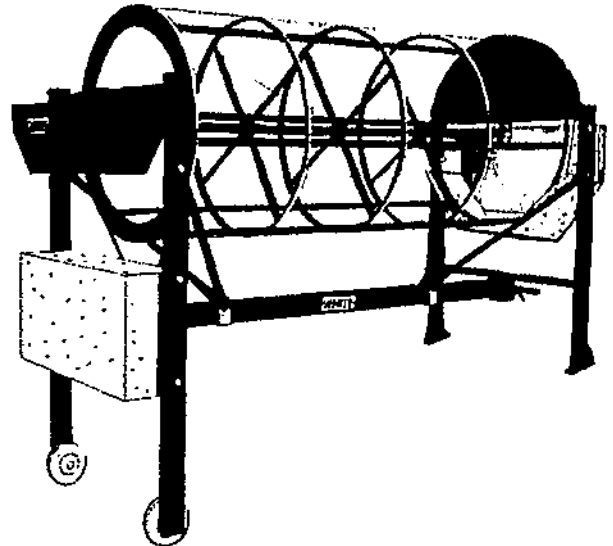
The Southpine Batch Tumbler is designed to extract seed from pine cones. It is equipped with three programmable time controls that operate the tumbler automatically. The first controller stops the tumbler for loading, the second controls the time cones are tumbled, and the third reverses directions of 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

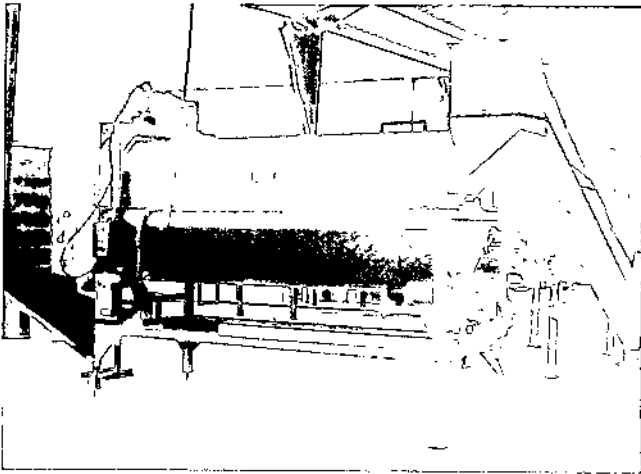
Several extractories have custom built their own tumblers by modifying rotating grain cleaners. The drums are 70 inches in length and either 30 or 36 inches in diameter with interchangeable screens.



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

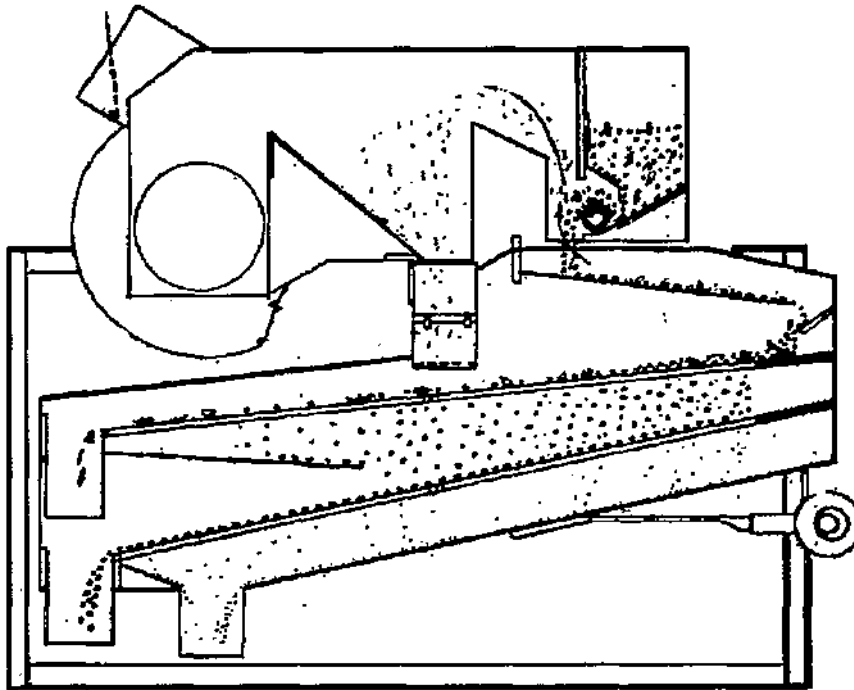
Snow Corp.
4350 McKinley
Omaha, NB 68112
(402) 453-2200

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	Forsbergs, Inc. P.O. Box 510 Thief River Falls, MN 56701 (218) 681-1927	Oliver Mfg. Co., Inc. P.O. Box 512 Rocky Ford, CO 81067 (303) 254-6371	Triple/S Dynamics 1031 S Haskell Ave. Dallas, TX 75223 (214) 828-8600
Crippen Mfg. Co., Inc. 700 W End St. Alma, MI 48801 (517) 463-2119	Hance Corp. 235 E Broadway Westerville, OH 43081 (614) 882-7400	Seedburo Equipment Co. 1022 W Jackson Blvd. Chicago, IL 60607-2990 (312) 738-3700	
	Ideal Grain and Seed Cleaner Co. 85 Second Ave. SE New Brighton, MN 55112 (612) 636-7323	Southpine, Inc. P.O. Box 530127 Birmingham, AL 35253 (205) 879-1099	

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

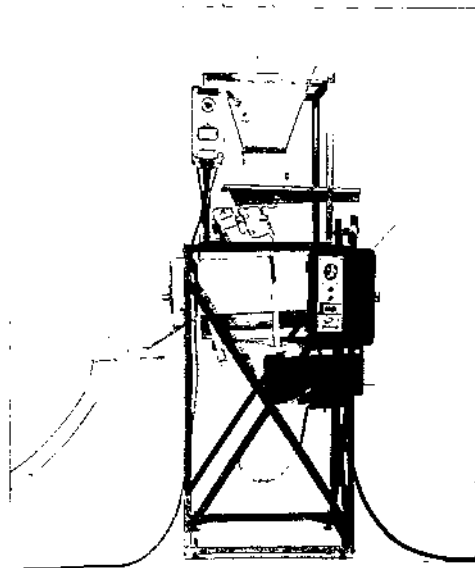
Most machine dewingers are rotating devices that dewing seed by rubbing the seed with paddles between two surfaces, or against the walls of the dewinger chamber. Chamber walls are made of wire, wood, or are lined with canvas or rubber. The paddles and brushes are made of wood, rubber, or metal. Seed 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:

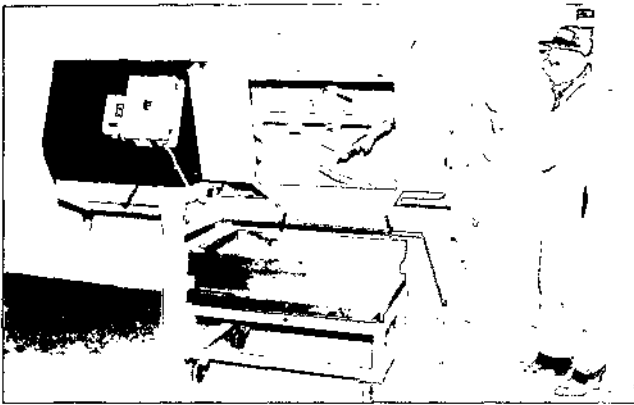
International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5749

McPherson Small Lot Dewinger:

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

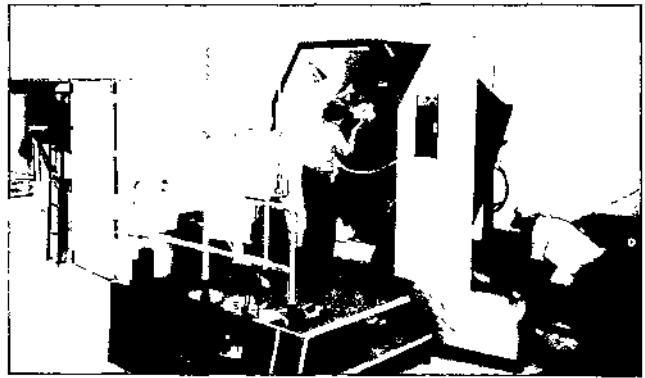
Southpine Paddle Dry Dewinger

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

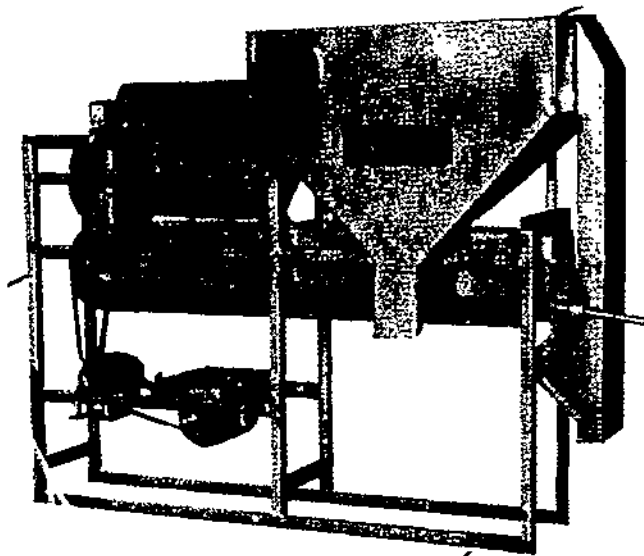
Wet Dewinger:

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.

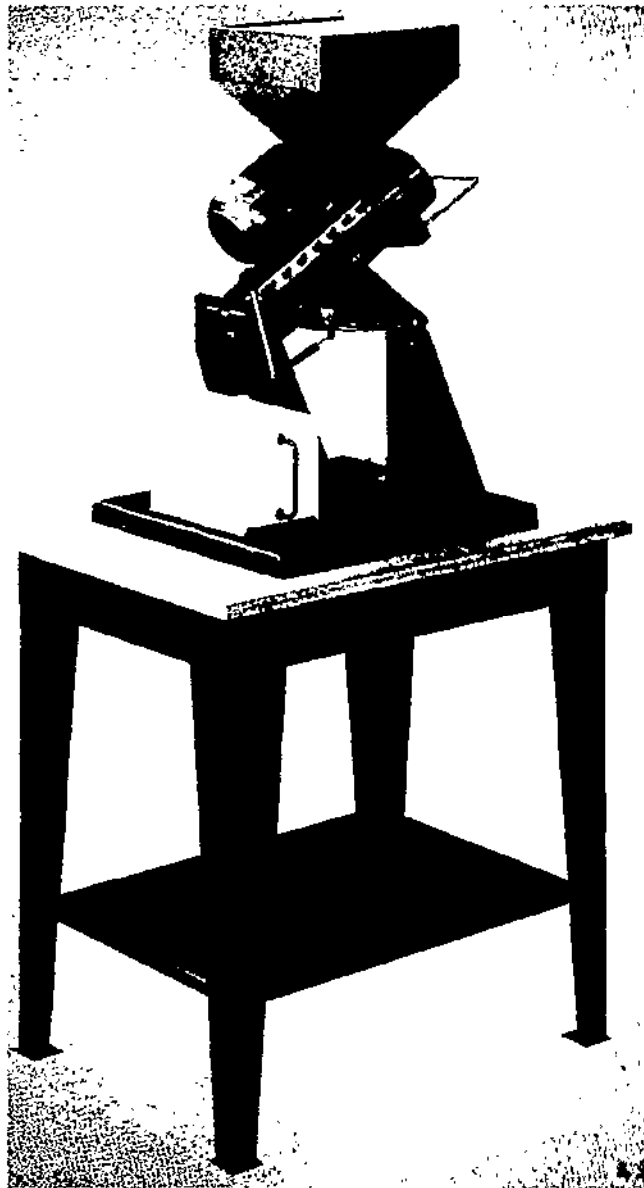


Dewinger:

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.



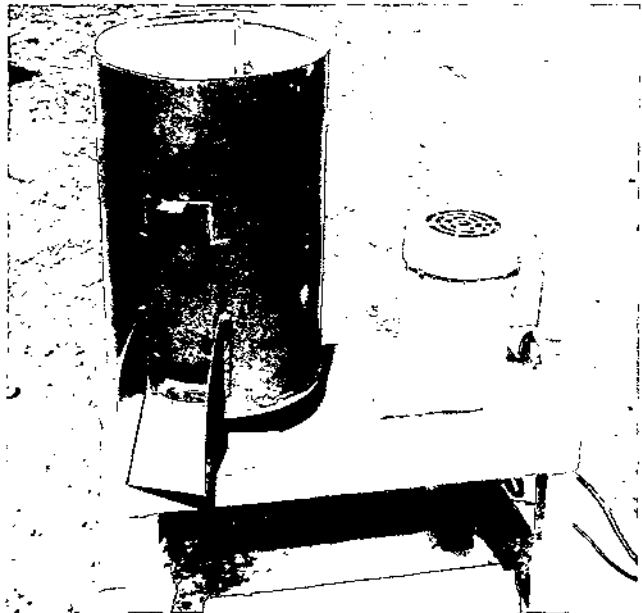
MAT-OSU Debearder:

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

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.



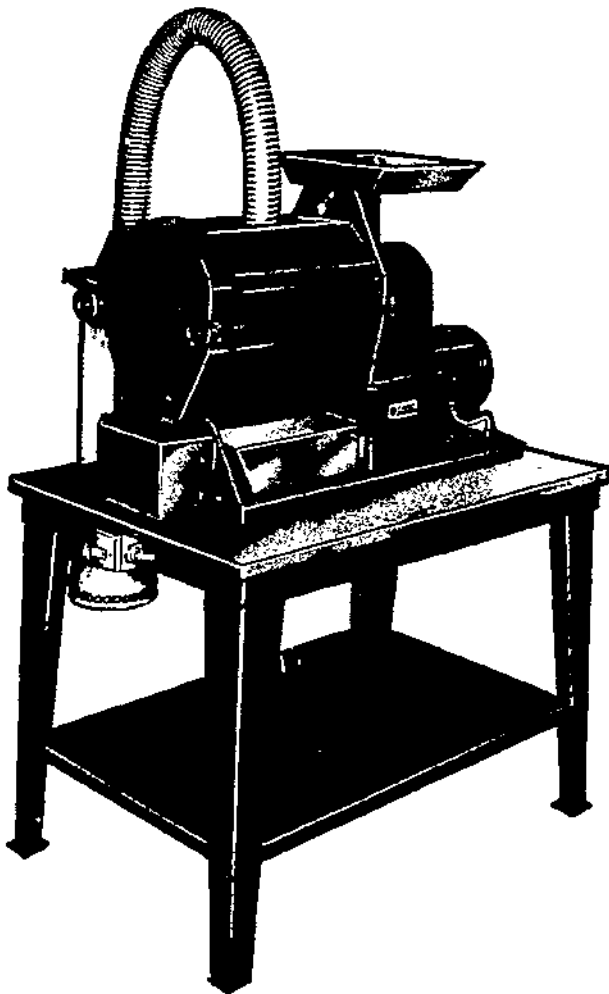
Dybvig Seed Cleaner:

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.



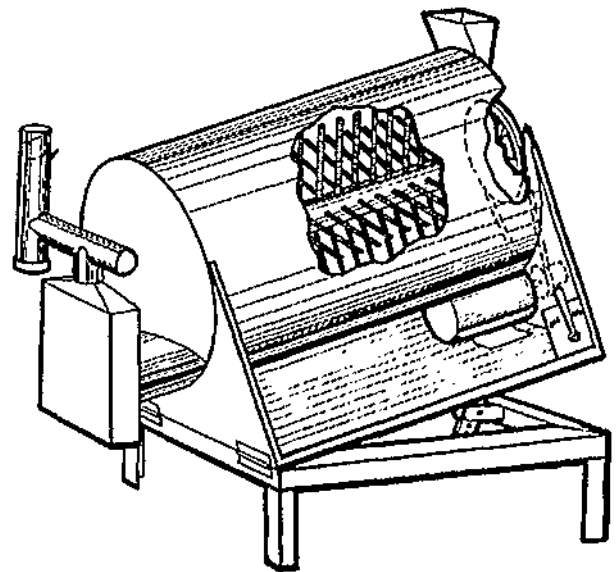
Coeur d'Alene Dewinger

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



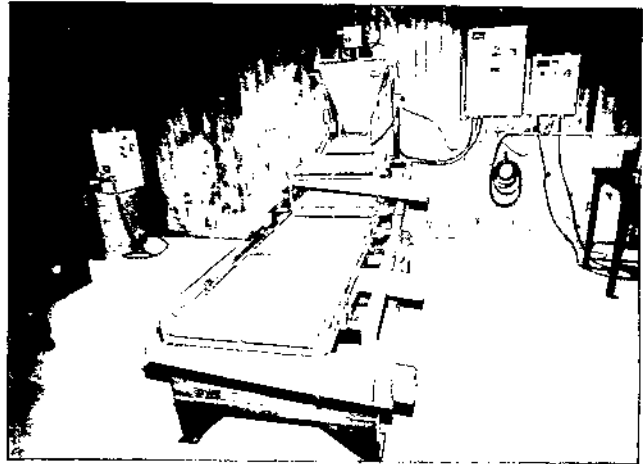
The most common principles of tree seed cleaning are: screening, air separation, and specific gravity separation. These principles are used separately or in combination to separate seed, usually into relatively pure fractions. All equipment in this section is a modification or adaptation of agricultural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

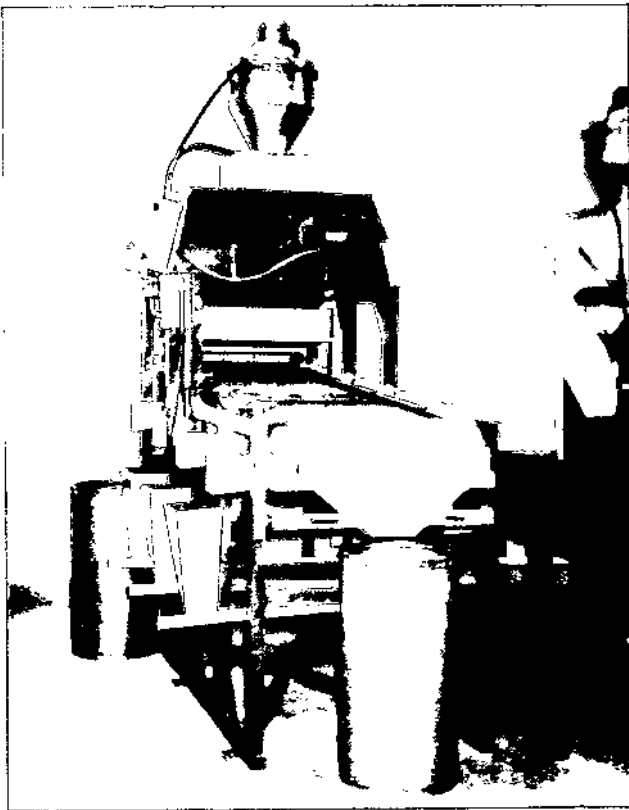


International Forest Seed Sizer/Scalper:

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.

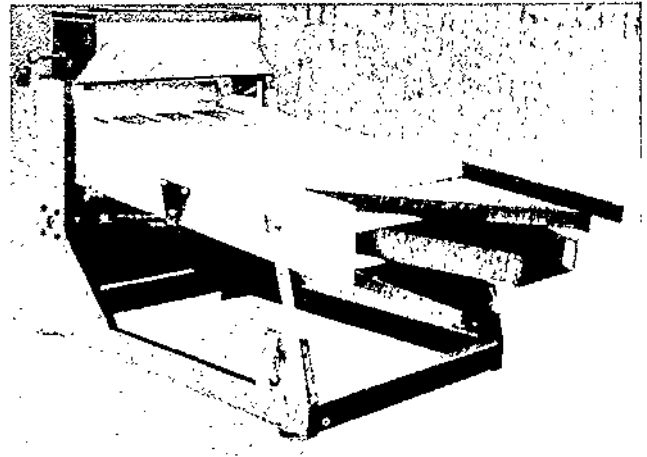


Southpine Cleaner/Sizer:

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:

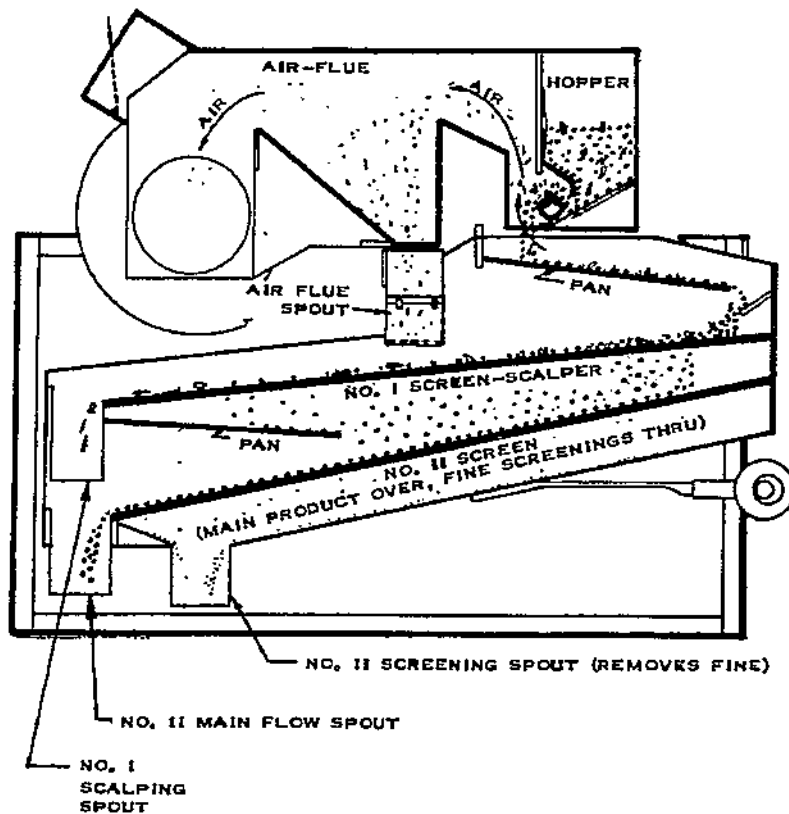
Damas A/S
Industrivej 2
Vester Aaby
DK-5600 Faaborg
Danmark

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.

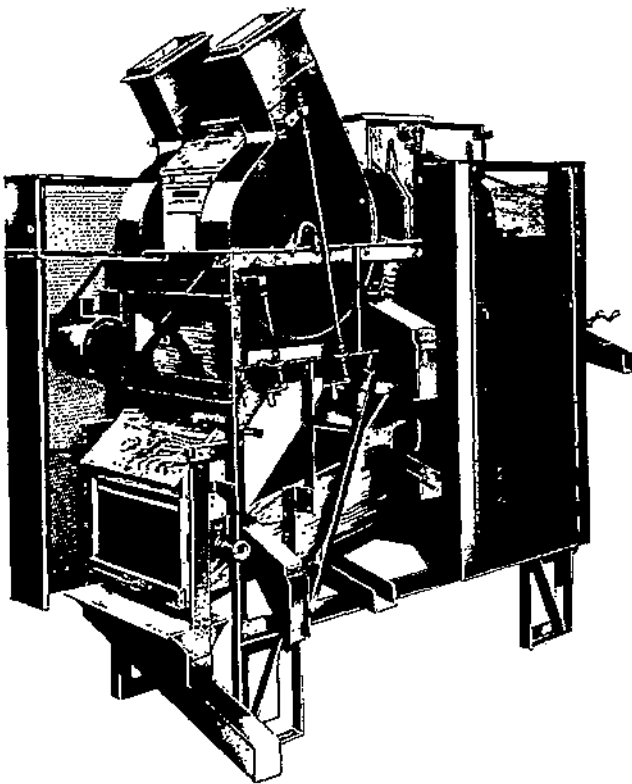
For example, in a two-screen separator, seeds and trash pass over a strong air jet. Fine particles are lifted away. The mixture then passes over the first screen, where the seeds and any remaining light debris drop through the holes. The large and long trash is not able to enter the holes and is discharged. 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.



Crippen Tree Seed Cleaner/Sizer

The Crippen cleaner is a small-capacity cleaner designed for forest tree seed. It uses four screens with a final air (terminal velocity) cleaning to cull out immature and unfilled seeds. Mobile brushes underneath clear the screens of blockage. Seeds and the heaviest liftings are visible in all separations. Air jets are adjustable.



Crippen Cleaner/Sizer:

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

Clipper M-2BC

This is probably the most common air-screen cleaner for processing tree seed. It has two screens for sizing and scalping. Cleaning brushes under the screens prevent seed from lodging in the screens.



Clipper M-2BC:

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

Air Screen and Screen Separators:			
Adasco, Inc. P.O. Box 58 Mound, MN 55364 (612) 472-6422	Damas Vester Aaby Industrivej 2 DK-5600 Fouborg Danmark	International Forest Seed Co. P.O. Box 490 Blair Farm Rd. Odenville, AL 35120 (205) 629-5726	Prater Industries., Inc. 1515 S 55th Court Chicago, IL 60650 (312) 656-8500
Ag-Machinery & Safety, Inc. (AMOS) P.O. Box 5613 Lafayette, IN 47903 (317) 447-5073	Forsberg, Inc. P.O. Box 510 Thief River Falls, MN 56701 (218) 681-1927	Koppers, Inc. Sprout-Waldron Div. Muncy, PA 17756 (717) 546-8211	Prosem Rt. 4 Howick, Quebec Canada JOS 1G0
Blount Industrial Products 805 S Decker Dr. Bluffton, IN 46714 (219) 824-3400	Gustafson, Inc. 1400 Preston Rd., Suite 400 Plano, TX 75075-5112 (214) 985-8877	Lightfoot, Inc. 1526 Marlin Rd. Bloomer, WI 52724 (715) 568-2333	Rebel Industries, Inc. 5700 W Broadwing Crystal, MN 55428 (800) 328-8348
Buhler-Miag, Inc. 1100 Xenium Ln. Minneapolis, MN 55441 (612) 545-1401	Hance Corp. 235 E Broadway Westerville, OH 43081 (614) 882-7400	MAGIK Corp. P.O. Box 467 Harlan, IA 51537 (712) 755-5016	Satake (U.S.A.), Inc. 11999 Katy Freeway Suite 505 Houston, TX 77079 (713) 493-6828
Carter-Day Co. 500-73rd Ave. NE Minneapolis, MN 55432 (612) 571-1000	Harlan Contracting Co. 1101 Chatburn Ave. Harlan, IA 51537 (712) 755-5016	Mater International, Inc. 101 SW Western Blvd. Corvallis, OR 97333 (503) 753-7335	Seedburo Equipment Co. 1022 W Jackson Blvd. Chicago, IL 60607 (312) 738-3700
Corn States Hybrid Serv., Inc. P.O. Box 2706 2505 McKinley Ave. Des Moines, IA 50325 (575) 285-3091	Henry Simon, Inc. 2955 Fairfax Trafficway Kansas City, KS 66115 (913) 621 6466	McLoughlin Ward and Co. 409 South 23rd St. Jackson, MI 49203 (517) 787-5030	Southpine, Inc. P.O. Box 53017 Birmingham, AL 35253 (205) 879-1099
Corn States Metal Fabricators P.O. Box 65635 1323 Maple St. Des Moines, IA 50265 (515) 225-7961	Hoffman Mfg. Co. 325 11th Ave. SE Albany, OR 97321 (503) 926-2920	Nasco 901 Janesville Ave. Ft. Atkinson, WI 58538 (414) 563-2446	Snow Corp. P.O. Box 12067 4350 McKinley St. Omaha, NE 68112 (402) 453-2200
Crippen Mfg. Co. 700 W End St. Alma, MN 48801 (517) 463-2119	S. Howes Co., Inc. 1974 Miller St. Silver Creek, NY 14136 (716) 934-2611	Oliver Mfg. Co., Inc. P.O. Box 512 Rocky Ford, CO 81067 (303) 254-6371	Triple/S Dynamics 1031 S Haskell Ave. Dallas, TX 75223 (214) 828-8600
	Huntley Mfg. Co. 6069 Peerless St. Brocton, NY 14716 (716) 792-9134	Pearson Industries, Inc. P.O. Box Z, U.S. Rte. 34 E Galva, IL 61434 (309) 932-8171	

Air (Terminal Velocity) Separators

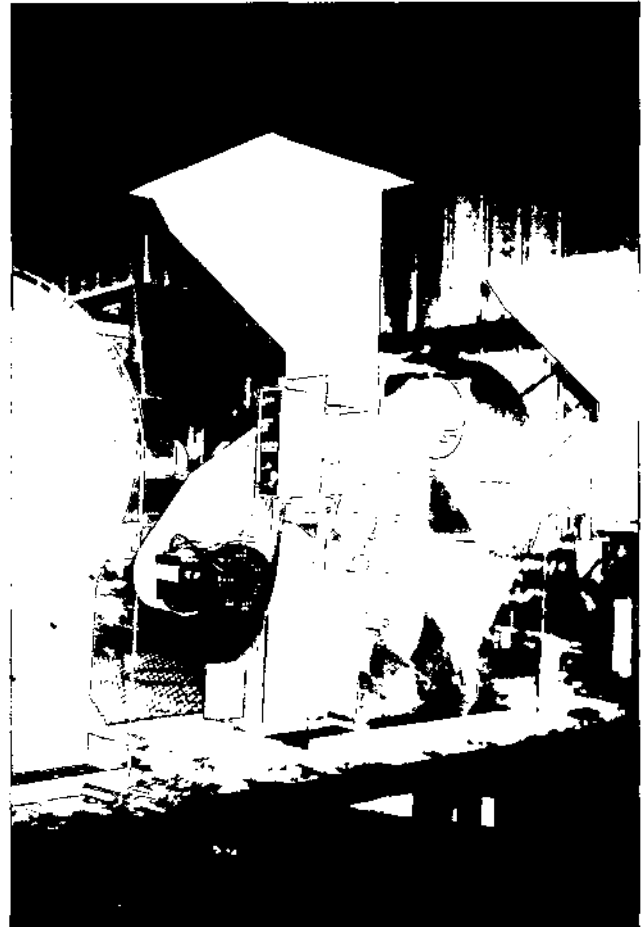
Air separation is used in separating seeds from other debris and removing empty seeds. It is a popular method, often used alone or in combination with air-screen and gravity separation. Air separators depend on the principle of terminal velocity, the air velocity needed to suspend a particle in a rising air current. The terminal velocity of a particle is determined by its specific gravity, shape, and surface texture. When the velocity of air in a column is adjusted to a certain level and material enters the air column, the material with a terminal velocity less than the air column velocity will be lifted, while the material with greater terminal velocity than the air column will drop.

When seeds are of the same shape and volume but differ in specific gravity, air can separate the light from the heavy seed. Also, if the seeds are of the same specific gravity but different in shape, they may also be separated by this process.

The difference between aspirators and pneumatic separators is that the fan is located at the discharge with aspirators and at the intake with pneumatic separators. Airstream volume and velocity are regulated by the speed of fans and size of the entrance or exit.

Southpine Seed Aspirator

Southpine offers a closed-system aspirator that separates viable from non-viable seed. The readings for the aspiration controller can be saved to use if the same batch of seeds is run again.

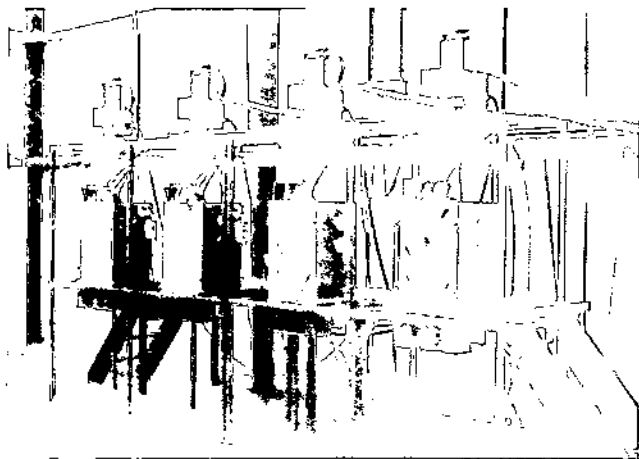


Southpine Seed Aspirator:

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

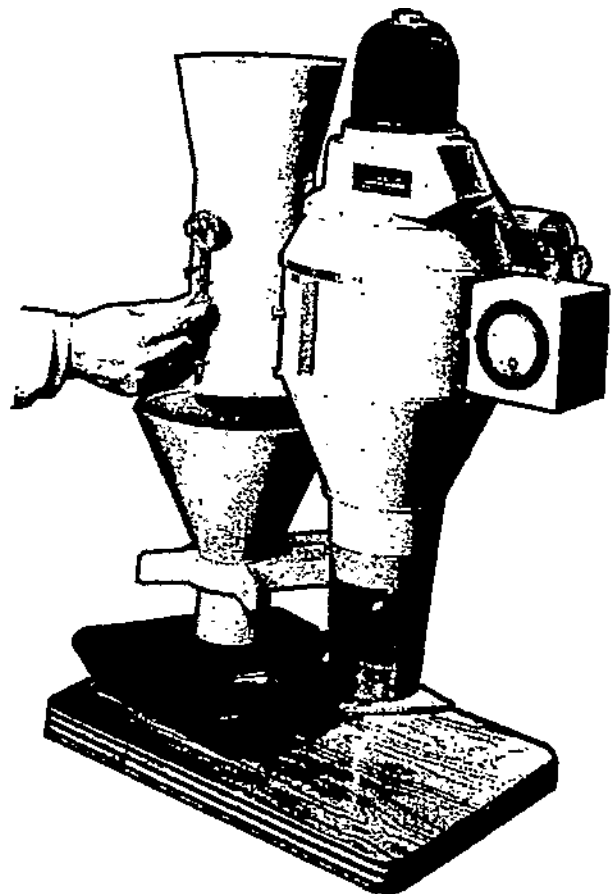
International Forest Seed Aspirator

This is a closed-system aspirator that separates undewinged and empty seeds from viable seeds.



Bates Laboratory Aspirator

This is a small laboratory aspirator designed for separating small samples of seed. It is available with a rheostat for variable fan speed, a necessity for use in processing tree seed.



International Forest Seed Aspirator:

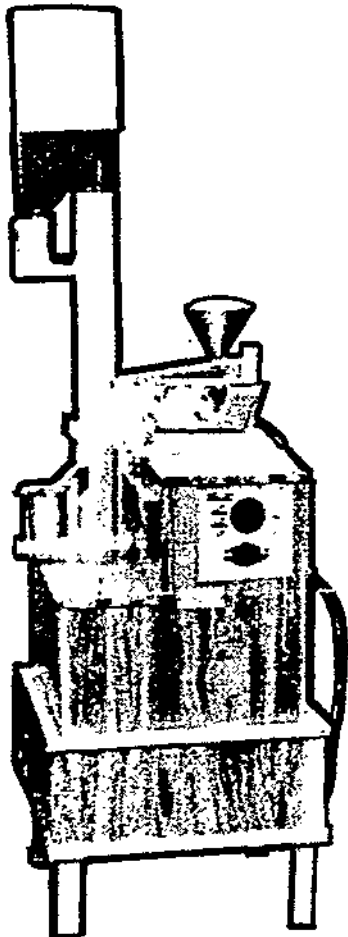
International Forest Seed Co.
P.O. Box 490
Blair Farm Rd.
Odenville, AL 35120
(205) 629-5726

Bates Aspirator:

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

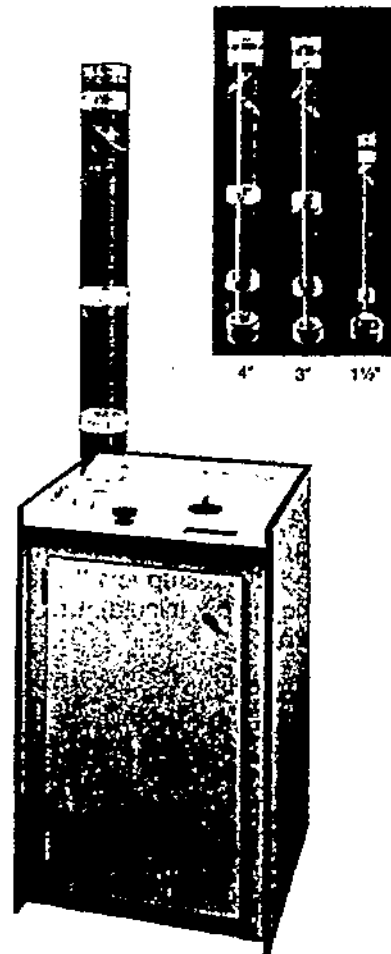
Continuous Seed Blower (MAT-OSU Continuous Seed Separator)

This is a continuous feed pneumatic separator with vibratory feeder and controls for regulating airflow and feed rate. Capacity is rated at 16 to 140 pounds per hour depending on seed weight.



South Dakota Seed Blower

The blower is a pneumatic separator of laboratory size. This model can be equipped with a 1- and 1/2-inch, 3-inch, or 4-inch diameter column. This separator is a batch type rather than a continuous flow separator. It is useful for very small tree improvement seed lots.



Continuous Seed Blower:

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

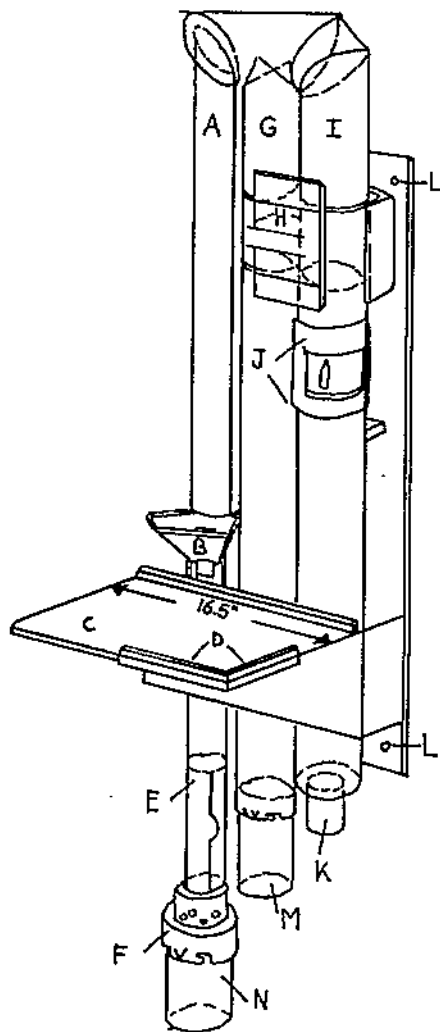
Seedbuero Equipment Co.
1022 W Jackson Blvd.
Chicago, IL 60607-2990
(312) 738-3700

South Dakota Seed Blower:

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

Barnes Tree Seed Separator

This pneumatic separator works on tree seed of all sizes and is sensitive enough to provide sizing as well as basic cleaning. It can be used as a continuous-feed machine or on a "batch" basis.



Barnes Tree Seed Separator:

Tree Improvement Enterprises
P.O. Box 630
1119- 1/2 S 4th St.
Cottage Grove, OR 97424
(503) 942-4066

Air Separators:

Ag-Machinery & Safety, Inc.
P.O. Box 5613
Lafayette, IN 47903
(317) 447-5073

American International Mfg. Co.
1230 Fortna Ave.
Woodland, CA 95695
(916) 666-2446

Barnes Tree Improvement Co.,
P.O. Box 630
1210 Vincent Pl.
Cottage Grove, OR 97424
(503) 942-4066

Buhler-Miag, Inc.
1100 Xenium Ln.
Minneapolis, MN 55441
(612) 545-1401

Carter-Day Co.
500 73rd Ave., NE
Minneapolis, MN 55432
(612) 571-1000

Corn States Metal Fabricators
P.O. Box 65635
1323 Maple St.
Des Moines, IA 50265
(515) 225-7961

Damas Industrivej 2
Vester Aaby
DK-5600 Faaborg
Danmark

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

Geosource, Inc.
9800 Townpark Dr.
Houston, TX 77036
(713) 981-9185

Gustafson, Inc.
1400 Preston Rd.
Suite 400
Plano, TX 75075-5112
(214) 985-8877

Hendrickson Enterprises
4050 NE Minnesota Ave.
Corvallis, OR 97330
(503) 754-7610

Hoffman Mfg. Co.
325 11th Ave. SE
Albany, OR 97321
(503) 926-2920

S. Howes, Co., Inc.
1974 Miller St.
Silver Creek, NY 14136
(716) 934-2611

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

Koppers, Inc.
Sprout-Waldron Div.
Muncy, PA 17756
(717) 546-8211

MAC Equipment, Inc.
P.O. Box 205
S Highway 75
Sabetha, KS 66534
(913) 284-2191

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

Prater Industries, Inc.
1515 S 55th Court
Chicago, IL 60650
(312) 656-8500

Prosum
Rt. 4
Howick, Quebec
Canada JOS 1G0

Satake (U.S.A.), Inc.
11999 Katy Freeway
Suite 505
Houston, TX 77079
(713) 493-6828

Scientific Separators, Inc.
621 17th St., Suite 1515
Denver, CO 80293
(303) 623-6178

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

Southpine, Inc.
P.O. Box 530217
Birmingham, AL 35253
(205) 879-1099

Stultz Scientific Engineering
3313 S 6th
Highway Frontage Rd. W
Springfield, IL 62703
(217) 529-3723

Tree Improvement Enterprises
P.O. Box 630
1119 1/2 S 4th St.
Cottage Grove, OR 97424
(503) 942-4066

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

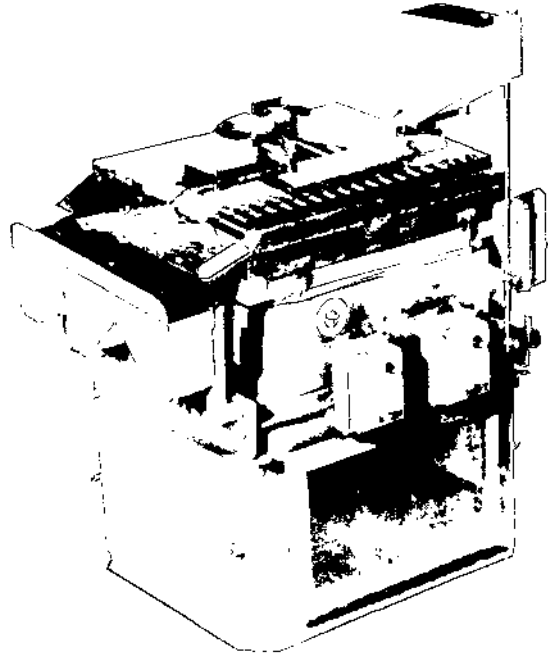
Specific Gravity Separators

Gravity separators primarily are used to size seed and to separate filled seed from empty seed. They are also used as a final cleaning step. They are used to make separations based on either density, size, or shape.

The specific gravity of a seed is determined by its weight relative to its volume. Gravity separation can separate seeds from debris, seeds of the same size but different densities, and different-sized seeds of the same densities. However, it cannot separate seeds with a mixture of different sizes and densities. Gravity separation is used successfully to size tree seed of the same species. It also is an excellent tool for removing debris when the particles are of similar size or weight compared to the seed.

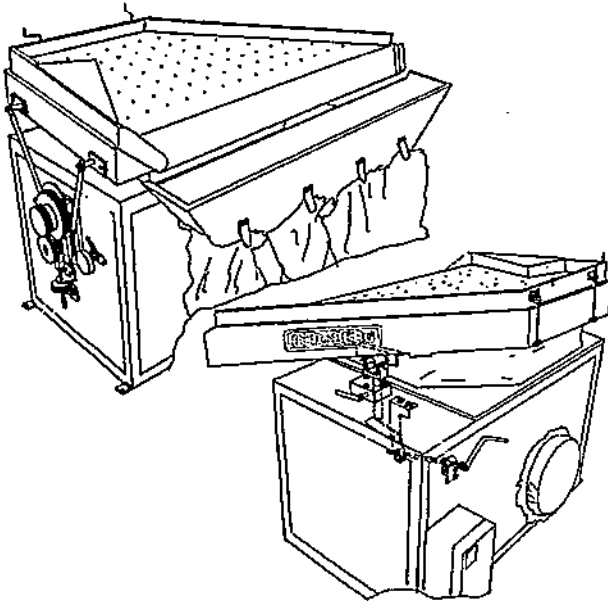
For separation, the seeds are fed onto a vibrating screen deck, where they are vertically stratified with air blowing through the deck. The light seeds or debris rise higher than the heavy seeds or debris. The oscillating motion of the deck "walks" the heavy material uphill. The air "floats" the light material downhill. Thus, the separation occurs, with the light material on the lower end of the deck, and the heavy material on the upper end of the deck.

Decks are covered with porous material such as cloth, woven wire screen, or perforated sheet metal. The deck materials are chosen according to the mixture to be separated. To maintain a uniform bed of seed on the deck, a uniform rate of feed is necessary.



Reverse Separation Modification

A modification of the traditional gravity separator was developed at L.A. Moran Reforestation Center to do a reverse separation of seed. This modification essentially reverses the normal process and allows the heaviest seed to move downhill. The modification does not allow the gravity separator to do the normal tasks for which it was designed. It can only do reverse separations. Drawings of this modification are also available from the Missoula Technology and Development Center, Building 1, Fort Missoula, Missoula, MT 59801.



Reverse Separation Modification:

L.A. Moran Reforestation Center
California Department of Forestry
P.O. Box 1590
5800 Chiles Rd.
Davis, CA 95616
(916) 322-2299

McPherson Gravity Separator (With Reverse Separation)

With a modification such as the reverse separation modification, a gravity separator can do a separation that essentially reverses the normal process and the heaviest material moves downhill on the table. A.W. McPherson and Associates offers a gravity separator with a modification that can be used for both a normal gravity separator and reverse separations.

McPherson Gravity Separator:

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

Specific Gravity Separators:	<p>Equipment Specialists, Inc. P.O. Box 392 Rt. 48 W Taylorville, IL 62568 (217) 287-7227</p>	<p>Henry Simon, Inc. 2955 Fairfax Trafficway Kansas City, KS 66115 (913) 621-6466</p>	<p>Satake (U.S.A.), Inc. 11999 Katy Freeway Suite 505 Houston, TX 77079 (713) 493-6828</p>
<p>Blount Industrial Products 805 S Decker Dr. Bluffton, IN 46714 (219) 824-3400</p>	<p>Forsbergs, Inc. P.O. Box 510 Thief River Falls, MN 56701 (218) 681-1927</p>	<p>Lewis M. Carter (LMC) Mfg. P.O. Box 428 Donalsonville, GA 31745 (912) 524-2197</p>	<p>Seedburo Equipment Co. 1022 W Jackson Blvd. Chicago, IL 60607 (312) 738-3700</p>
<p>Buhler-Miag, Inc. 1100 Xenium Lane Minneapolis, MN 55441 (612) 545-1401</p>	<p>Gustafson, Inc. 1400 Preston Rd. Suite 400 Plano, TX 75075-5112 (214) 985-8877</p>	<p>McLoughlin Ward and Co. 409 S 23rd St. Jackson, MI 49203 (517) 787-5030</p>	<p>Triple/S Dynamics 1031 S Haskell Ave. Dallas, TX 75223 (214) 828-8600</p>
<p>W.C. Cantrell P.O. Box 11216 3245 May (76110) Ft. Worth, TX 76109 (817) 923-7382</p>	<p>Hance Corp. 235 E Broadway Westerville, OH 43081 (614) 882-7400</p>	<p>Oliver Mfg. Co., Inc. P.O. Box 512 Rocky Ford, CO 81067 (303) 254-6371</p>	
<p>Carter-Day Co. 500 73rd Ave. NE Minneapolis, MN 55432 (612) 571-1000</p>			

2.6 Seed Drying



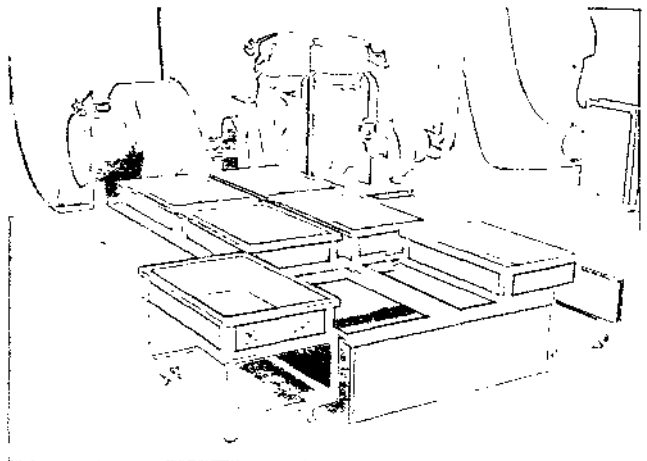
Seed must be redried after wet dewing. Seed may be damaged if placed into cold storage with moisture contents above 10 percent. Most nurseries build their own drying ovens or modify them from commercially available drying ovens.

Dryers

Seed dryers use the same principles as cone dryers. The main difference is that usually the dryers are smaller and of a more simple design. Normally the temperature and air flow are the only variables that are controlled. Some extractories have used modified egg incubators to dry seed.

International Forest Seed Dryer

Up to 600 pounds of seed may be dried in an hour with this dryer. It consists of several boxes to direct airflow, eight dryer boxes, a fan, a gas burner, and a control panel. The stripped-down version is available without the fan, gas burner, or controls. The seeds are loaded 50 pounds to a box, and 12 boxes can be dried in an hour.

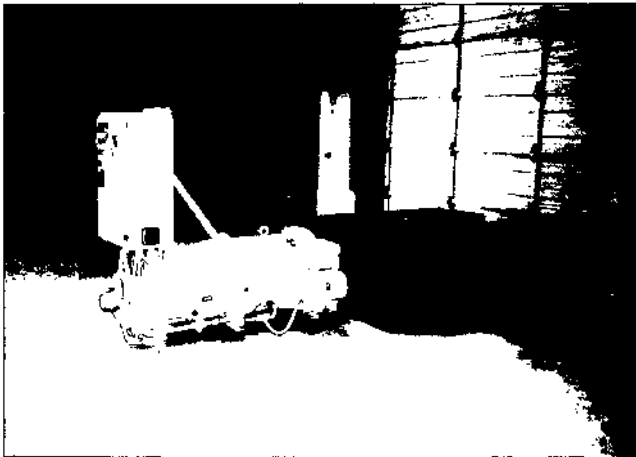


Seed Dryer:

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

Southpine Seed Dryer

The Southpine Seed Dryer has a tray base with air control dampers. Four seed drying trays with perforated metal on angle-iron framed tray bottoms, and a LP or natural gas direct-fired non-recirculating heating system with a tubular fan. The control panel includes a programmable digital temperature controller with two set points, one for air temperature and one for high limit shut down. The control dryer has a power switch with light indicator, manual/automatic selector switch, illuminated fan push/start button, illuminated burner start button, light to indicate pilot on, lowfire-automatic switch, manual switch to raise and lower burner firing level, and a stop switch. All of the control panel items are fully integrated into a factory prewired electrical enclosure. Included are all necessary fail-safe safety controls needed to comply with insurance standards.



Seed Dryer:

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

McPherson Seed Dryer

This standard small lot cone and seed dryer can be used to dry up to 72 separate lots at the same time. This unit can be expanded to accommodate up to 216 lots drying at one time.



Seed Dryer:

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

Dryers:

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

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

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

2.7 Seed Testing



After the seedlot has been satisfactorily cleaned, certain tests must be performed to both describe the quality of the seedlot and provide information necessary for sowing calculations: purity, germination, and seeds per pound.

Seed purity is the percentage of the seedlot that is pure seed. For example, a seedlot with 95 percent purity has 5 percent debris, empty seed, and foreign seed by weight.

Germination percent is an indication of the potential viability of the seedlot, and is usually determined by the percentage of seeds germinating in a growth chamber within a given time period. Standardized germination tests are usually performed by specialized testing laboratories on a fee basis.

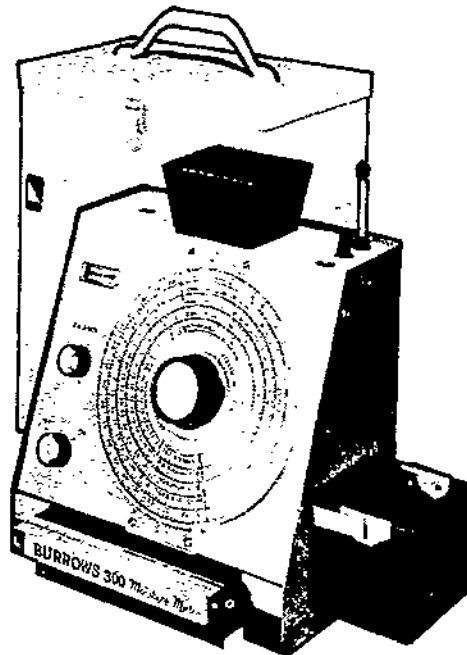
The number of seeds per pound varies between species and seedlots.

Moisture Meters

Proper moisture content is essential if seeds are to maintain their viability during extended storage. Seed moisture content is normally determined by using moisture meters. They are available in a wide variety of sizes and styles.

Moisture meters read out results immediately. For example, an 8 percent reading means that 8 percent of the total seed weight is water. The Forest Service provides a moisture chart for 44 tree species, including several tropical species. This chart can be obtained from:

National Tree Seed Lab
P.O. Box 182-B
5156 Riggins Mill Rd., Rte 1
Dry Branch, GA 31020
(912) 744-3312.

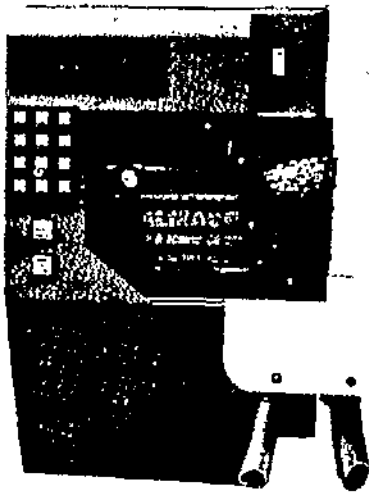
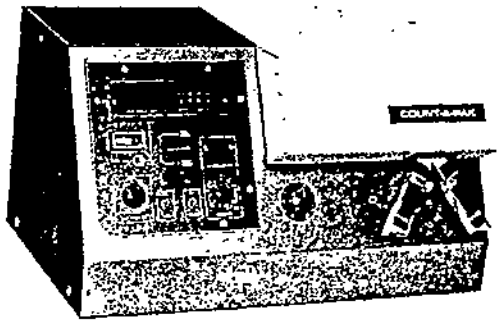


Moisture Meters:	Control-Tek Applications, Inc. 172-34 Henley Rd. Jamaica, NY 11432 (718) 526-6800	Kernco Instrument Co., Inc. 420 Kenazo Ave. El Paso, TX 79927 (915) 852-3375	Solomat Instrumentation Div. Glenbrook Industrial Pk. 652 Glenbrook Rd. Stamford, CT 06906 (203) 348-9700
	CSC Scientific Co., Inc. 8325 Lee Highway Fairfax, VA 22031 (800) 621-4778	Ohaus Corp. P.O. Box 900 29 Hanover Rd. Florham Pk., NJ 07932-0900 (201) 377-9000	Southpine, Inc. P.O. Box 530127 Birmingham, AL 35253 (205) 879-1099
Almaco P.O. Box 296 99 M Ave. Nevada, IA 50201 (515) 382-3506	Delmhorst Instrument Co. P.O. Box 68 51 Indian Lane E Towaco, NJ 07082 (201) 334-2557	Seedburo Equipment Co. 1022 W Jackson Blvd. Chicago, IL 60607-2990 (312) 738-3700	Testing Machines Inc. 400 Bayview Ave. Amityville, NY 11701 (516) 842-5220
C.W. Brabender Instruments, Inc. P.O. Box 2127 50 E Wesley St. South Hackensack, NJ 07606 (201) 343-8425			

Seed Counters

These machines count the number of seeds in a given weight. This information is necessary as part of the seedlot history. It is used in calculating the amount of seed to sow for a given number of seedlings.

Most seed counters consist of a vibratory feeder and a photoelectric cell. Vibratory feeders with spiral-tracked hoppers space the seeds in single file, and then the seeds pass by the photoelectric cell and are counted. Most manufacturers provide models or attachments for any size seed.



Seed Counters:

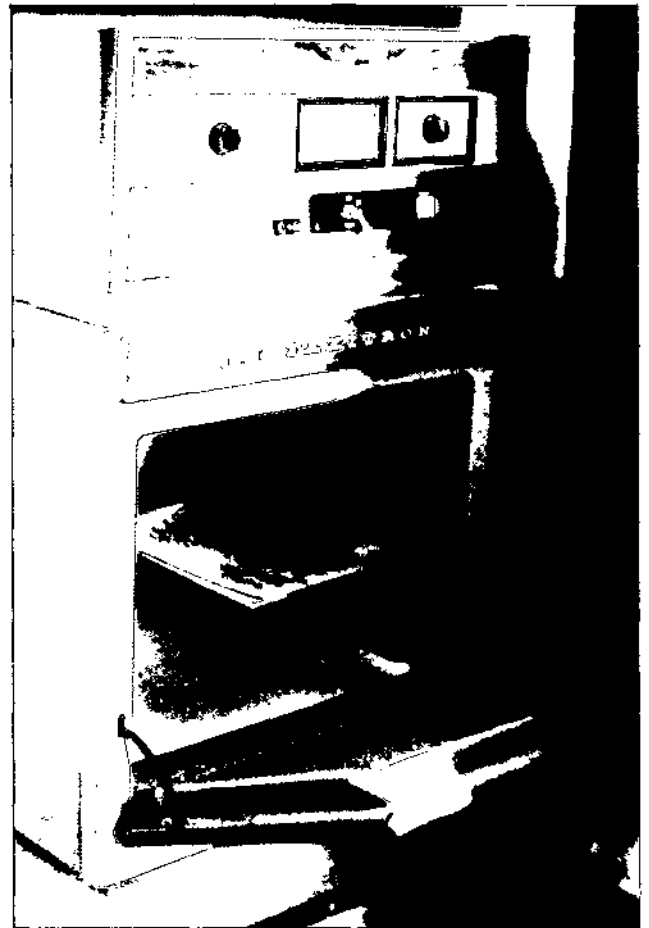
Almaco
P.O. Box 296
99 M Ave.
Nevada, IA 50201
(515) 382-3506

The Old Mill Co.
Savage Industrial Center
Savage, MD 20763
(301) 725-8181

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

X-Ray Machines

X-Ray machines are used as a rapid test of seed lot quality because they can detect the presence of empty or damaged seed in a seed lot. They are useful in the cleaning process for a final check of seed quality.



X-Ray Machines:

Faxitron Series Hewlett Packard
McMinneville Div.
1700 SW Baker St.
McMinneville, OR 97128
(503) 472-5101

2.8 Seed Handling and Storage



After the final cleaning process, a seedlot can be stored under refrigeration for many years. Seed is a living perishable biological product that must be protected to retain its viability. A high moisture content and heating of the seed are two of the most common causes of viability loss.

Seed is stored at low temperatures, typically between 0° and 20° F. The storage containers must do two things: protect the seed from being damaged and maintain moisture content. This is usually accomplished by a double container— a sturdy outer container and an inner, moistureproof barrier. Periodically during the storage period, seedlots are routinely monitored for moisture content and germination.

Drums and Cans

Metal and fiber drums are widely used for seed storage. Drums are often lined with plastic bags or by caulking the lids to provide a moisture barrier. Many sizes are available and drums can be made to order.





Drums and Cans:

Canpak, Inc.
3351 Stokley St.
Philadelphia, PA 19130
(215) 223-5715

Consolidated Container Corp.
735 N Third St, Dept. 110
Minneapolis, MN 55401
(612) 338-0753

Drum Service Co. of Florida
803 Jones Ave.
Zellwood, FL 32798
(407) 889-5500

Eastern Steel Barrel Corp.
4110 New Brunswick Ave.
Piscataway, NJ 08854
(201) 752-1211

Freund Can Co.
199 West 8th St
Chicago, IL 60620
(312) 224-4230

General Container Corp.
P.O. Box 686-T
Hillside, NJ 07205
(201) 687-8233

Natico, Inc.
6700 S LeClaire Ave.
Chicago, IL 60638
(312) 767-2900

Pacific Rim
Packaging Corp.
P.O. Box 4026
801-T Chesley Ave.
Richmond, CA 94804-0026
(800) 372-7311

Plastech International, Inc.
P.O. Box C-5050
John Fitch Indust. Pk.
Warminster, PA 18974
(215) 441-5200

Plyfiber Container Corp.
Johnson Dr.
Raritan NJ 08869
(201) 526-8333

Skolnick Industries, Inc.
4900 S Kilbourn Ave.
Chicago, IL 60632
(312) 735-0700

Sonoco Fibre Drum, Inc.
One Parkway Center
1850 Parkway Place
Marietta, GA 30067
(404) 423-2500

United States Plastic Corp.
1376 Neubrecht
Lima, OH 45801
(419) 228-2242

Utensco
United Molded Products Div.
United Utensils Co., Inc.
P.O. Box 710
Port Washington, NY 11050
(516) 838-7300

Van Leer Containers, Inc.
4300-T W 130th St.
Chicago, IL 60658
(312) 568-3535

Bins and Containers:

Cartons and Boxes
Corrugated Paper
Products, Inc.
13 Ranick Dr. W
Amityville, NY 11701
(516) 842-5100

Day-Pac, Inc.
2208 Sandridge Rd.
Dayton, OH 45439
(513) 294-7311

Display Pack, Inc.
1342 Monroe Ave. NW
Grand Rapids, MI 49505
(616) 451-3061

Gaylord Container Corp.
210 Water St.
Baltimore, OH 43105
(614) 862-4161

Great Northern Corp.
Plastics Group
P.O. Box 939
Appleton, WI 54912
(414) 739-3671

International Paper Co.
Container Div.
6400 Poplar Avenue
Memphis, TN 38119
(800) 223-1268

T.R. Miller Mill Co.
P.O. Box 708
Brewton, AL 36427
(205) 867-4331

NVF Co.
P.O. Box 68-T
Haley Dr.
Yorklyn, DE 19736
(302) 239-5281

Plashford Packaging Group
1140 Hayden St.
Fort Wayne, IN 46803
(219) 423-9431

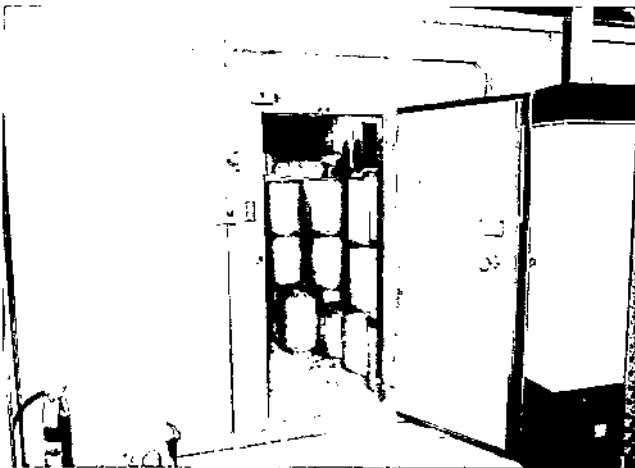
Plastech International, Inc.
P.O. Box C-5050
John Fitch Indust. Pk.
Warminster, PA 18974
(215) 441-5200

Regal Plastic Co.
4401 E 11th St
Kansas City, MO 64127
(816) 483-3040

Tri-State, Inc.
P.O. Box 337
505 Fourth St
Henderson, KY 42420-0337
(502) 826-8361

Refrigerated Storage

Refrigerated storage of seed is a common and necessary practice. Sliding-floor and upright walk-in refrigerators of various sizes are available, with maximum operating temperatures ranging from -40° to 50°F. Many nurseries use custom-designed units from local refrigeration sources.



Refrigerated Storage:

Bally Engineered Structures, Inc.
P.O. Box 98
20 N Front St.
Bally, PA 19503-0098
(215) 845-2311

Warren Refrigerator Co.
1010 I-10 E
Beaumont, TX 77703
(409) 838-3791

The Geldback Refrigerator Co.
P.O. Box 276-T
1 Demarest Rd.
Sparta, NJ 07871
(201) 383-6368

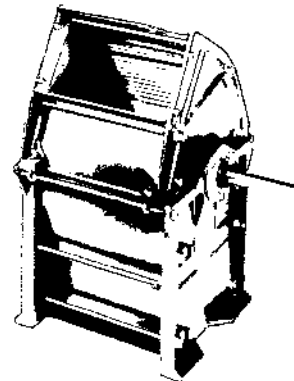
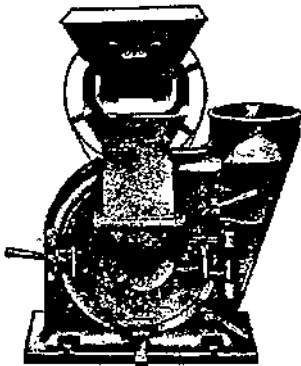
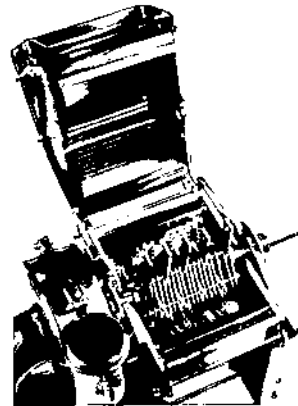
2.9 Miscellaneous Equipment



Hammermills for grinding cones and other by-products of the seed process and dust control systems are an integral part of a seed extractory operation.

Hammermills

Hammermills may be used to grind spent cones and other waste into mulch. They consist of a hopper, a grinding chamber, and a discharge auger or spout. Cones are fed from the hopper into the grinding chamber where they are pulverized by rotating hammers. A fan then discharges the remnants through sieve screens. Most manufacturers provide screens of various sizes. Some hammermills are portable. Electric or gas motors as well as V-belts attached to a vehicle engine may be used to power hammermills.



Hammermills:

C.S. Bell Co.
P.O. Box 291
170 W Davis St.
Triffin, OH 44883
(419) 448-0791

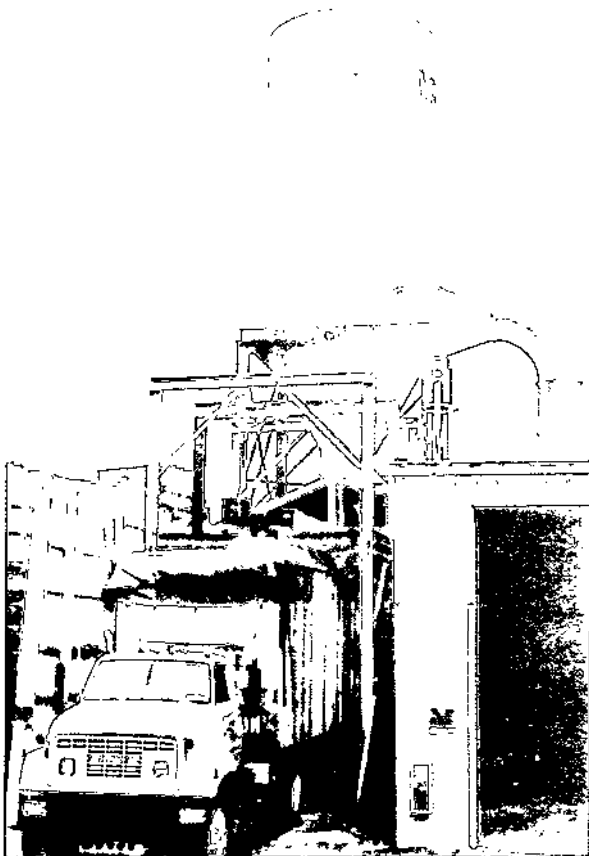
The Duplex Mill and Mfg. Co.
P.O. Box 1266
415 Sigler St.
Springfield, OH 45501
(513) 325-5555

Hege Equipment, Inc.
P.O. Box 34 A
Rt. 1
Colwich, KS 67030
(316) 796-0992

Prater Industries, Inc.
1515 S 55th Court
Chicago, IL 60650
(312) 656-8500

Dust Collection Systems

These systems are designed to remove particulate from the exhaust of seed-separating equipment. Basically two types are being used— a bag house or a cyclone separator . The cyclone separator is the most common.



Southpine Transition Hopper

Most nurseries have developed their own system of bagging seed. Southpine has a large funnel mounted on a frame that allows seeds to be poured from a square drying box into a round fiber drum.



Southpine Transition Hopper:

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

Dust Collection Systems:

Dixie Air Engineering Co., Inc.
111 Kane St.
Baltimore, MD 21224
(301) 633-2644

Dustvent, Inc.
100 W Fay St.
Addison, IL 60101
(312) 543-9007

Evans Process Equipment
9875 W Grand Ledge Highway
Sunfield, MI 48890
(517) 566-8041

Forsbergs
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

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

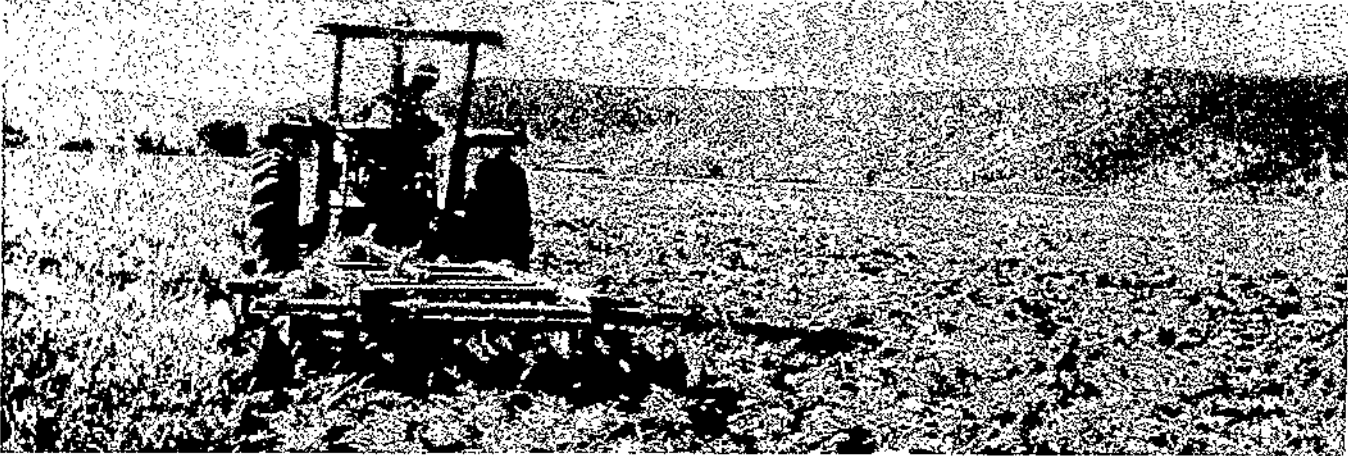
Murphy-Rodgers, Inc.
2301 Belgrave Ave.
Huntington Park, CA 90255
(213) 587-4118

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

Tri-State Metal Fabricators, Inc.
Bldg. 8,
Spokane Industrial Park
Spokane, WA 99216
(509) 926-7165



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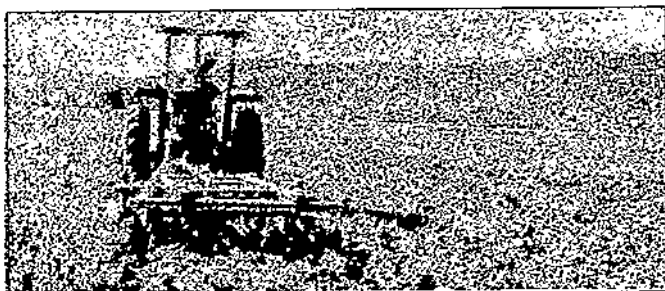
After the existing crop has been removed from the field, bareroot nursery managers go through a series of cultural procedures to prepare the soil for sowing. These tasks are usually accomplished with agricultural equipment and basic farming techniques.

Growing bareroot tree seedlings is an intensive form of agriculture and, therefore, forest nurseries use crop rotation to maintain soil productivity. Most bareroot seedlings reach shipping size in 1 to 3 years. Nurseries produce one or two crops before rotating the land with a 1 to 2 year rest or fallow period. During this time, some nurseries remove all vegetation from the soil surface with frequent cultivation to discourage the buildup of soilborne pests. Others grow green manure to maintain the soil's organic matter level or grow cover crops to protect the exposed soil between crops. Before the tree crop can be sown, all existing vegetation and debris that could hinder sowing or subsequent cultivation must be removed from the site. This is important because even relatively small pieces of debris can plug seed-sowing equipment.

To produce quality tree seedlings, the soil must be in the proper physical condition. Tree seedlings require a well-drained soil with good aeration for both proper root growth and ease of harvesting during the wet winter months. The soil profile should be deep-ripped to below the normal rooting zone to promote draining excessive moisture and all large clods should be broken up so the soil achieves a crumb structure. The field should be leveled and crowned to encourage surface water to drain away from the growing area.

The final presowing activities include fumigating to eliminate soil pests and incorporating fertilizers and other soil amendments into the soil.

RA - Tractors and Other Draft Equipment



Today's tractors are the result of an evolutionary process over the last century. Many different designs and attachments have been developed for general as well as specific crop and field conditions. There are two basic types of tractors: Wheel tractors and crawler tractors. This catalog discusses wheel tractors.

Tractors

Most modern tree seedling nurseries use tractors for a variety of purposes from presowing cultivation to transporting harvested seedlings from the field. The best tractor will depend on the specific task. Large nurseries may have several different sizes ranging from small models for light hauling and within-row cultivation to large four-wheel-drive models for deep ripping. For one-time tasks, it may be prudent to rent or contract a specialized tractor or piece of equipment. The current trend is toward four-wheel-drive or front-wheel-assist tractors for added drawbar pull in less than desirable field conditions. Many small, high clearance and speciality tractors have recently become available. Tractors are usually purchased through local dealers.



Tractors:

Agro-Util Div.
Kalamazoo International Inc.
P.O. Box 271
South Haven, MI 49090-0271
(616) 637-2178

Belarus Machinery, Inc.
P.O. Box 23608
Milwaukee, WI 53223
(414) 355-2000

Big Bud Mfg. Co.
P.O. Box 1790
Havre, MT 59501
(406) 265-1247

Bolens Corp.
215 S Park St.
Port Washington, WI 53074
(414) 284-5521

Bombardier, Inc.
Industrial Equipment Div.
Walcourt Quebec
Canada J0E 2L0
(514) 523-2211

Brown Bear Corp.
Blue Grass Industrial Pk.
Corning, IA 50841
(515) 322-4220

J.I. Case, A Tenneco Co.
700 State St.
F Racine, WI 53404
(414) 636-5399

Caterpillar
100 NE Adams St.
Peoria, IL 61629
(309) 675-1000

CBT/USA, Inc.
4575 Hilton Parkway
Colorado Springs, CO 80907
(719) 590-1118

Cheap Tractors
P.O. Box 658
Bethlehem, CT 06751
(203) 266-7387

Comaway, Inc.
P.O. Box 303
Lawrence, PA 15055
(412) 746-2550

Crandel-Hicks Co.
P.O. Box 5012
30 Oak St.
Westboro, MA 01581
(508) 898-2808

Cub Cadet Corp.
P.O. Box 360930
Cleveland, OH 44136
(216) 273-4550

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Deutz-Allis Corp.
3883 Steve Reynolds Blvd.
Norcross, GA 30093
(404) 564-7100

Eagle Tractor Co., Inc.
P.O. Box 806
367 N Freedom St.
Ravenna, OH 44266
(216) 297-1484

Engineering Products Co.
P.O. Box 1510
Waukesha, WI 53187
(414) 785-0786

Ferrari Tractors, Inc.
P.O. Box 278
Poynette, WI 53955
(608) 635-7350

Ford New Holland, Inc.
500 Diller Ave.
New Holland, PA 17557-0903
(717) 355-1121

Graveley International, Inc.
P.O. Box 5000
Clemmons, NC 27012-5000
(919) 766-4721

Hagie Mfg. Co.
P.O. Box 273
Clarion, IA 50525
(515) 532-2861

The Hamby Co.
5200 N. Columbia
Plainview, TX 79072
(806) 293-1010

Hesston Corp.
245 E North Ave.
Carol Stream, IL 60188
(312) 260-4490

JCB, Inc.
P.O. Box 209
10939 Philadelphia Rd.
White Marsh, MD 21162-0209
(301) 335-2800

Kubota Tractor Corp.
550 W Artesia Blvd.
Compton, CA 90220
(213) 537-2531

Landini
7049 NW 4th St.
Plantation, FL 33317
(305) 321-9711

W.F. Larson, Inc.
P.O. Box 1967
Plainview, TX 79073-1967
(806) 293-1353

Lely Kioti, Inc.
P.O. Box 1060
Wilson, NC 27894-1060
(919) 291-7050

Long Mfg. N.C., Inc.
P.O. Box 1139
Tarboro, NC 27886
(919) 823-4151

Manitoba Industry
Trade & Technology
500-155 Carlton St.
Winnipeg, Manitoba
Canada R3C 3H8
(204) 945-2466

Massey-Ferguson, Inc.
1901 Bell Ave.
Des Moines, IA 50315
(515) 247-2233

MF Industrial
1700 Belle Meade Ct.
Lawrenceville, GA 30243
(404) 822-3072

Mid-America Agricultural, Ltd.
12800 Pfummm
Olathe, KS 66062
(913) 829-6007

Nibex, Inc.
P.O. Box 8585
Emeryville, CA 94662
(415) 428-0871

Power King Tractors
P.O. Box 1510
Waukesha, WI 53187
(414) 785-0786

Robinson & Grissom
Tractor Co., Inc.
P.O. Box 36
Rt. 2
Guntown, MS 38849
(601) 869-1028

Rokon International, Inc.
P.O. Box 189
Jaffrey, NH 03452
(800) 632-2481

SAME Tractors
P.O. Box 127
St. Nazianz, WI 54232
(414) 773-2121

Simplicity Mfg., Inc.
500-T N Spring St.
Port Washington, WI 53074
(414) 284-5535

Sprayrite Mfg. Co.
P.O. Box 3289
West Helena, AR 72390
(501) 572-6737

Steiger Tractor, Inc.
P.O. Box 6006
Fargo, ND 58108
(701) 293-4714

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Wengers Farm Machinery, Inc.
251 S Race St.
Myerstown, PA 17067
(717) 866-2130

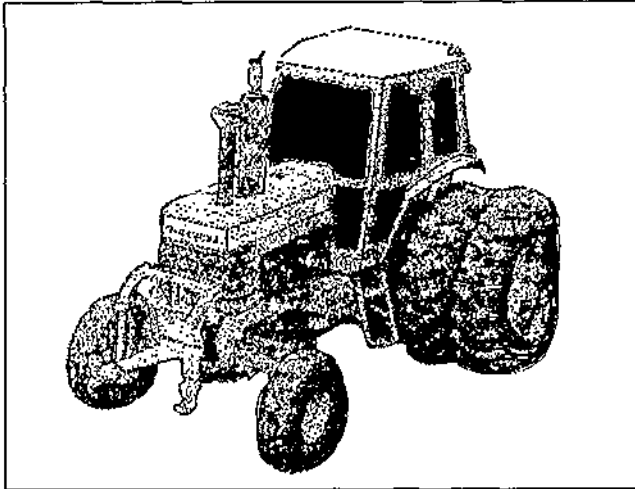
White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Yanmar Tractor (USA), Inc.
951 Corporate Grave Dr.
Mt. Prospect, IL 60089
(708) 459-7800

Zetor Tractors
American Jama, Ltd.
7301 Allentown Blvd.
Harrisburg, PA 17112
(717) 540-5618

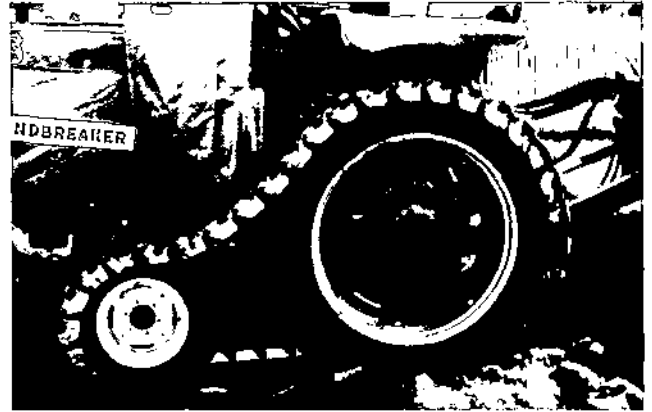
Front Hitch Converters

Manufacturers offer kits that allow a 3-point implement to be attached to the front of a tractor. The hitches can be used for tillers, sprayers, fertilizer tanks, cultivators, rope wick applicators, and other tasks.



Tire Crawler Tracks

Many nurseries use after-market devices such as crawler tracks to increase traction and floatation of their tractors during lifting operations. These systems can make the difference in being able to operate in the fields under adverse conditions.



Front Hitch Converters:

Edwards Equipment Co., Inc.
4312 Main St.
Yakima, WA 98903
(509) 248-1770

Wil-Rich
Farm Equipment Div.
Lear Siegler, Inc.
P.O. Box 1013
Wahpeton, ND 58074
(701) 642-2621

Worksaver
P.O. Box 1000
Litchfield, IL 62056
(217) 324-5973

Tire Crawler Tracks:

Grouser Products
P.O. Box 545
West Fargo, ND 58078
(701) 282-7710

Intertractor American Corp.
P.O. Box 627
Elkhorn, WI 53121

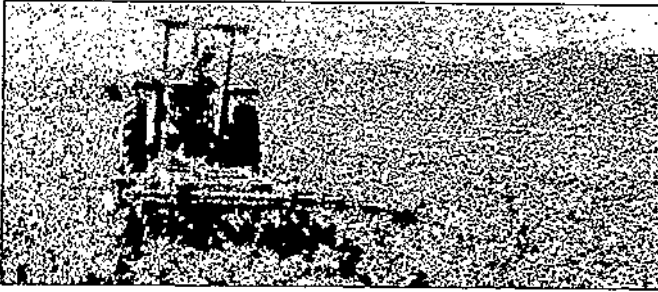
Loeering Mfg., Inc.
P.O. Box 870 IT
Casselton, ND 58012
(701) 347-5441

C.F. Struck Corp.
P.O. Box 307
Cedarburg, WI 53012
(414) 377-3900

Trac 4, Inc.
P.O. Box 58
Wilmington, IL 60421
(815) 476-6778

Trademark Sales &
Marketing, Inc.
1920 American Ct.
Neanah, WI 54956
(414) 727-1818

3.2 - Sowing Cover or Green Manure Crops



"Cover crops" are plants sown during the fallow year to protect the soil from wind or water erosion. Green manure crops are plants that have been sown to improve the fertility or organic matter content of the soil. These crops are typically grown to fortify the soil before the area is converted into a seedbed, or for protection during the fallow year in the crop rotation.

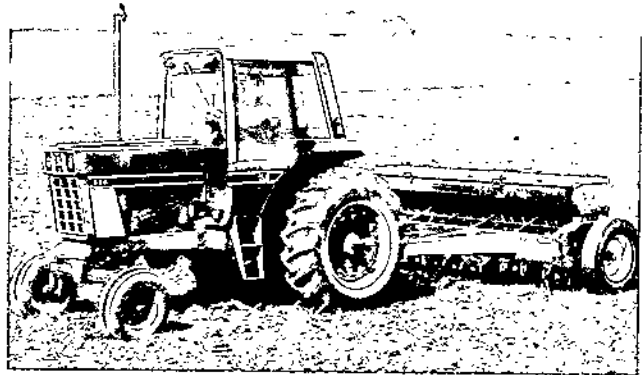
Nurseries use a variety of standard agricultural equipment to sow the seed.

Agricultural Seeders

These are two basic types of seeders: grain drills (planters) and broadcast seeders. Grain drills are designed to plant seeds as evenly as possible in rows. To do this they must 1) open a furrow in the soil; 2) meter the seed; 3) place the seed; 4) cover the seed; and, 5) firm the seed bed.

Broadcast seeders are designed to broadcast small grains and grass or legume seeds (See *Section 5.2*). Seeds are scattered on a random, non-row basis, on top of the seedbed. Another field operation is required to cover the seed.

Both types of seeders are used for sowing cover crops, but grain drills are preferred.



Agricultural Seed Drills:

Barber Engineering Co.
N. 1404 Regal
Spokane, WA 99202

Blanchard Co.
P.O. Box 1607
Minot, ND 58702
(701) 852-1924

Brown Mfg. Corp.
P.O. Box 339
Rt. 3
Highway 27 E
Ozark, AL 36360
(205) 795-6603

Buffalo Farm Equipment
Fleischer Mfg. Inc.
P.O. Box 848
Columbus, NE 68601
(402) 564-3244

J.I. Case,
A Tenneco Co.
700 State St.
Racine, WI 53404
(414) 636-5399

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Deutz-Allis Corp.
3883 Steve Reynolds Blvd.
Norcross, GA 30093
(404) 564-7100

Farnam Equipment
P.O. Box 34820
Phoenix, AZ 85067
(602) 285-1660

Gandy Co.
528 Gandrud Rd.
Owatonna, MN 55060
(507) 451-5430

Garber Seeders
Div. of Riburn, Inc.
P.O. Box 770
St. Paris, OH 43072
(513) 663-4865

Great Plains Mfg., Inc.
P.O. Box 218
Assaria, KS 67416
(913) 667-4755

Haybuster Mfg.
P.O. Box 1940
Jamestown, ND 58401
(701) 252-4601

Hege Equipment, Inc.
P.O. Box 34A
Rt. 1
Colwich, KS 67030
(316) 796-0992

Herd Seeder Co., Inc.
P.O. Box 448
Logansport, IN 46947
(219) 753-6311

Johnson's Industrial Supply Co.
1941 Karlin Dr.
St. Louis, MO 63131
(314) 966-2420

Kelley Mfg. Co.
P.O. Drawer 1467
Tifton, GA 31793
(912) 382-9393

Kinze Mfg., Inc.
P.O. Box 806
Williamsburg, IA 52361
(319) 668-1300

Kirby Mfg. Inc.
P.O. Box 989
Merced, CA 95341
(209) 723-0778

Kuhn Farm Machinery, Inc.
P.O. Box 224
Vernon, NY 13476
(315) 829-2620

The Lely Corp.
P.O. Box 1060
Wilson, NC 27893
(919) 291-7050

Lift-it/PCM Corp.
P.O. Box 106
Industrial Park
Unionville, MO 63565
(816) 947-2446

Marliss Supply Co., Inc.
P.O. Box 9370
Jonesboro, AR 72403
(501) 932-7550

My-D Han-D Mfg., Inc.
Rt. 1 W McArtor
Dodge City, KS 67801
(316) 225-0263

New Idea Farm Equipment Div.
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Powell Mfg. Co., Inc.
P.O. Drawer 707
Bennettsville, SC 29512
(803) 479-6231

Stanhay Webb, Ltd.
Exning, Suffolk
Newmarket
England CB8 7HD
44 63877 206

The Tye Co.
P.O. Box 218
Lockney, TX 79241
(806) 652-3376

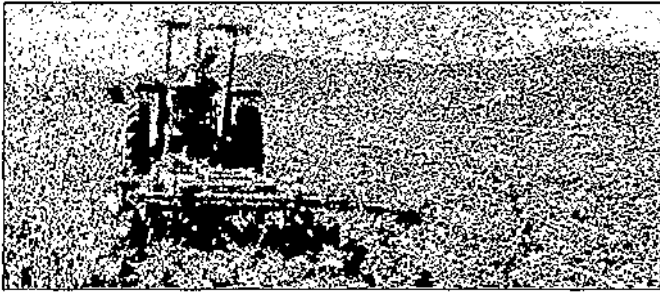
United Farm Tools, Inc.
P.O. Box 4026
Glasgow, KY 42142
(502) 651-7121

Vada Covington Corp.
Covington Planter
P.O. Box 2
Albany, GA 31702
(912) 888-2032

White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Worksaver, Inc.
P.O. Box 1000
Litchfield, IL 62056
(217) 324-5973

3.3 Presowing Cultivation



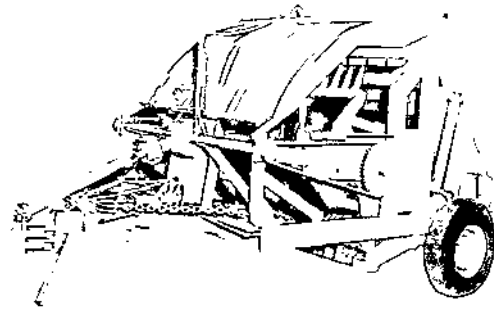
Nursery soil must be prepared for sowing through a series of sequential operations, each with a different implement. Primary cultivation is the process of breaking-up the undisturbed soil. Secondary cultivation refers to working the soil into the proper crumb-like structure.

After the residual vegetation has been incorporated, the soil must be prepared for sowing. This may involve rock picking if the topsoil is shallow. Nursery soils that have been in cultivation for several years often develop compacted layers called "pans" at various depths in the soil. These pans inhibit drainage and limit root development and must be broken-up so the entire soil profile has a uniform, friable texture. Quality bareroot seedlings should have a well-developed, fibrous root system of 10 to 12 inches, and therefore the soil profile must be prepared to a 12- to 18-inch depth. This is much deeper than most agricultural crops.

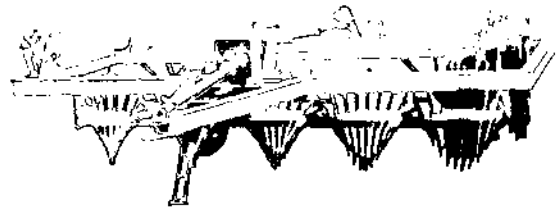
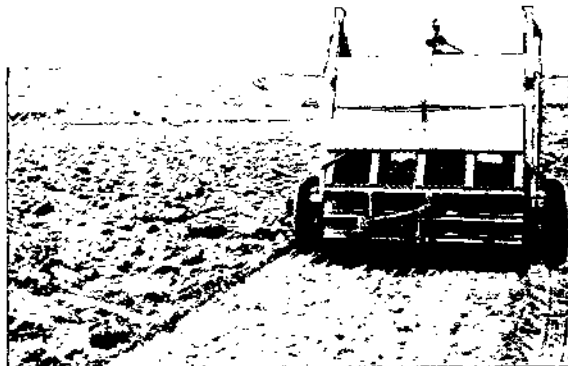
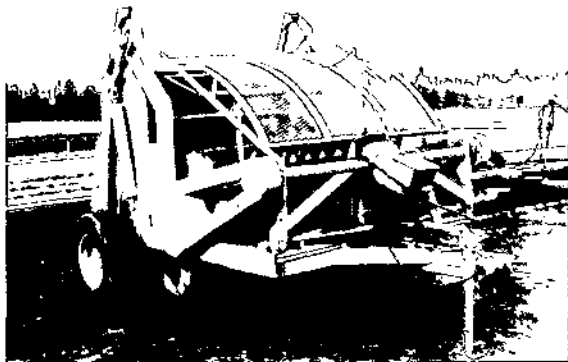
A variety of different tractor-drawn implements are used to prepare the soil for sowing.

Rock Pickers and Rakes

Rock pickers and rakes are used to remove rocks from land so that it can be cultivated. Rock pickers are tractor-drawn and have incline teeth that travel on or under the soil surface, some to a depth of 7 inches. The rocks are lifted by the teeth and moved to a hopper in the rear. Some pickers are equipped to dump hydraulically. Potato-picking machines are used as rock pickers by some nurseries. Rock rakes are tractor-drawn implements used to gather or windrow rocks so that they can be picked up and removed from the field.



Rock Pickers:	Gallenberg Equipment, Inc. W 9112 Chery Rd. Amigo, WI 54409 (715) 623-3754	Leon-Ram Enterprises, Inc. 135 York Rd. E Yorkton, Saskatchewan Canada S3N 3Z4 (306) 783-6592	Rite Way Mfg. Co., Ltd. P.O. Box 3344 1891 Albert St. N Regina, Saskatchewan Canada S4P 3H1 (306) 543-6777
Armor Metal Products P.O. Box 4609 2500 Phoenix Ave. Helena, MT 59604 (406) 442-5560	Glenmac, Inc. P.O. Box 2135 Jamestown, ND 58402 (800) 437-9779	Maritime Farm Implements, Ltd. P.O. Box 209 Middletown, Nova Scotia Canada B0S 1P0 (902) 825-4040	Roseman Tractor Equipment, Co. 2620 Crawford Ave. Evanston, IL 60201 (312) 864-1842
H. Barber & Sons, Inc. 15 Ray Tkwich Rd. Naugatuk, CT 06770 (203) 729-9000	Harmon International Industries, Inc. P.O. Box 1444 2401 Millar Ave. Saskatoon, Saskatchewan Canada S7K 3P7 (306) 931-1161	Norcan Farm Equipment, Ltd. P.O. Box 1237 Cambridge, Ontario Canada N1R 6C9 (519) 623-8261	Schulte Industries, Ltd. P.O. Box 70 Englefeld, Saskatchewan Canada S0K 1N0 (306) 287-3715
Beaver Valley Supply Atwood, KS 67730 (913) 626-3251	Haybuster Mfg. P.O. Box 1940 Jamestown, ND 58401 (701) 252-4601		
Degelman Industries, Inc. P.O. Box 490 Minot, ND 58701 (701) 852-1876			



Rock Pickers:

Summers Mfg. Co.
338 Railway Ave.
Maddock, ND 58348
(701) 438-2855

Union Tools
P.O. Box 1940
Columbus, OH 43216
(614) 222-4400

United Farm Tools, Inc.
P.O. Box 4026
Glasgow, KY 42142
(502) 651-7121

Vermeer Mfg. Co.
P.O. Box 200
Pella, IA 50219
(515) 628-3141

Viel Mfg. Co.
P.O. Box 632
Billings, MT. 59103
(406) 252-6808

Wishek Steel Mfg., Inc.
P.O. Box 185
Wishek, ND 58495
(701) 452-2449

Worksaver Inc.
P.O. Box 1000
S State St.
Litchfield, IL 62056
(217) 324-5973

Rock Rakes:

Armor Metal Products
P.O. Box 4609
2500 Phoenix Ave.
Hefena, MT 59604

Beaver Valley Supply
Atwood, KS 67730
(913) 626-3251

Degelman Industries, Inc.
P.O. Box 490
Minot, ND 58701
(701) 852-1876

Gill Industries
P.O. Box 7324
Charlotte, NC 28241-7324
(800) 476-1511

Hiniker Co.
P.O. Box 3407
Mankato, MN 56002
(507) 624-6621

Leinback Machines Co.
P.O. Box 11786
Winston-Salem, NC 27116
(919) 924-4115

Nicholls Farm Equipment
Rt. 3
Wainfleet, Ontario
Canada L0S 1V0
(416) 732-2000

Roseman Tractor Equipment Co.
2620 Crawford Ave.
Evanston, IL 60201
(312) 344-1842

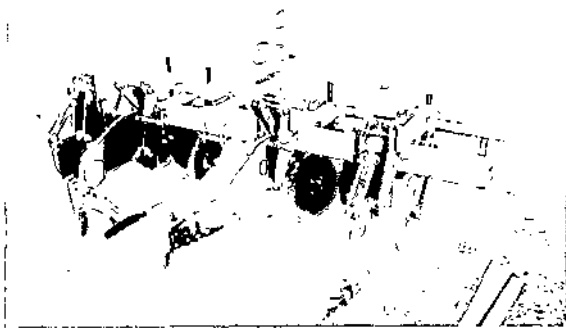
Viel Mfg. Co.
P.O. Box 632
Billings, MT. 59103
(406) 252-6808

Worksaver, Inc.
P.O. Box 1000
S State St.
Litchfield, IL 62056
(217) 324-5973

York Modern Corp.
P.O. Box 488
Umadilla, NY 13849
(607) 369-7111

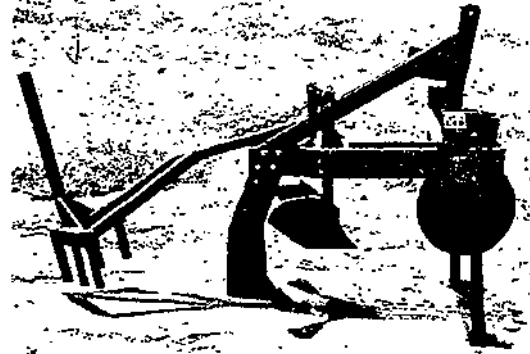
Subsoilers and Rippers

Subsoiling and deep ripping reduce soil compaction by fracturing the soil profile at a depth of 1 to 3 feet. Although it doesn't mix the topsoil and subsoil, subsoiling can reduce the energy needed to plow. Subsoilers are composed of two to six heavyweight, straight or curved shanks mounted on a conventional 3-point hitch. Parabolic-shaped shanks are most effective. Some models have winged shanks that increase the degree of fracturing and allow effective ripping at greater depths.



Whitfield Subsoiler

Whitfield's heavy-duty subsoiler turns compacted sod into a bed suitable for planting. A coulter opens the sod. Underneath the coulter is a rigid undercutting blade that severs vertical roots. A subsoiler behind the coulter then widens and deepens the furrow. The long shank subsoiler behind the share deepens the cut and breaks up the subsoil. Finally, a rear projection of heavy-duty harrow tines smooths the soil and breaks up clumps of weeds.



R.A. Whitfield Mfg. Co.
P.O. Box 188
Mableton, GA 30059
(404) 948-1212

Subsoilers and Rippers:

Agridisc & Implements Corp.
5502 NW 72nd Ave.
Miami, FL 33166
(305) 884-6100

E.L. Anderson Mfg., Inc.
P.O. Box 5602
Eugene, OR 97405
(503) 344-4932

Beaver Valley Supply
Atwood, KS 67730
(913) 626-3251

Bigham Brothers, Inc.
P.O. Box 3338
Lubbock, TX 79452
(806) 765-8201

Blessent Mfg. Co.
5 Triumph Dr.
Urbana, IL 61801
(217) 367-3636

Brillion Iron Works, Inc.
200 Park Ave.
Brillion, WI 54110
(414) 756-2121

Brown Mfg. Corp.
P.O. Box 339
Rt. 3, Highway 27 E
Ozark, AL 36360
(205) 795-6603

Bush Hog Div.
Allied Prod. Corp.
P.O. Box 1039
Selma, AL 36702-1039
(205) 872-6262

J.I. Case
A Tenneco Co.
700 State St.
Racine, WI 53404
(414) 636-5399

Chem-Farm Inc.
P.O. Box 6510
Evansville, IN 47719
(812) 423-8017

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Dickey Machine Works
P.O. Box 5610
Pine Bluff, AR 71611
(501) 536-1300

DMI, Inc.
P.O. Box 65
Goodfield IL 61742
(309) 965-2233

ED-KA Mfg. Co.
P.O. Box 37
Garfield, WA 99130
(509) 635-1521

The Ferguson Mfg. Co., Inc.
P.O. Box 1098
Suffolk, VA 23434
(804) 539-3409

Forest City Machine Works, Inc.
P.O. Box 984
Forrest City, AR 72335-0984
(501) 633-1514

Forest Soil Restoration
36195 SE Boitono Rd.
Sandy, OR 97055
(503) 668-4405

Graham-Hoeme
P.O. Box 3779
Amarillo, TX 79106
(214) 475-0405

G.T., Inc.
P.O. Box 525
Clay Center, KS 67432
(913) 632-2151

Haven Steel Products, Inc.
P.O. Box 430
Haven, KS 67543
(316) 465-2271

Holland Hitch Western, Ltd
17909 Roam Place
Surray, British Columbia
Canada V36 5K1

Howse Implement Co., Inc.
P.O. Box 86
Laurel, MS 39441
(601) 428-0841

Kelley Mfg. Co.
P.O. Drawer 1467
Tifton, GA 31793-1467
(912) 382-9393

Kello-Bilt Industries, Ltd.
P.O. Box 1119
Stettler, Alberta
Canada T0C 2L0
(403) 742-3663

Subsollers and Rippers:

Kewanee Farm Equipment Co.
1516 Burlington Ave.
Kewanee, IL 61443
(309) 852-2191

Kirchner Machine, Ltd.
2419 Second Ave. N
Lethbridge, Alberta
Canada T1H 0C1
(403) 328-5569

Lehman H. Feeder & Plow, Inc.
P.O. Box 53
Rt. 3
Corpus Christi, TX 78415
(512) 855-0049

Maritime Farm Implements, Inc.
P.O. Box 209
Middletown, Nova Scotia
Canada B0S 1P0
(902) 825-4040

Marvin Landplane
P.O. Box 1880
Woodland, CA 95695
(916) 662-2871

Miskin Scraper Works, Inc.
P.O. Box 218
Ucon, ID 83454
(208) 522-2139

Orthman Mfg., Inc.
P.O. Drawer B
Lexington, NE 68850
(308) 324-4654

Powell Mfg. Co., Inc.
P.O. Drawer 707
Bennettsville, SC 29512
(803) 479-6231

Rome Industries
P.O. Box 48
Cedar Town, GA 30125
(404) 748-4450

R&R Agri-Products, Inc.
P.O. Box 121
Rt. 1
Wilbur, WA 99185
(509) 647-5707

Shaver Mfg. Co.
P.O. Box 358
Graettinger, IA 51342
(712) 859-3293

Taylor/Pittsburgh Implements
P.O. Box 769
Athens, TN 37303
(615) 745-3110

Tebben Mfg.
P.O. Box 140
Rt 2
Clara City, MN 56222
(612) 847-2200

Temco H-M Parts Co.
P.O. Box 40210
Memphis, TN 38174-0210
(901) 274-1158

Tilth, Inc.
26979 Dawson Rd.
Monroe, OR 97456
(503) 847-6200

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Thurston Mfg. Co.
Blu-Jet Products
P.O. Box 218
Thurston, NE 68062
(402) 385-3041

The Tye Co.
P.O. Box 218
Lockney, TX 79241
(806) 652-3367

The Vassar Co.
P.O. Box 609
207 N Main
Perkins, OK 74059
(405) 547-2454

W&A Mfg. Co.
P.O. Box 5238
Pine Bluff, AR 71611
(501) 534-7420

R.A. Whitfield Mfg. Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

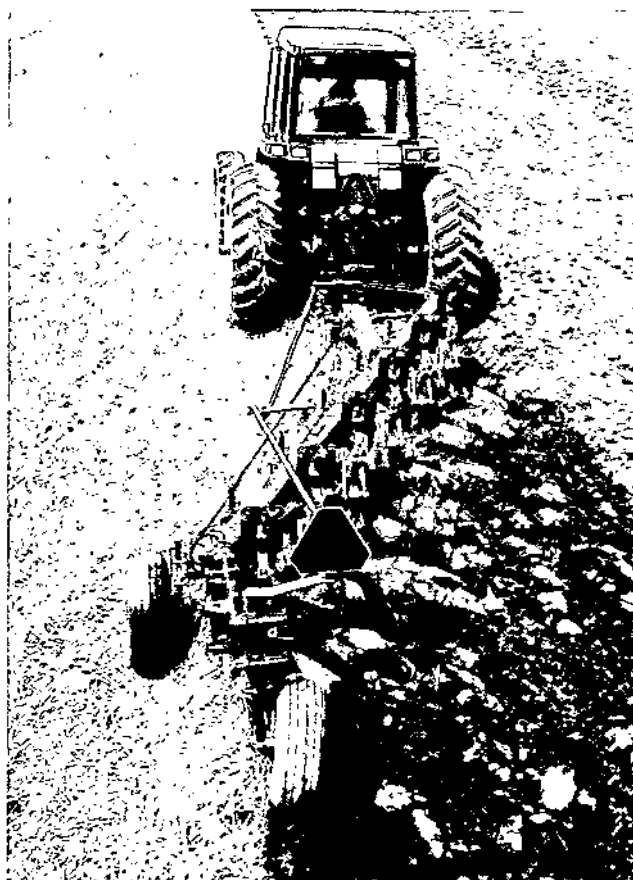
Wil-Rich
P.O. Box 1030
Wahpeton, ND 58074
(701) 642-2621

Worksaver, Inc.
P.O. Box 1000
S State St.
Litchfield, IL 62056
(217) 324-5973

Year-A-Round Cab Corp.
P.O. Box 2075
Mankato, MN 56001
(507) 624-9381

Plows

Plows are tractor-drawn primary tillage implements that are used to invert the soil profile. There are basically two types of plows: the moldboard and the disc. Plows are usually mounted on the rear 3-point hitch of a tractor and are adjustable to an operational depth of 12 inches. The curved blade of a moldboard plow is known as the "bottom" or "share" and different models range in size from 1-bottom to 12-bottom. Common plowing widths vary from 14 to 18 inches. Disc plows contain large circular, concave discs and are mounted in gangs. Plows are available for all categories of tractors.



Plows:

Ace Supply Inc.
P.O. Box 1098
Caldwell, ID 83606-1098
(208) 459-0731

Arts-Way Mfg. Co.
P.O. Box 288
Armstrong, IA 50514
(712) 864-3131

Brinly-Hardy Co. Inc.
P.O. Box 1116
Louisville, KY 40201
(502) 585-3351

Callahan Implement Mfg., Inc.
107 11th Ave. N
Nampa, ID 83651
(208) 466-0871

**J.J. Case
A Tenneco Co.**
700 State St.
Racine, WI 53404
(414) 636-5399

**Central Tractor Farm &
Family Center**
P.O. Box 3330
Des Moines, IA 50316
(515) 266-3101

Chapin Equipment Co.
202 Fulton St.
Fresno, CA 93721
(209) 233-7141

Conway Technologies Corp.
P.O. Box 350
McAllen, TX 78502
(512) 687-7500

CrustBuster/Speed King, Inc.
P.O. Box 1438
Fort Dodge Rd.
Dodge City, KS 67801
(316) 227-7106

**Deere & Co.
John Deere Rd.**
Moline, IL 62165
(309) 765-5678

ED-KA Mfg. Co.
P.O. Box 37
Garfield, WA 99130
(509) 635-1521

Engineering Products Co.
P.O. Box 1510
Waukesha, WI 53187
(414) 785-0786

Ford New Holland, Inc.
500 Diller Ave.
New Holland, PA 17557
(717) 355-1121

Forage King Industries, Inc.
P.O. Box 215
Ridgeland, WI 54763
(715) 949-1020

Hester Plow Co., Inc.
P.O. Box 340
Lake City, FL 32056-0340
(904) 755-0960

Howse Implement Co., Inc.
P.O. Box 86
Laurel, MS 39441
(601) 428-0841

Kello-Bilt Industries, Ltd.
P.O. Box 1119
Stettler, Alberta
Canada T0C 2L0
(403) 742-3663

Kewanee Farm Equipment Co.
1516 Burlington Ave.
Kewanee, IL 61443
(309) 852-2191

King Kutter, Inc.
P.O. Box 480
Winfield, AL 35594
(205) 487-3202

Plows:

KMN Modern Farm Equipment, Inc.
P.O. Box 1896
West Memphis, AR 72301
(501) 732-4270

Leinback Machines Co.
P.O. Box 11786
Winston-Salem, NC 27116
(919) 924-4115

M&M Plow & Equipment Mfg. Co., Inc.
P.O. Box 831
San Angelo, TX 76902
(915) 653-7231

Marvin Landplane
P.O. Box 1880
Woodland, CA 95695
(915) 662-2871

Massey-Ferguson, Inc.
1901 Bell Ave.
Des Moines, IA 50315
(515) 247-2011

May-Wes Mfg. Inc.
P.O. Box 33
Gibbon, MN 55335
(507) 834-6572

Mil-Rich
P.O. Box 1030
Wahpeton, ND 58074
(701) 642-2621

Morris Industries, Ltd.
85 York Rd.
Yorkton, Saskatchewan
Canada S3N 2X2
(306) 783-8585

MTD Products, Inc.
P.O. Box 36900
Cleveland, OH 44136
(216) 225-2600

The Murray Ohio Mfg., Co.
P.O. Box 268
Brentwood, TN 37027
(615) 373-6500

Nibex, Inc.
P.O. Box 8585
Emeryville, CA 94662
(415) 428-0871

Norcan Farm Equipment, Ltd.
P.O. Box 1237
Cambridge, Ontario
Canada N1R 6C9
(519) 623-8261

Overun Farm Machinery, Inc.
866 Langs Dr.
Cambridge, Ontario
Canada N3H 2N7
(519) 653-8880

Power King Tractors
P.O. Box 1510
Waukesha, WI 53187
(414) 785-0786

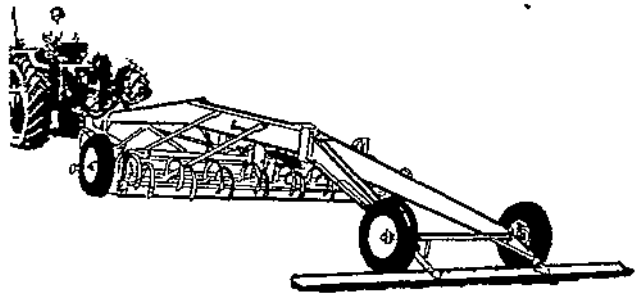
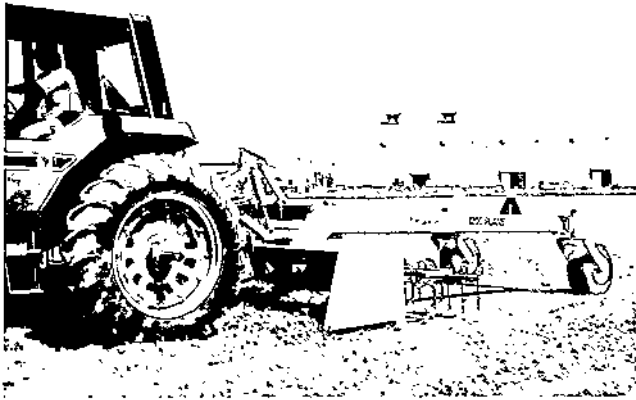
Rokon International, Inc.
P.O. Box 189
Jaffrey, NH 03452
(800) 632-2481

Taylor/Pittsburgh Implements
P.O. Box 769
Athens, TN 37303
(615) 745-3110

The Vassar Co.
P.O. Box 609
207 N Main
Perkins, OK 74059
(405) 547-2454

White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Wishek Steel Mfg., Inc.
P.O. Box 185
Wishek, ND 58495
(701) 452-2449



Levelers:

E. L. Anderson Mfg., Inc.
P.O. Box 5602
Eugene, OR 97405
(503) 344-4932

Ashland Industries, Inc.
P.O. Box 717
Ashland, WI 54806
(715) 682-4622

Automatic Equipment Mfg. Co.
One Mill Rd.
Pender, NE 68047
(402) 385-3051

Bowman Mfg. Co., Inc.
P.O. Box 705
Rt. 3
Newport, AR 72112
(501) 523-2785

Conway Technologies Corp.
P.O. Box 350
McAllen, TX 78502
(512) 687-7500

Degelman Industries, Inc.
P.O. Box 490
Minot, ND 58701
(701) 852-1876

Enid Fabricators Inc.
P.O. Box 3411
Enid, OK 73702
(405) 233-3111

Eversman, Inc.
P.O. Box 390336
Denver, CO 80239
(303) 371-0333

House Mfg. Co., Inc.
P.O. Box 214
Cherry Valley, AR 72324
(501) 588-3307

Hurricane Ditcher Co.
2815 Old Decker Rd.
Vincennes, IN 47591
(812) 886-9663

Kirchner Machine, Ltd.
2419 Second Ave. N
Lethbridge, Alberta
Canada T1H 0C1
(403) 328-5569

Marvin Landplane
P.O. Box 1880
Woodland, CA 95695
(916) 662-2871

Leon-Ram Enterprises, Inc.
135 York Rd. E
Yorkton, Saskatchewan
Canada S3N 3Z4
(306) 783-6592

Miskin Scraper Works, Inc.
P.O. Box 218
Ucon, ID 83454
(208) 522-2139

Pathfinder Snowplows
Rt. 3
Exeter, RI 02822
(401) 397-5053

Prime Mfg. Co., Inc.
P.O. Box 433
Poplarville, MS 39470
(601) 795-4553

Rayne Land Planes Inc.
P.O. Box 549
Rayne, LA 70578
(318) 334-2101

Reiten Inc.
P.O. Box 589
Cooperstown, ND 58425
(701) 797-2751

Rome Industries
P.O. Box 48
Cedartown, GA 30125
(404) 748-4450

Rowse Hydraulic Rakes Co., Inc.
P.O. Box 42
HC 80
Burwell, NE 678823
(308) 348-2276

T.G. Schmeiser Co., Inc.
P.O. Box 1047
Fresno, CA 93714
(209) 268-8128

Soilmover Mfg. Corp.
P.O. Box P
Pender, NE 68047
(402) 385-3051

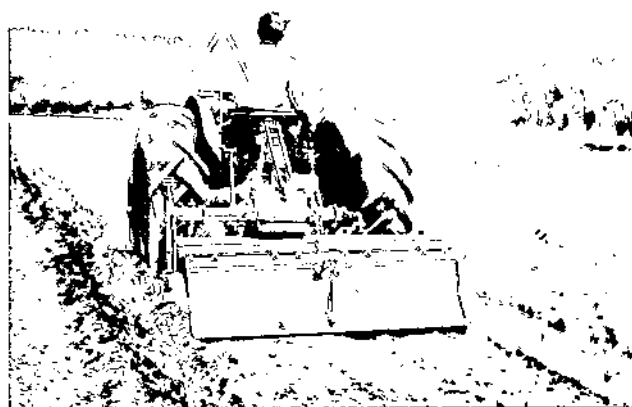
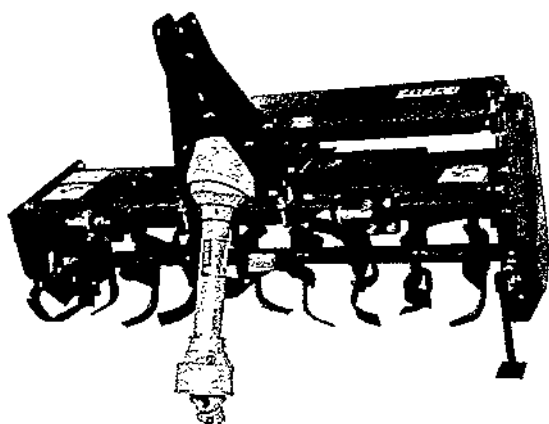
The Vassar Co.
P.O. Box 609
207 N Main
Perkins, OK 74059
(405) 547-2454

Westendorf Mfg., Co., Inc.
P.O. Box 29
Onawa, IA 51040
(712) 423-2762

York Modern Corp.
P.O. Box 488
Umadilla, NY 13849
(607) 369-7111

Rotary Tillers

Rotary tillers are secondary tillage implements designed to loosen, mix, and blend soils to a uniform structure for planting. They are available in a wide selection of sizes. The actual tillers are small, hooked blades that are gang-mounted on an rotating axle. Most rotary tillers have adjustments for rotation speed (the faster the rotation, the smaller the size of the soil particles) and depth (from 1 to 8 inches).



Rotary Tillers:

Alloway Mfg. and Dist. Co.
P.O. Box 2825
Fargo, ND 58108
(701) 282-7014

Beaver Valley Supply
Atwood, KS 67730
(913) 626-3251

BEFCO, Inc.
P.O. Box 6036
Rocky Mount, NC 27801
(919) 977-9920

Bush Hog Division
Allied Prod. Corp.
P.O. Box 1039
Selma, AL 36702-1039
(205) 872-6261

J.J. Case
A Tenneco Co.
700 State St.
Racine, WI 53404
(414) 636-5399

Continental Belton Co.
P.O. Box 660
920 E 6th St.
Belton, TX 76513
(817) 939-3731

CrustBuster/Speed King, Inc.
P.O. Box 1438
Fort Dodge Rd.
Dodge City, KS 67801
(316) 227-7106

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765 5678

Eversman, Inc.
P.O. Box 390336
Denver, CO 80239
(303) 371-0333

The Ferguson Mfg. Co., Inc.
P.O. Box 1098
Suffolk VA 23434
(804) 539-3409

Great Plains Mfg., Inc.
P.O. Box 218
Assaria, KS 67416
(913) 667-4755

The Green Hoe Co., Inc.
W Main Rd.
Portland, NY 14769
(716) 792-9433

HCC, Inc.
1501 First Ave.
Mendota, IL 61342
(815) 539-9371

Hester Plow Co., Inc.
P.O. Box 340
Lake City, FL 32056-0340
(904) 755-0960

Impex International, Inc.
115A Belton Dr.
Spartanburg, SC 29304
(800) 274-4410

Kelley Mfg., Co.
P.O. Drawer 1467
Tifton, GA 31793-1467
(912) 382-9393

KMN Modern Farm Equipment, Inc.
P.O. Box 1896
West Memphis, AR 72301
(501) 732-4270

Kubota Tractor Corp.
550 W Artesia Blvd.
Compton, CA 90220
(213) 537-2531

Kuhn Farm Machines, Inc.
P.O. Box 224
Vernon, NY 13476
(315) 829-2620

Long Mfg. NC, Inc.
P.O. Box 1139
Tarboro, NC 27886
(919) 823-4151

Marvin Landplane
P.O. Box 1880
Woodland, CA 95695
(916) 662-2871

Mitchell, Lewis & Staver Co.
9925 SW Commerce Circle
Wilsonville, OR 97070
(503) 682-0991

M&W Gear Co.
Rt. 47 S
Gibson City, IL 60936
(217) 784-4261

Rotary Tillers:

Nichols Tillage Tools, Inc.
312 Hereford Ave.
Sterling, CO 80751
(303) 522-8676

Utility Tool & Body Co., Inc.
P.O. Box 360
Clintonville, WI 54929
(715) 823-3167

Northwest-Tillers, Inc.
P.O. Box 10932
Yakima, WA 98909
(509) 575-1950

Vandermolen Corp.
119 Dorsa Ave.
Livingston, NJ 07039
(201) 992-8506

Sunflower Mfg. Co., Inc.
P.O. Box 566
Beloit, KS 67420
(913) 738-2261

White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Taylor/Pittsburgh Implements
P.O. Box 769
Athens, TN 37303
(615) 745-3110

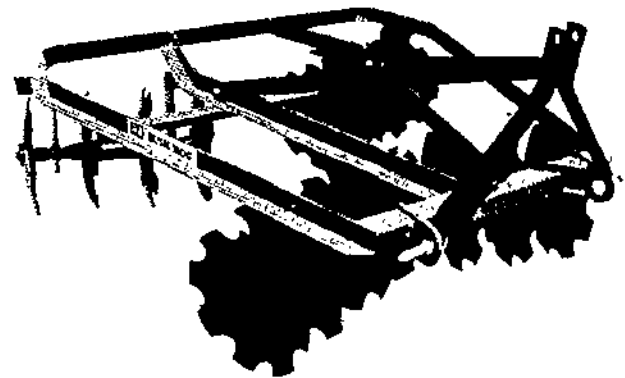
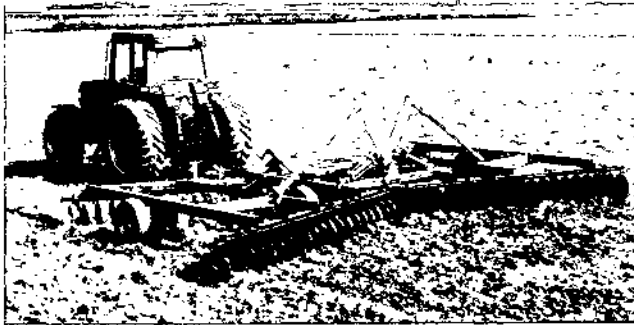
Yard-Man Co.
P.O. Box 360940
5965 Crafon Rd.
Cleveland, OH 44136
(216) 273-3600

Timm Enterprises, Ltd.
P.O. Box 157
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Yetter Mfg. Co., Inc.
P.O. Box 358
Colchester, IL 62326
(309) 776-4111

Discs

Discs are tractor-drawn secondary tillage implements that consist of a gang of round, concave metal discs that are spaced several inches apart and mounted on a bias. They are adjustable and have an effective operating depth of 8 inches. Discs are available for all categories of tractors and in widths from 6 to 35 feet.



<p>Discs:</p> <p>Agridisc & Implements Corp. 5502 NW 72nd Ave. Miami, FL 33166 (305) 884-6100</p> <p>Amco Mfg., Inc. P.O. Box 1107 Yazoo City, MS 39194 (601) 746-4464</p> <p>Athens Plow Co. Athens, TN 37303 (615) 744-7569</p> <p>Beaver Valley Supply Atwood, KS 67730 (913) 626-3251</p> <p>Brown Mfg. Corp. P.O. Box 339 Rt 3 Highway 27 E Ozark, AL 36360 (205) 795-6603</p> <p>Callahan Implement Mfg., Inc. 107 - 11th Ave. N Nampa, ID 83651 (208) 466-0871</p>	<p>J.I. Case A Tenneco Co. 700 State St. Racine, WI 53404 (414) 636-5399</p> <p>Chapin Equipment Co. 202 Fulton St. Fresno, CA 93721 (209) 233-7141</p> <p>Conway Technologies Corp. P.O. Box 350 McAllen, TX 78502 (512) 687-7500</p> <p>Deere & Co. John Deere Rd. Moline, IL 61265 (309) 765-5678</p> <p>Deutz-Allis Corp. 3883 Steve Reynolds Blvd. Norcross, GA 30093 (404) 564-7100</p> <p>Edwards Equipment Co. 4312 Main St. Yakima, WA 98903 (509) 248-1770</p>	<p>Engineering Products Co. P.O. Box 1510 Waukesha, WI 53187 (414) 785-0786</p> <p>Ezee-On Mfg., Ltd. Highway 16 W Vegreville, Alberta Canada 50B 4L0 (403) 632-2126</p> <p>Ford New Holland, Inc. 500 Diller Ave. New Holland, PA 17557 (717) 355-1121</p> <p>Hesston Corp. 245 E North Ave. Carol Stream, IL 60188 (312) 260-4490</p> <p>Hester Plow Co., Inc. P.O. Box 340 Lake City, FL 32056-0340 (904) 755-0960</p> <p>Howse Implement Co., Inc. P.O. Box 86 Laurel, MS 39441 (601) 428-0841</p>	<p>Hutch Master Products P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621</p> <p>Kello-Bilt Industries, Ltd. P.O. Box 1119 Stettler, Alberta Canada T0C 2L0 (403) 742-3663</p> <p>Kewanee Farm Equipment Co. 1516 Burlington Ave. Kewanee, IL 61443 (309) 852-2191</p> <p>King Plow Co. P.O. Box 93009 Atlanta, GA 30377 (404) 876-4476</p> <p>Krause Plow Corp. P.O. Box 2707 Hutchinson, KS 67504-2707 (316) 663-6161</p> <p>Leinbach Machines Co. P.O. Box 11786 Winston-Salem, NC 27116 (919) 924-4115</p>
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Discs:

Marvin Landplane
P.O. Box 1880
Woodland, CA 95695
(916) 662-2871

Massey-Ferguson, Inc.
1901 Bell Ave.
Des Moines, IA 50315
(515) 247-2011

McConnell Mfg. Co., Inc.
McConnell Ave.
Prattsburg, NY 14873
(607) 522-3701

Modem, Inc.
P.O. Box 790
Beaumont, TX 77704
(409) 833-2665

Narcan Farm Equipment, Ltd.
P.O. Box 1237
Cambridge, Ontario
Canada N1R 6C9
(519) 623-8261

Nicholls Farm Equipment
Rt. 3
Wainfleet, Ontario
Canada L05 1V0
(416) 732-2000

Portable Elevator Division
920 E Grove St.
Bloomington, IL 61701
(309) 329-1235

Prime Mfg. Co., Inc.
P.O. Box 433
Poplarville, MS 39470
(601) 795-4553

Rite Way Mfg. Co., Ltd.
P.O. Box 3344
Regina, Saskatchewan
Canada S4P 3H1
(306) 543-6777

Rome Industries
P.O. Box 48
Cedartown, GA 30125
(404) 748-4450

Steiger Tractor, Inc.
P.O. Box 6006
Fargo, ND 58108
(701) 293-4714

Summers Mfg. Co.
338 Railway Ave.
Maddock, ND 58348
(701) 438-2855

Sunflower Mfg. Co., Inc.
P.O. Box 566
Beloit, KS 67420
(913) 738-2261

Taylor/Pittsburgh Implements
P.O. Box 769
Athens, TN 37303
(615) 745-3110

Timm Enterprises, Ltd.
P.O. Box 157
Oakville, Ontario
Canada L6UJ 4Z5
(416) 878-4244

Tractor Implement Supply Co.
232 Lothenback Ave.
St. Paul, MN 55118
(612) 455-6682

The Vassar Co.
P.O. Box 609
207 N Main
Perkins, OK 74059
(405) 547-2454

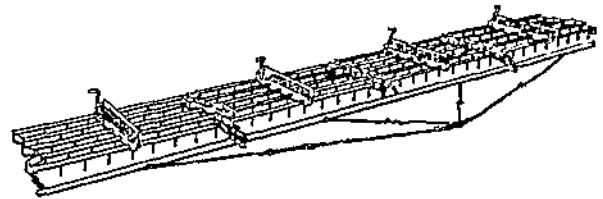
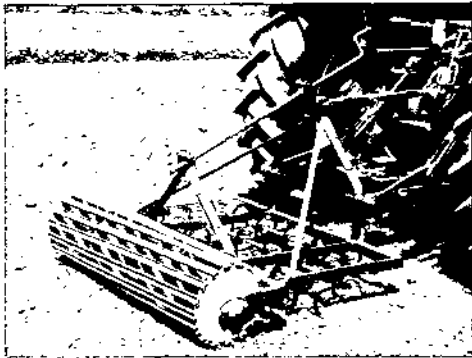
White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Wil-Rich
P.O. Box 1030
Wahpeton, ND 58074
(701) 642-2621

Wishek Steel Mfg., Inc.
P.O. Box 185
Wishek, ND 58495
(701) 452-2449

Harrows

Harrows are tractor-drawn secondary tillage implements that break up clods and smooth the soil. They are available in a variety of widths. There are basically three types of harrows: the "spring-tooth," with curved tines; the "spike tooth" with rigid teeth; and the "flexible" that contours to the ground. Harrows can be mounted with other implements for a variety of different effects. For example, they can be mounted behind discs to break up clods before they harden. Some harrows have rubber tire carriers for road travel and many have long sections that can be folded for transport.

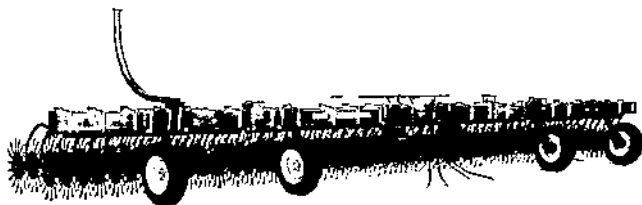


Harrows:	J.I. Case A Tenneco Co. 700 State St. Racine, WI 53404 (414) 636-5399	DMI, Inc. P.O. Box 65 Goodfield, IL 61742 (309) 965-2233	Forrest City Machine Works, Inc. P.O. Box 984 Forrest City, AR 72335-0984 (501) 633-1514
ACI Sales & Service P.O. Drawer Z Filer, ID 83328 (208) 326-4305	Corsicana Grader & Machine Co. P.O. Box 1699 Corsicana, TX 75110 (214) 872-1241	ED-KA Mfg. Co. P.O. Box 37 Garfield, WA 99130 (509) 635-1521	Fuerst Brothers, Inc. P.O. Box 427 Gibson City, IL 60936 (217) 784-4266
Alloway Mfg. & Dist. Co. P.O. Box 2825 Fargo, ND 58108 (701) 282-7014	CrustBuster/Speed King Inc. P.O. Box 1438 Fort Dodge Rd. Dodge City, KS 67801 (316) 227-7106	Farm King Allied, Inc. P.O. Box 1003 Winnipeg, Manitoba Canada R3C 2W5 (204) 661-8711	Harriston Industries, Inc. P.O. Box 378 Minot, ND 58261 (701) 248-3286
Baker, The Tillage Co. 625 Linden Alva, OK 73717 (405) 327-0234	Deere & Co. John Deere Rd. Moline, IL 61265 (309) 765-5678	Farnam Equipment P.O. Box 34820 Phoenix, AZ 85067 (602) 285-1660	Hinniker Co. P.O. Box 3407 Mankato, MN 56002 (507) 625-6621
Bigham Brothers, Inc. P.O. Box 3338 Lubbock, TX 79452 (806) 765-8201	Degelman Industries, Inc. P.O. Box 490 Minot, ND 58701 (701) 852-1876	Fast Track Harrow 72188 Cosmic Dr. Temecula, CA 92390 (714) 676-6749	Howse Implement Co., Inc. P.O. Box 86 Laurel, MS 39441 (601) 428-0841
Blanchard Co. P.O. Box 1607 Minot, ND 58702 (701) 852-1924	Deutz-Allis Corp. 3883 Steve Reynolds Blvd. Norcross, GA 30093 (404) 564-7100	Flexi-Coil, Ltd. P.O. Box 1928 Saskatoon, Saskatchewan Canada S7K 3S5 (306) 934-3500	
Brillion Iron Works, Inc. 200 Park Ave. Brillion, WI 54110 (414) 756-2121			

Harrows:			
Kasco Mfg. Co., Inc. P.O. Box 393 Rt. 3 Shelbyville, IN 46176 (317) 398-7973	McFarlane Mfg. Co., Inc. P.O. Box 577 1259 S Water St. Sauk City, WI 53583 (608) 643-3321	Rome Industries P.O. Box 48 Cedartown, GA 30125 (404) 748-4450	Timm Enterprises, Ltd. P.O. Box 157 Oakville, Ontario Canada L6J 4Z5 (416) 878-4244
Kent Mfg. Co., Inc. P.O. Box 126 Tipton, KS 67485 (913) 373-4145	My-D Han-D Mfg., Inc. Rt. 1, W McArtor Dodge City, KS 67801 (316) 225-0263	Speed King Mfg. Co., Inc. P.O. Box 1438 Dodge City, KS 67801 (316) 227-7106	Traver Sales Corp. 84636 Highway 25 Folsom, LA 70437 (504) 796-3286
King Plow Co. P.O. Box 93009 Atlanta, GA 30377 (404) 876-4476	Noble P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621	Sprayrite Mfg. Co. P.O. Box 3289 West Helena, AR 72390 (501) 572-6737	Tri-Ag Corp. 555 N Tenth Logan, UT 84321 (801) 753-1950
Knowles Mfg. Co. P.O. Box 97 Glenbeulah, WI 53023 (414) 526-3241	Northwest-Tillers, Inc. P.O. Box 10932 Yakima, WA 98909 (509) 575-1950	Steelcraft, Inc. P.O. Box 1284 505 - 30th Ave. NW Miami, OK 74355 (918) 542-4466	Unverferth Mfg. Co., Inc. P.O. Box 357 Star Rt. 224 Kalida, OH 45853 (419) 532-3121
Jack Kovar Sales Co. 1329 3rd Ave. S Anoka, MN 55303 (612) 421-4047	Pepin Farm Implements P.O. Box 158 610 Pine St. Pepin, WI 54759 (715) 442-2111	Stocker & Son, Inc. P.O. Box 749 Bayport, NY 11705 (516) 472-1881	W&A Mfg., Co. P.O. Box 5238 Pine Bluff, AR 71611 (501) 534-7420
Leinbach Machinery Co. P.O. Box 11786 Winston-Salem, NC 27116 (919) 924-4115	Portable Elevator Div. 920 E Grove St. Bloomington, IL 62701 (309) 829-1235	Sunflower Mfg. Co., Inc. P.O. Box 566 Beloit, KS 67420 (913) 738-2261	Western Mfg. Co., Inc. P.O. Box 55 Bottineau, ND 58318 (701) 228-3757
Lorenz Mfg. Co. P.O. Box 127 Benson, MN 56215 (612) 843-3210	Rears Mfg. Co. 2140 Prairie Rd. Eugene, OR 97402 (503) 688-1002	Taylor/Pittsburgh Implements P.O. Box 769 Athens, TN 37303 (615) 745-3110	Wil-Rich P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621
McConnell Mfg. Co., Inc. McConnell Ave. Prattsburg, NY 14873 (607) 522-3701	Remlinger Mfg. Co., Inc. P.O. Box 299 Kalida, OH 45853 (419) 532-3647	TEMCO H-M Parts Co. P.O. Box 40210 Memphis, TN 38174-0210 (901) 274-1158	White Farm Equipment 123 W Sycamore St. Coldwater, OH 45828 (419) 678-5311

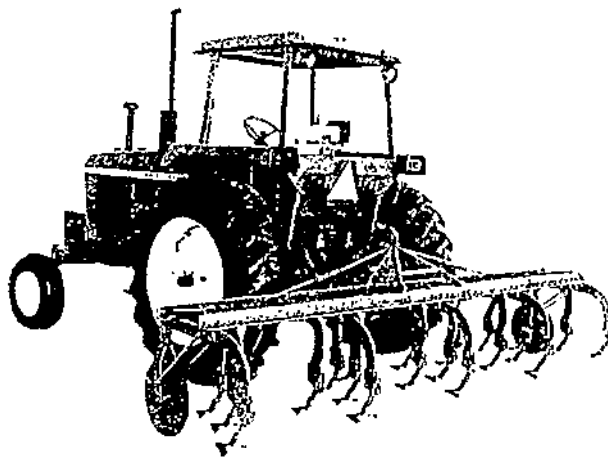
Cultivators

Cultivators are used for seedbed preparation, weed control, stubble-mulch tillage, summer fallow, and roughing fields to increase moisture absorption and to control wind and water erosion. Chisel plows are included, however, they are of heavier construction, designed for deeper operation, and are used for primary tillage. Versatility is often increased by adding various attachments such as fertilizers, sprayers, harrows, or seeders to cultivators.



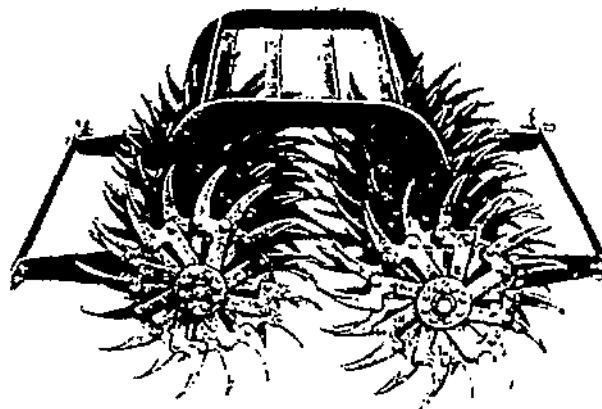
Chisel Plow

A chisel plow is a tractor-drawn implement that breaks up the soil or subsoil. It may be used for primary or secondary tillage, depending on the model. Chisel plowing increases water and root penetration in some soil conditions. Chisel models are available for soil penetration from 4 to 30 inches deep and in widths ranging from 6 to 40 feet for all categories of tractors.



Rotary Hoe

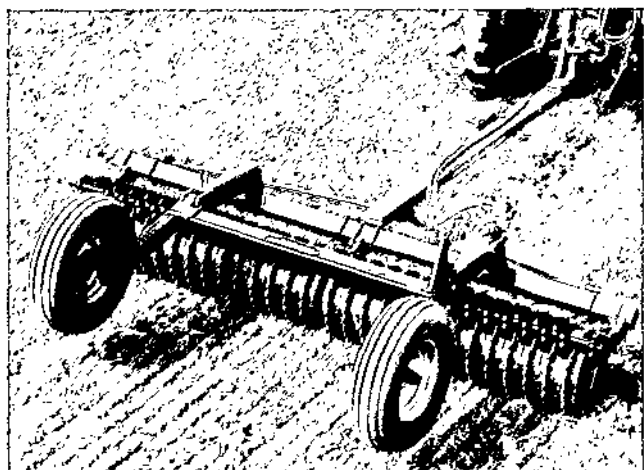
A rotary hoe is a tractor-drawn secondary tillage or cultivation implement. It may be used to weed new seedbeds or to break up crusty surface soil. It consists of tandem multi-teeth wheels that penetrate the soil to a maximum depth of 2 inches. Rotary hoes are available in widths from 4 to 20 feet for all categories of tractors.



Cultivators:			
Ace Supply, Inc. P.O. Box 1098 Caldwell, ID 83606-1098 (208) 459-0731	Dickey Machine Works P.O. Box 5610 Pine Bluff, AR 71611 (501) 536-1300	Landoll Corp. 1700 May St. Marysville, KS 66508 (913)562-5381	Sprayrite Mfg. Co. P.O. Box 3289 West Helena, AR 72390 (501) 572-6737
Alloway Mfg. & Distributors Co. P.O. Box 2825 Fargo, ND 58108 (701) 282-7014	Eversman, Inc. P.O. Box 390336 Denver, CO 80239 (303) 371-0333	Lorenz Mfg.Co. P.O. Box 1507 Waterton, SD 57201 (605)886-9596	Sukup Mfg. Co. P.O. Box 677 Sheffield, IA 50475 (515) 892-4222
BEFCO, Inc. P.O. Box 6036 Rocky Mount, NC 27801 (919) 977-9920	Famhand, Inc. P.O. Box 1500 Excelsior, MN 55331 (612) 474-1941	J.E. Love Co. 309 California St. Garfield, WA 99130 (509) 635-1321	Taylor/Pittsburgh Implements P.O. Box 769 Athens, TN 37303 (615) 745-3110
Bigham Brothers, Inc. P.O. Box 3338 Lubbock, TX 79452 (806) 765-8201	Fleischer Mfg., Inc. P.O. Box 848 Columbus, NE 68602-0848 (402) 564-3244	Massey-Ferguson, Inc. 1901 Bell Ave. Des Moines, IA 50315 (515) 247-2011	Tebben Mfg. P.O. Box 140 Rt. 2 Clara City, MN 56222 (612) 847-2200
Brillion Iron Works, Inc. 200 Park Ave. Brillion, WI 54110 (414) 756-2121	Ford New Holland, Inc. 500 Diller Ave. New Holland, PA 17557 (717) 355-1121	McConnell Mfg. Co., Inc. McConnell Ave. Prattsburg, NY 14873 (607) 522-3701	Timm Enterprises, Ltd. P.O. Box 157 Oakville, Ontario Canada L6J 4Z5 (416) 878-4244
Brown Mfg. Corp. P.O. Box 339 Rt. 3 Highway 27 E Ozark, AL 36360 (205) 795-6603	Graham-Hoeme P.O. Box 3779 Amarillo, TX 79106 (214) 475-0405	Mid-States Equipment Co., Inc. P.O. Box 146 Lake View, IA 51540 (712) 657-8585	United Farm Tools, Inc. P.O. Box 4026 Glasgow, KY 42142 (502) 651-7121
Bryan Co. Salinas Farm Implements P.O. Box 1196 Salinas, CA 93902 (408) 754-6674	The Green Hoe Co., Inc. W Main Rd. Portland, NY 14769 (716) 792-9433	The Murray Ohio Mfg. Co. P.O. Box 268 Brentwood, TN 37027 (615) 373-6500	The Vassar Co. P.O. Box 609 207 N Main Perkins, OK 74059 (405) 547-2454
Buckeye Tractor Co. P.O. Box 123 Columbus Grove, OH 45830 (419) 659-2162	Harriston Industries, Inc. P.O. Box 378 Minot, ND 58261 (701) 248-3286	Noble P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621	Vicom Farm Machinery, Inc. 2885 Charlestown Rd. Lancaster, PA 17603 (717) 872-8661
Bush Hog Div. Allied Products Corp. P.O. Box 1039 Selma, AL 36702-1039 (205) 872-6261	Hesston Corp. 245 E North Ave. Carol Stream, IL 60188 (312) 260-4490	Northwest-Tillers, Inc. P.O. Box 10932 Yakima, WA 98909 (509) 575-1950	White Farm Equipment 123 W Sycamore St. Coldwater, OH 45828 (419) 678-5311
J.J. Case A Tenneco Co. 700 State St. Racine, WI 53404 (414) 636-5399	Hiniker Co. P.O. Box 3407 Mankato, MN 56002 (507) 624-6621	Orthmon Mfg., Inc. P.O. Drawer B Lexington, NE 68850 (308) 324-4654	Wil-Rich P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621
Deere & Co. John Deere Rd. Moline, IL 61265 (309) 765-5678	C.C. Kelley & Son 61501 Bremen Highway Mishawaka, IN 46544 (219) 255-4746	Pepin Farm Implements P.O. Box 158 610 Pine St. Pepin, WI 54759 (715) 442-2111	Worksaver, Inc. P.O. Box 1000 S State St. Litchfield, IL 62056 (217) 324-5973
Deutz-Allis Corp. 3883 Steve Reynolds Blvd. Norcross, GA 30093 (404) 564-7100	Kewanee Farm Equipment Co. 1516 Burlington Ave. Kewanee, IL 61443 (309) 852-2191	Remlinger Mfg. Co., Inc. P.O. Box 299 Kalida, OH 45853 (419) 532-3647	Yetter Mfg. Co., Inc. P.O. Box 358 Colchester, IL 62326 (309) 776-4111
	Krause Plow Corp. P.O. Box 2707 Hutchinson, KS 67504-2707 (316) 663-6161	Rome Industries P.O. Box 48 Cedartown, GA 30125 (404) 748-4450	

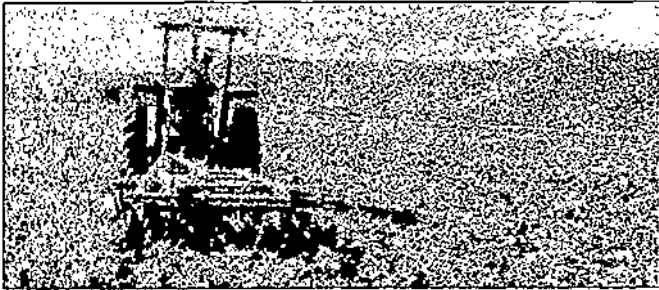
Roller Packers

Roller packers are tractor-drawn secondary tillage implements that are used to prepare seedbeds of proper tilth. They break clods, pulverize and firm the soil surface as well as close air pockets. (See *drum rollers Section 4.1*). Cultipackers have row indentation collars that are either serrated or smooth and create depressions for sowing seeds of cover or green manure crops. Cultipackers are used with harrows or cultivators and are available in a number of different sizes. Tandem models have arms that fold up for transport.



Roller Packers:	DMI, Inc. P.O. Box 65 Goodfield, IL 61742 (309) 965-2233	Kewanee Farm Equipment Co. 1516 Burlington Ave. Kewanee, IL 61443 (309) 852-2191	T.G. Schmeiser Co., Inc. P.O. Box 1047 Fresno, CA 93714 (209) 268-8128
Bigham Brothers, Inc. P.O. Box 3338 Lubbock, TX 79452 (806) 765-8201	ED-KA Mfg. Co. P.O. Box 37 Garfield, WA 99130 (509) 635-1521	McConnell Mfg. Co., Inc. McConnell Ave. Prattsburg, NY 14873 (607) 522-3701	Taylor/Pittsburgh Implements P.O. Box 769 Athens, TN 37303 (615) 745-3110
Blanchard Co. P.O. Box 1607 Minot, ND 58702 (701) 852-1924	Farmhand, Inc. P.O. Box 1500 Excelsior, MN 55331 (612) 474-1941	New Castings, Inc. Spokane Industrial Park Bldg. 4 Spokane, WA 99216 (509) 924-6464	Tebben Mfg. P.O. Box 140 Rt. 2 Clara City, MN 56222 (612) 847-2200
Brillion Iron Works, Inc. 200 Park Ave. Brillion, WI 54110 (414) 756-2121	Flexi-Coil, Ltd. P.O. Box 1928 Saskatoon, Saskatchewan Canada S7K 3S5 (306) 934-3500	Prime Mfg. Co., Inc. P.O. Box 433 Poplarville, MS 39470 (601) 795-4553	
B&W Foundry & Mfg. Co. 520 Upton St. San Angelo, TX 76901 (915) 653-4516	Harmon International Industries, Inc. P.O. Box 1444 Saskatoon, Saskatchewan Canada S7K 3P7 (306) 931-1161	Reiten, Inc. P.O. Box 589 Cooperstown, ND 58425 (701) 797-2751	
Clyde Machinery, Inc. P.O. Box 194 Glenwood, MN 56334			

3.4 Soil Fumigation



Many nursery pests, such as pathogenic fungi or insects, live in the soil and can build up their populations to harmful levels on crops of tree seedlings or in the cover crop or green manure crop. Because germinating seeds and young tree seedlings are particularly susceptible to these soilborne pathogens, nurseries often fumigate their seedbeds before sowing. Pesticides used for soil fumigation are extremely toxic, and therefore many nurseries contract with fumigation specialists to accomplish the task.

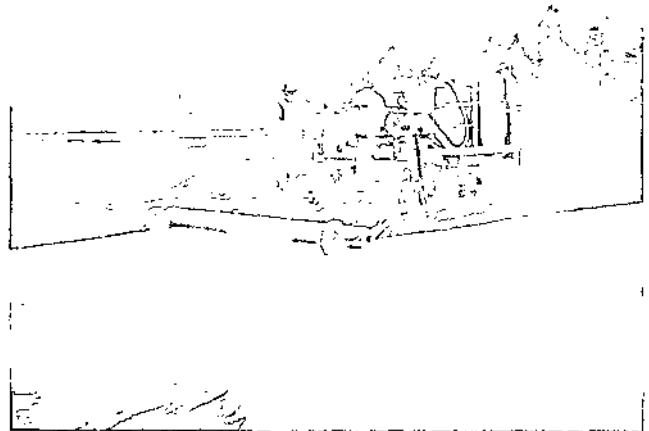
The key to successful fumigation is warm ($>50^{\circ}\text{F}$), moist, and porous soils that both stimulate dormant pests and allow the fumigant to penetrate thoroughly. Some southern nurseries are able to fumigate immediately before spring sowing, but cold, wet spring soil conditions force many other nurseries to fumigate the previous fall. The actual fumigation can be done in a few days if the weather cooperates, and the soil is ready for planting after allowing several weeks for ventilation.

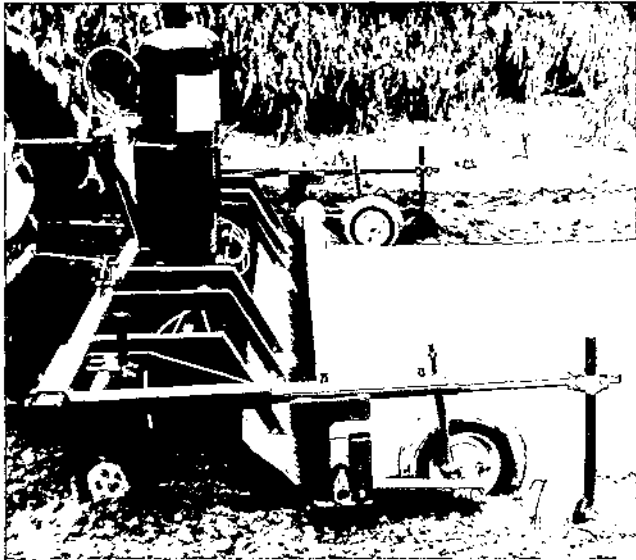
Fumigants

All fumigants function as gases. Some can be applied as pressurized liquids, such as methyl bromide/chloropicrin (MBC), or as fine powders, such as dazomet.

MBC is applied with a tractor-drawn implement consisting of ground-penetrating shanks that inject the pressurized liquid, connecting hoses, gages, the fumigant tank, and a roll of plastic tarp to cover the treated soil. Two tarping techniques have been used for covering injected fumigants. In "strip fumigation" the fumigant is applied under separate sections of tarp that are covered on both sides with soil. After the designated waiting period, the alternate untreated strips are then fumigated. With "continuous tarp fumigation" the application equipment has a liquid glue gun that seals each plastic tarp to the adjacent one so that the entire area can be treated at once.

Microgranule fumigants (dazomet) are applied through drop type spreaders (See *Section 5.2*), immediately incorporated into the soil, and physically sealed with a drum roller (See *Section 4.1*) and/or irrigation. Water converts the fine powder to gas and, after the prescribed waiting period, the treated area is cultivated to release the fumigant.





Fumigation Equipment:	
Coastal Chemical Corp. P.O. Box 856 Greenville, NC 27834 (919) 756-1156	Hendrix and Dail, Inc. P.O. Box 648 Greenville, NC 27835 (919) 758-4263
Great Lakes Chemical Corp. P.O. Box 2200 Highway 52 NW West Lafayette, IN 47906 (317) 497-6100	Reddick Equipment Co., Inc. P.O. Box 71 Williamston, NC 27892 (919) 792-1191
	Tri-Cal P.O. Box 1327 8770 Highway 25 Hollister, CA 95024 (916) 966-2930

Granular Fumigants:	
Farm Bureau Co. P.O. Box 54 Amigo, WI 54409 (715) 627-4844	Northwest Chemical Salem, OR (503) 390-3030
Hopkins Agricultural Chemical, Co. P.O. Box 7532 537 Atlas Ave. Madison, WI 53707 (800) 356-7202	Settlers Corp. P.O. Box 93 Bruce Crossing, MI 49912 (906) 827-3515
A.H. Hummert Seed Co. 2746 Chouteau Ave. St. Louis, MO 63103 (800) 325-3055	Smoke River Chemicals Caldwell, ID (208) 454-0475
Loveland Industries P.O. Box 1289 Greeley, CO 80632 (303) 346-8920	Tri-River Chemical Co., Inc. P.O. Box 2778 Pasco, WA 99302
J. Mollerma & Sons 5400 36th St. SE Grand Rapids, MI 49508 (616) 940-1441	Volm Bag Co. P.O. Box B 1804 N Edison Amigo, WI 54409 (715) 627-4826

Fumigation Contractors:

A.G. Fumigation
P.O. Box 9068
Brooks, OR 97305
(503) 393-1077

Aguite Crew
P.O. Box 415
Independence, OR 97351-0415

Anderson Reclamation
1125 W Baseline 295
Mesa, AZ 85210

Blair Soil Fumigation
1401 Camellia Dr.
Quitman, GA 31643
(912) 263-7083

Ray Burkhart
P.O. Box 1112
Redmond, OR 97756

Coastal Chemical Corp.
P.O. Box 856
Greenville, NC 27834
(919) 756-1156

Dodyns-Hart Pest Control
P.O. Box 1005
Pendleton, OR 97801-0020

Evert Fumigation Co., Inc.
4040 Colvert St.
Lincoln, NE 68506
(402) 488-2478

Hendrix and Dail, Inc.
P.O. Box 648
Greenville, NC 27835
(919) 758-4263

Northwest Chemical Corp.
4560 Ridge Dr. NE
Salem, OR 97303
(503) 390-3030

NW Pesticides Enterprises, Inc.
14520 Beck Rd.
Dallas, OR 97338

Reddick Equipment Co., Inc.
P.O. Box 71
Williamston, NC 27892
(919) 792-1191

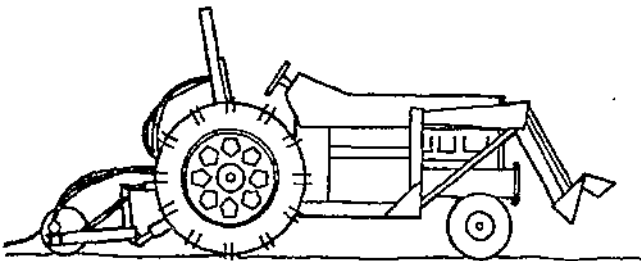
Rite-Way Fumigation Co., Inc.
1705 N 13th St.
Norfolk, NE 68701
(402) 371-2421

Soilfume, Inc.
209 Riverside Rd.
Watsonville, CA 95076
(408) 728-1732

Trident Agricultural Products, Inc
8002 NE, Highway 99
Suite 259
Vancouver, WA 98665

Nursery Tarp Roller

After MBC fumigation, the tarp must be removed from the treated area. A commercial tarp remover is available from the Humbolt and Coeur d'Alene Nurseries. It consists of a roller driven by a hydraulic motor. The apparatus is mounted on a 3-point hitch.



Drawings are available from:

USDA Forest Service
Humbolt Nursery
P.O. Box 2158
McKinleyville, CA 95521
(707) 839-3256

or

USDA Forest Service
Coeur d'Alene Nursery
3600 Nursery Rd.
Coeur d'Alene, ID 83814
(208) 765-6365

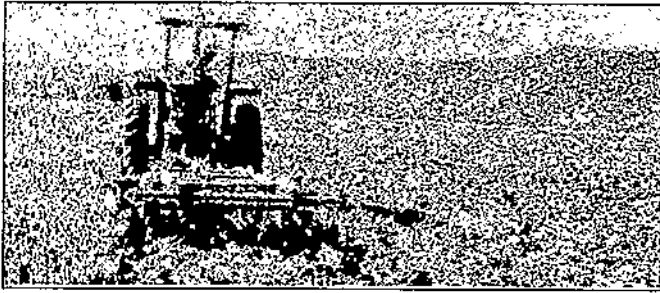
or

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900

Tarp Roller:

Yellow Devil Tarp Layer
Magnolia Agriculture Supply, Inc.
P.O. Box 6948
Jackson, MS 39212

3.5 Applying Soil Amendments



The final step in presowing soil preparation is to apply fertilizers or other soil amendments that must be incorporated. Some fertilizers and other chemical amendments cannot be applied as a top dressing after the crop is sown. Bareroot nurseries usually apply sulfur (to lower soil pH) or dolomitic limestone (to raise pH) during the fallow year or just before sowing. Among the macronutrient fertilizers, phosphorus, and potassium (potash) are incorporated into the seedbed before sowing.

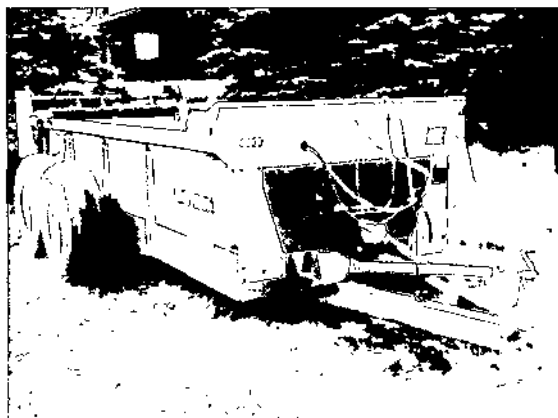
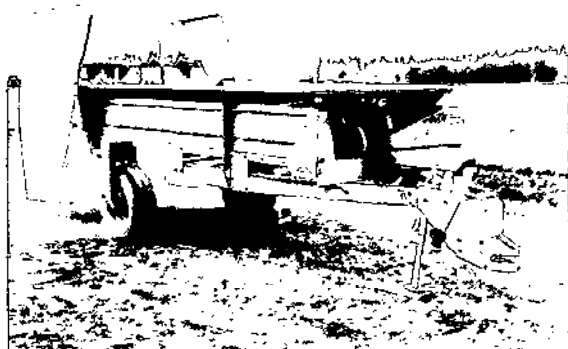
During the fallow year, presowing chemical amendments are normally broadcast with large-capacity agricultural fertilizer spreaders (See Section 5.2) and incorporated with standard cultivation equipment. This may be done before sowing the cover or green manure crop. Another alternative is to apply the amendments immediately before sowing. This can be done either as a broadcast application and incorporation or with drop spreaders mixed directly into the seedbed during bed formation.

Organic amendments, such as sawdust, are also applied as presowing incorporations. With sawdust, it is particularly important to apply the amendment as early in the fallow season as possible and to add supplemental nitrogen fertilizer at the same time to hasten decomposition. Uncomposted sawdust should never be applied immediately before sowing because it will utilize existing soil nitrogen for decomposition and result in nitrogen deficiency in the tree seedling crop.

Bulk organic amendments like sawdust have traditionally been applied with modified agricultural manure spreaders. It is extremely difficult to achieve even distribution of this material with stock equipment. Specialized manure spreaders have been constructed by many forest nurseries. Manure spreaders are available from standard agricultural equipment suppliers (See Section 4.4).

Agricultural Manure Spreaders

Manure usually is a readily available and inexpensive fertilizer. Besides adding nutrients to the soil, it also improves soil structure. Manure wagons are available with various paddles for varied spread patterns. They vary in capacity from 100 to 420 bushels. Some are equipped with steep sides to aid spreading. Many manufacturers provide tank spreaders for liquid manure, such as Ford New Holland. Capacity on tank spreaders ranges from 1,000 to 2,500 gallons. Manure wagons also may be used to spread mulch on seedbeds.



Manure Spreaders:

Ag-Chem Equipment Co., Inc.
5720 Smetana Dr.
Suite 100
Minnetonka, MN 55343
(612) 933-9006

Badger Northland, Inc.
P.O. Box 1215
Kaukauna, WI 54130
(414) 766-4603

Balzer Mfg. Co.
Highway 60 E
Mountain Lake, MN 56159
(507) 217-3133

Belarus Machinery, Inc.
P.O. Box 23608
Milwaukee, WI 53223
(414) 355-2000

Big A Equipment Co., Inc.
Industrial Rd.
Jackson, MN 56143
(913) 825-1631

J.I. Case Co.
A Tenneco Co.
700 State St.
Racine, WI 53404
(414) 636-5397

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Du-Al Mfg. Co.
1000 W Cherokee
Sioux Falls, SD 57117-5041
(605) 336-3860

Dyco Industries
2 Powder Mill Rd.
Maynard, MA 01754
(617) 897-6381

Famam Equipment
P.O. Box 34820
Phoenix, AZ 85067
(602) 285-1660

Forage King Industries, Inc.
P.O. Box 215
Ridgeland, WI 54763
(715) 949-1020

Ford New Holland, Inc.
P.O. Box 1895
500 Diller Ave.
New Holland, PA 17557-0903
(717) 355-1121

Gehl Co.
143 Water St.
West Bend, WI 53095
(414) 334-9461

H. & S. Mfg. Co., Inc.
P.O. Box 768
Marshfield, WI 54449
(715) 387-3414

Highway Equipment Co.
616 D Ave. NW
Cedar Rapids, IA 52605
(319) 363-8281

Huebner Implement Works, Inc.
P.O. Box 95
Forest Junction, WI 54123
(414) 989-1215

Kelly Ryan Equipment, Co.
P.O. Box 488
Blair, NE 68008
(402) 426-2151

Kirby Mfg., Inc.
P.O. Box 989
Merced, CA 95341
(209) 723-0778

Knight Mfg. Corp.
P.O. Box 167
Broadhead, WI 53520
(608) 897-2131

Meyer Mfg. Corp.
P.O. Box 405
Dorchester, WI 54425
(715) 654-5192

Miller-St. Nazianz, Inc.
511 E Main St.
St. Nazianz, WI 54232
(414) 773-2121

New Idea Farm Equipment Div.
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Off-Road Floater Equipment, Co.
627 Adena Rd.
Chillicothe, OH 45601
(614) 775-2666

Pequea Machine
3230 Gordonville Rd.
Gordonville, PA 17259
(717) 768-3197

United Farm Tools
P.O. Box 4026
Glasgow, KY 42141
(502) 651-7121

4.0 Sowing and Transplanting



4.1 Seed Bed Formation	86	4.5 Transplanting	102
Bed Formers	86	Transplanters	102
Frobro Kulti-Rotor Bed Shaper		Egedal Transplanter	
Whitfield Bed Builder and Leveler		Mechanical Transplanter	
Rototiller Bed Formers		Holland Transplanter	
Drum Rollers	88	Hardwood Cuttings Transplanter	
Egedal Bed Roller		Plug Transplanters	
4.2 Row Seeding	89		
Seeders and Planters	89		
Whitfield Nursery Seeder			
Wind River Seed Drill			
Love/Oyjord Seed Drill			
Frobro Pneumatic Seeder			
Hege Drill Planter			
Egedal Seeder			
Stanhay Seeder			
Love Precision Vacuum Seed Drill			
Silver Mountain Seed Drill			
Frobro MiniAir Seed Drill			
4.3 Applying Fertilizer and Mycorrhizal Fungi Inoculum	95		
Solid Fertilizer Injectors	95		
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4.4 Seedbed Mulching and Stabilization	96		
Spreaders	96		
Egedal Sand Spreader			
J. Herbert Stone Mulch Spreader			
Coeur d'Alene Sander			
Mulch Stabilization Chemicals			
Hydro Mulchers	99		
Miscellaneous	100		
Erosion Netting			
Stake Driver			
Netting Spreader Retrieval System			

To produce the requested number of seedlings, nurseries progress through a number of steps. Seed and ground must be prepared for sowing and cared for after sowing.

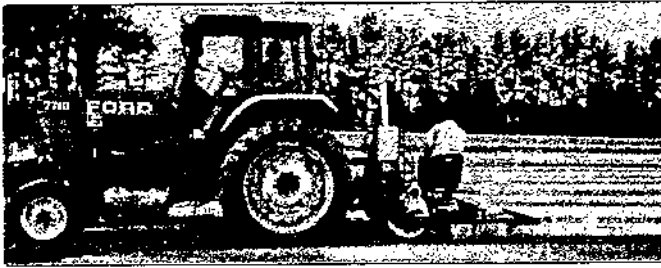
An initial step is completing sowing calculations that take into consideration the seedlot information—germination percentage, purity percentage, seeds per pound, and factors that are unique to individual nurseries. An estimate of the amount of nursery ground required to sow the seed is also necessary.

Ground preparation includes the incorporation of pre-sown fertilizers and seedbed formation. Seedbeds must be of a texture that allows the seed to be sown to the proper depth and to be covered.

Sowing is accomplished utilizing broadcast sowers or seed drills. Broadcast sowers scatter seed randomly over a section of seedbed. Seed drills drop the seed in individual rows. Precision seed drills, are capable of placing seeds at specific distances between seeds.

Once the seed has been placed in the ground it needs to be covered. Coverings include native soil, sand, and various types of mulches. Mulches of sawdust, peat moss, and other fine textured or light weight material may need to be secured to the ground. This can be accomplished with either a hydromulching material or a liquid polymer mulch.

4.1 Seed Bed Formation

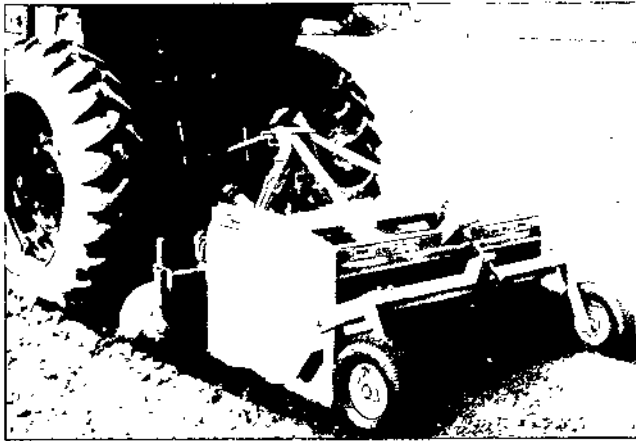


Seedbeds are formed using a variety of sowing and cultural equipment to enhance drainage.

The most efficient use of nursery ground depends on the formation of straight seedbeds. Seedbeds are formed using different equipment and techniques including rototillers (See Section 3.3) and bed formers.

Bed Formers

Bed formers are designed to shape seedbeds and condition the soil to the proper tilth. These implements work the soil to the middle, shape it to create a raised bed, and smooth and firm the surface. Bedforming equipment is usually capable of forming beds between 1 and 6 inches high. Four inches is common.

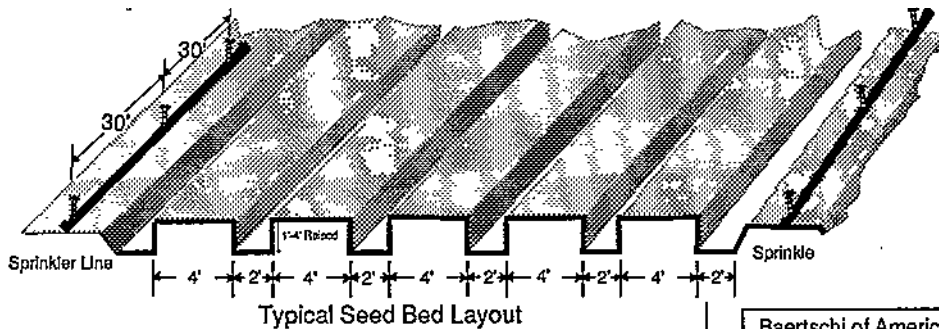
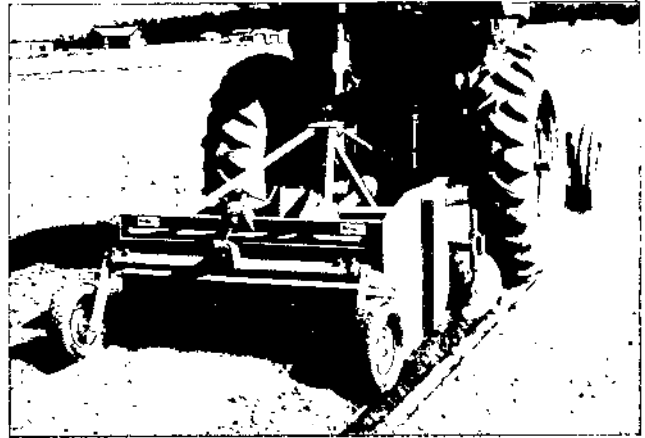


Frobro Kulti-Rotor Bed Shaper

This small tractor-pulled implement is designed to shape seed or transplant beds after basic soil preparation like subsoiling, chiseling, discing, or plowing.

The front rotor with curved blades breaks the ground into clods without forming a plow pan. The two adjustable front discs raise the bed to the desired height. Then, a counter-driven rear drum with spikes crumbles and firms the top soil.

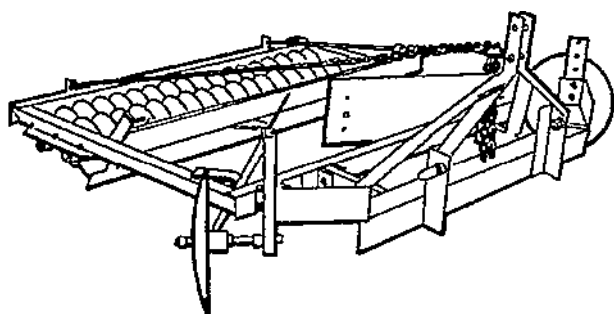
Fertilizer spreaders or bed rollers may be attached to the implement. A furrowing implement is available to form furrows for hand-planting.



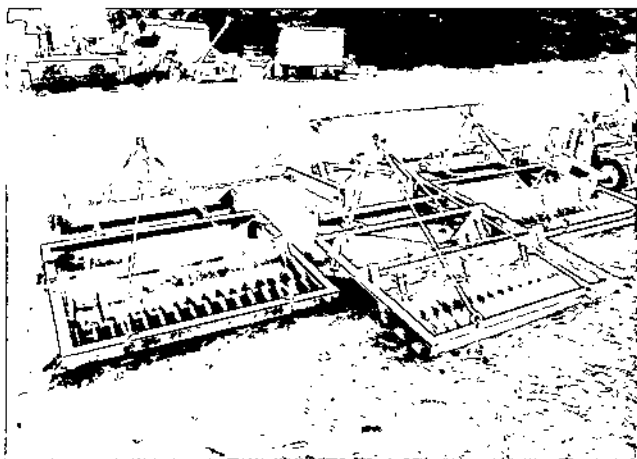
Baertschi of America Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Whitfield Bed Builder and Leveler

The Whitfield bed builder opens and lifts seedbeds to the desired height. The machine consists of two front discs, shaping bars, and tandem rollers. The discs work the center soil, while the shaping bars deflect soil to the middle of the row to create a raised bed. The tandem rollers in the rear pulverize the soil and prepare it for planting. The bed builder is available in category I and II 3-point hitch. The finished bed is 54 inches wide on the top, 60 inches wide at the base.



Some nurseries are mounting bed builders in parallel on tool bars to do three beds in one pass.



Bed Builder and Leveler:

R.A. Whitfield Mfg. Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

Rototiller Bed Formers

Some rototillers have bed-forming accessories. A wide variety of sizes are available (See *Rotary Tillers Sec. 3.3*).

Bed Formers:

Baertschi of America, Inc
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Kennco Mfg., Inc.
P. O. Box 1158
Ruskin, FL 33570
(813) 645-2591

Larchmont Engineering &
Irrigation, Inc.
11 Larchmont Lane
Lexington, MA 02173

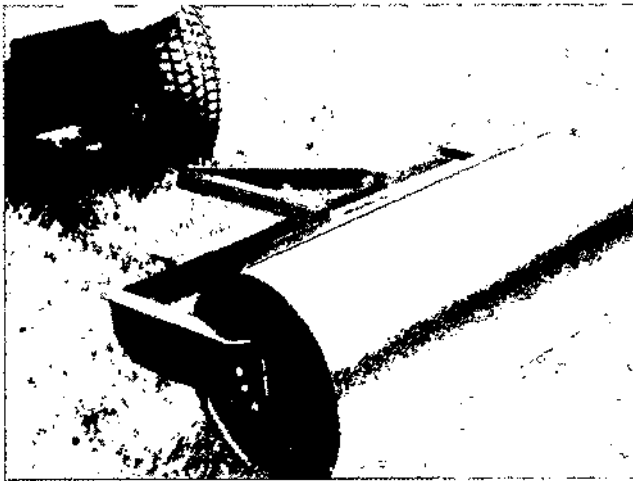
R.A. Whitfield Mfg. Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

Drum Rollers

Drum rollers have a smooth surface and are used to firm the soil or seal the surface. They are often mounted directly in front of seed drills or used alone to seal the soil surface after incorporating granular fumigants. Some models can be filled with water to increase their weight. They come in a variety of widths.

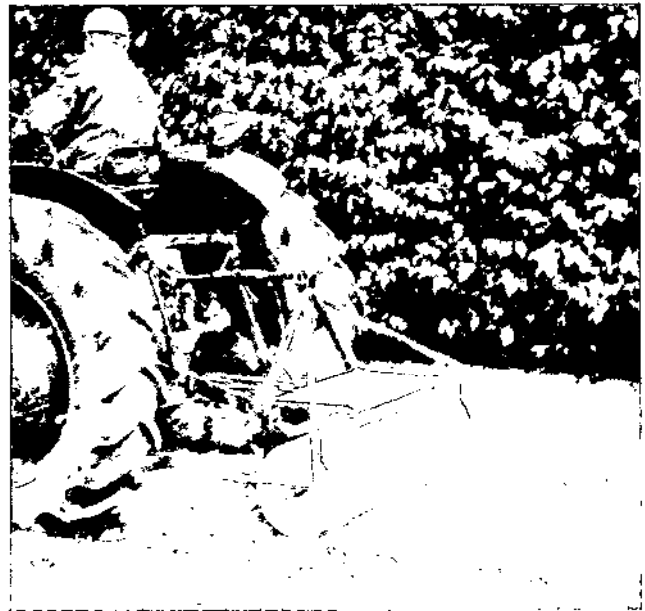
Before sowing, many nurseries roll seedbeds with smooth or collared rollers. Collared rollers have a smooth drum with 1/4- to 1/2-inch rings welded around it. The rings are positioned to provide a depression corresponding to the seed rows.

Rolling may be done as a separate operation; however, some nurseries have rollers mounted on seeders and combine rolling with seeding. Most rollers are custom built.



Egedal Bed Roller

The Egedal Bed Roller is a smooth 100-centimeter-wide drum roller that mounts on a 3-point hitch. A screw plug at one end allows it to be filled with water for weight control. Various widths are available on special order.



Egdal Bed Roller:

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Drum Rollers:

Ames Lawn and Garden Tools
P.O. Box 1774
Parkersburg, WV 26102
(304) 424-3288

Baertschi of America, Inc
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Gandy Co.
P.O. Box 528
528 Gandrud Rd.
Owatonna, MN 55060
(507) 451-5430

Kenoco Mfg., Inc.
P. O. Box 1158
Ruskin, FL 33570
(813) 645-2591

A.M. Leonard, Inc.
P. O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

True Temper Hardware Div.
Ernhart Consumer Group
P.O. Box 3500
465 Railroad Ave.
Shiremanstown, PA 17011

R.A. Whitfield Mfg. Co.
Whitfield Forestry Equip.
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

Worksaver, Inc.
P.O. Box 1000
S State St.
Litchfield, IL 62056
(217) 324-5973

4.2 Row Seeding

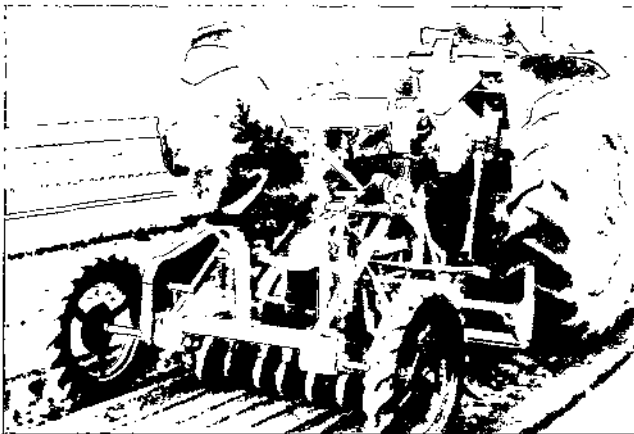


Precision row spacing and uniform spacing of trees within the row aid in weed control, other cultural activities, and lifting of seedlings. Due to these requirements, seeders commonly used in today's tree nurseries are row-crop seeders. They drop seeds individually in rows. The rows are normally spaced on 6-inch centers. Seed spacing within the rows varies depending on the desired seedling density and the sowing calculations.

Seeders and Planters

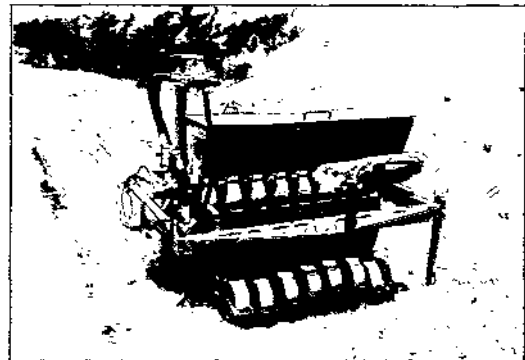
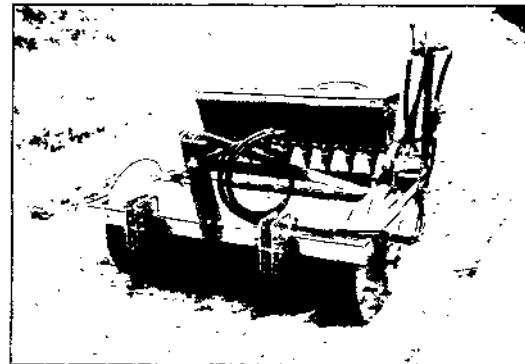
In most bareroot nurseries, seed drills are used to sow tree seed in rows. Sometimes the rows are referred to as drills. The seed drill delivers seed from a hopper to a metering device and through a drop tube to the seedbed. Once the seed is distributed to the bed, it is usually packed and covered by the closing devices located on the drill. Some seed drills do not cover the rows and a separate pass over the bed with a different piece of equipment is necessary. Drum rollers (Section 4.1) and spreaders (Section 4.4) are often used for this secondary operation.

Grain seed drills are used to sow cover and green manure crops. Some nurseries use grain drills to spread fertilizer as well (See Section 3.2).



Whitfield Nursery Seeder

The Whitfield Nursery Seeder consists of a feeder box, a seed metering device, eight drop tubes, a ground penetrating drill, and eight seed-covering devices. Row spacing is 6 inches. Eight V-type planting shoes are supplied with height adjustment. Customers can choose either a flat drum roller or a concave drum for raised beds.



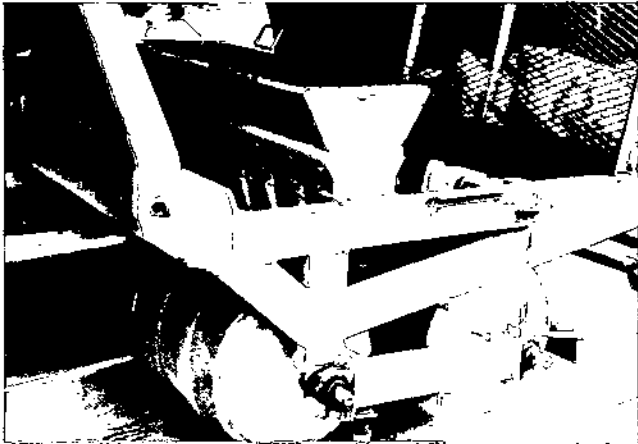
Whitfield Nursery Seeder:

R.A. Whitfield Mfg. Co.
Whitfield Forestry Equipment
P. O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

Wind River Seed Drill

The Wind River Seed Drill is custom-made following local patterns. It was originally designed and built at the Forest Service Wind River Nursery, Carson, Washington. This seed drill is not commercially manufactured and no plans are available. It is used by some tree nurseries.

The Wind River Seed Drill consists of a hopper, drop tubes, rollers, soil-penetrating shoes, and metering devices. A metering device consists of ground-driven short cylinders that are fluted and cup-shaped at both ends. When the cups rotate, the seed is metered from the hopper into the drop tubes. To allow different seed sizes, the cups at one end of the cylinder are deeper than the other. Most nurseries using Wind River seed drills have made changes in the basic design. Parts are difficult, if not impossible, to obtain. The original Wind River Seed Drill was a combination of parts from an International Harvester grain drill and a Planet Jr. Seeder.



Love/Oyjord Seed Drill

The Love/Oyjord seed drill adjusts to different row sizes and seeding depths, and consists of a wide front-packing roller that firms the ground. Ground opening discs dig furrows into which a seed metering device distributes the seed. Trailing packer wheels close and firm the furrow. Three- to eight-row models are available as well as a 16-row version. The seeder is designed for use on prepared flat or raised (6-inch maximum) seedbeds.

This seed drill has a unique metering device. Seed empties into a spinner that divides the seed equally to each planting head. Calibration is simple and may be done by seed weight or count. Ground openers adjust to depth and follow ground contour for uniform depth of seed. The trailing packer wheels may be either flat or concave.



Love/Oyjord Seed Drill:

J.E. Love Co.
309 California St.
Garfield, WA 99130
(509) 635-1321

Frobro Pneumatic Seeder

This seed drill uses a wheel-driven metering system for seed metering and then an air and distributing head to distribute the seed in up to eight rows. Each row has independently adjustable planting shoes with rubber packing wheels. This seeder is capable of planting speeds of 3 mph or more.

Hege Drill Planter

Primarily designed for planting cereal grain crops, this system has been used to plant other sizes of seed, including forest tree seed.

Double discs open a furrow for the seed. Seeds fall from a belt cone into a rotary distributor. This is adjustable for all sizes of seeds. The seeds fall into a slotted metering device enclosed in clear plastic for visibility. The seeding rate is controlled by a mechanical unit with precision settings. These can easily be changed.

The standard model uses seven drills with 7-inch centers, but the seeder can be custom-made to other specifications. The operator can manipulate the number of rows and distance between centers by adjusting the dividers in the seed box. These can be set so that seed falls through some holes but not others.



Frobro Pneumatic Seeder:

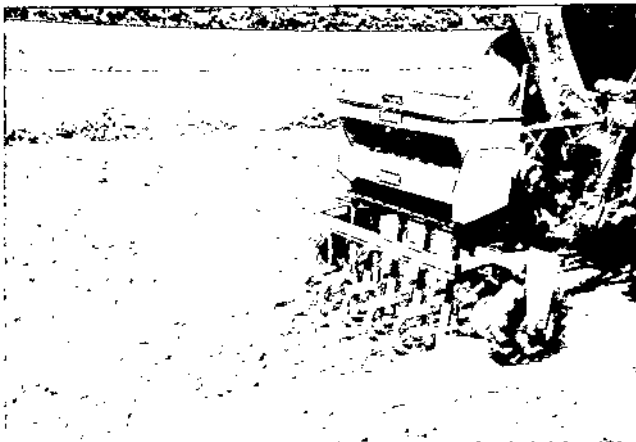
Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Hege Drill Planter:

Hege Equipment, Inc.
P.O. Box 34A
Rt. 1
Colwich, KS 67030
(316) 796-0992

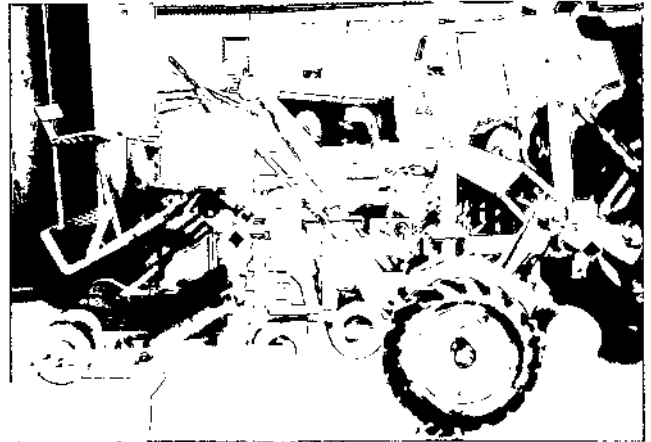
Egedal Seeder

The Egedal Seeder is a ground-driven seeder that can be delivered with the required number of sowing units and row widths up to a maximum of nine rows. Calibration is accomplished by gear cassettes and a cone gear box. This provides 160 settings. To insure uniform and correct sowing depth, the units are independent, which allows them to follow the ground surface.



Stanhay Seeder

The Stanhay Seeder is manufactured in England and sold commercially in the U.S. It has been used by Weyerhaeuser Co. as well as other private nurseries. Individual units for each row are mounted on a common frame. Each unit has a rubber belt with holes that meters the seeds onto the ground. The seeding rate can be adjusted by gearing changes, using belts with different hole sizes and spacing, and by using different plates under the belt.



Egedal Seeder:

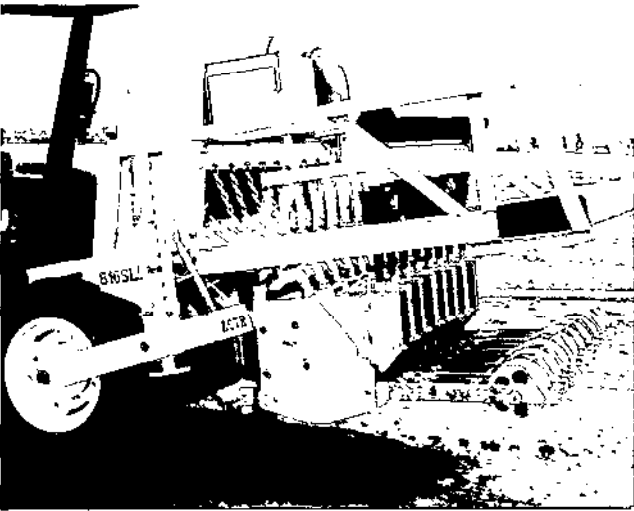
Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Stanhay Seeder:

Solex
P. O. Box 490
220 S Jefferson
Dixon, CA 95620

Love Precision Vacuum Seed Drill

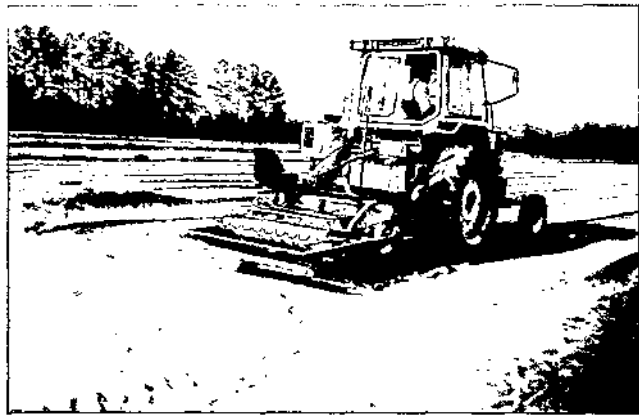
This seed drill uses vacuum discs to place the seed. Eight double-row planting heads using two discs per planting head are normally used. The discs are easily changed to accommodate different seed sizes. Vacuum pressure can be adjusted according to seed and soil conditions. The seed heads maintain a uniform distance from the ground, and seed depth is easily adjustable. A soil layer of 1/8- to 1/4-inch covers the seeds. Tractor sizes of 40 hp and 5,000 lbs are needed to pull this seeder.



Silver Mountain Seed Drill

The Silver Mountain Seed Drill shapes a seed bed and sows it with a precisely controlled vacuum drum seeder. A rotating vacuum head picks up a single seed from the hopper. From inside the vacuum head, a metal spine emerges to break the vacuum and shove the seed off the head where it falls to the earth. The head retracts, then thrusts out again to knock away any dirt that has attached to the drum. Because pickup is by vacuum and not entrance to a particular size of seed tube, the seeder can plant any size and shape of seed. Calibration is done by entering the spacing desired on the seeder's computer. The computer controls the speed of the vacuum drum in relation to ground speed. Spacing between seeds is kept constant, despite fluctuations in tractor speed. The operator can control all aspects of sowing while in operation. The furrow depth, depth of seed covering, and amount of bed firming are adjustable.

The seed drill has eight seeding units, and is designed for a tractor of 60 hp, although it has been used successfully by smaller tractors. The seed drill comes equipped with either flat or concave bed formers.



Love Precision Seed Drill:

J.E. Love Co.
309 California St.
Garfield, WA 99130
(509) 635-1321

Silver Mountain Seed Drill:

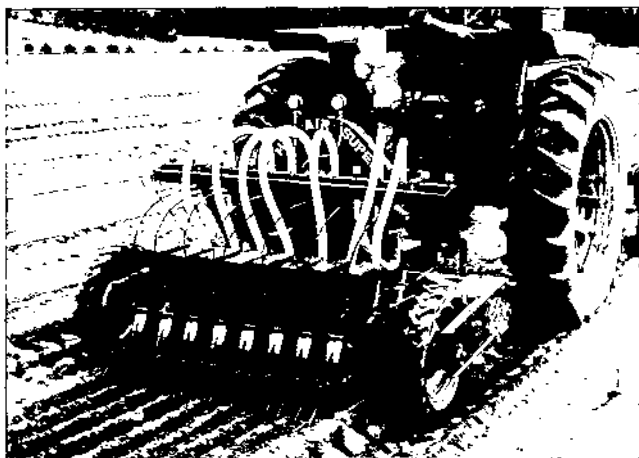
Silver Mountain Equipment, Inc.
4672 Drift Creek Rd. SE
Sublimity, OR 97385
(503) 769-7127

Frobro Miniair Seed Drill

The Frobro Miniair Super-Precision Seed Drill shapes the bed and plants seeds using a vacuum disc. Discs are different sizes to accommodate a wide variety of tree seed sizes and shapes. Discs can be changed in the field without tools.

In operation, seeds are drawn onto a revolving seed disc that turns and brings the seed near the planting entrance. An angled metal flap prevents more than one seed from reaching the seeder opening. The seed is brushed through the opening into the furrow, and a jet of air cleans dust from the opening in preparation for the next cycle.

The number of seeding units is adjustable from 3 to 25. Sowing depth, vacuum strength, and distance between rows are adjustable.



Frobro Miniair Seed Drill:

Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Seed Drills:

Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Hege Equipment, Inc.
P.O. Box 34A
Rt. 1
Colwich, KS 67030
(316) 796-0992

J.E. Love Co.
309 California St.
Garfield, WA 99130
(509) 635-1321

Silver Mountain Equipment, Inc.
4672 Drift Creek Rd. SE
Sublimity, OR 97385
(503) 769-7127

Sofex
220 S. Jefferson
P.O. Box 490
Dixon, CA 95620

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

R.A. Whitfield Mfg. Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW¹
Mableton, GA 30059
(404) 948-1212

4.3 Applying Fertilizer and Mycorrhizal Fungi Inoculum



Fertilizer is often applied just before the sowing operation or as part of the sowing process. Because certain minerals are insoluble, they need to be incorporated in the soil before sowing. Because of the possible increase in pathogen levels and the inability of the seedling to immediately utilize nitrogen, the application of nitrogen before sowing is not recommended.

Either broadcast or drill-type fertilizer spreaders may be used (See Section 3.5 Applying Soil Amendments). Solid and liquid formulations of fertilizer are both used.

Solid Fertilizer Injectors

Units are available to attach to cultivators, tractors, or seeders. A unit consists of a hopper, a metering system, and drop tubes. The tubes can be routed to furrow openers on planters, or to tines for cultivators. They are used to incorporate fertilizers in the soil.



Solid Fertilizer Injectors:

Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

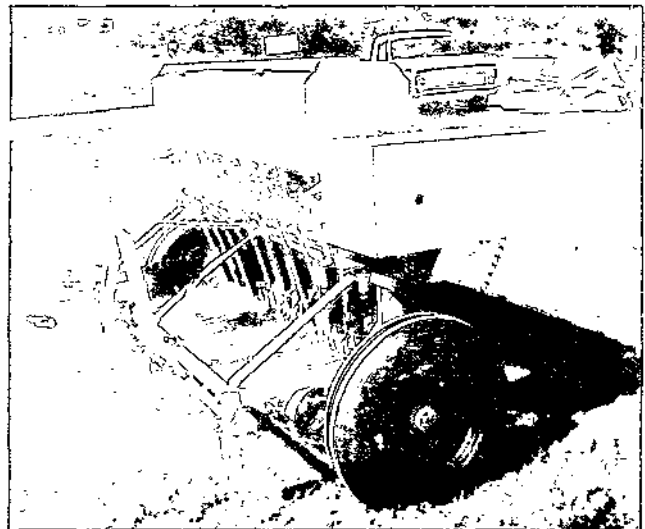
Barber Agricultural Sales
E 2904 Mission
Spokane, WA 99202
(509) 535-3051

Gandy Co.
P.O. Box 528
528 Gandrud Rd.
Owatonna, MN 55060-0528
(507) 451-5430

Mycorrhizal Injectors

Mycorrhizal Fungi Inoculum can be injected into the soil approximately 3 inches deep in 2-inch wide strips with an attachment mounted to a seeder. Whitfield manufacturers a multi-row nursery seeder with a detachable mycorrhizal applicator. The mycorrhizal applicator can be bought separately and installed by bolting the unit onto a seeder. Plans for a mycorrhizal applicator are also available from:

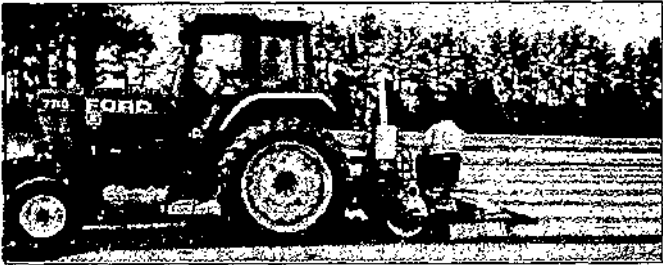
USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



Mycorrhizal Injectors:

R.A. Whitfield Mfg., Co.
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

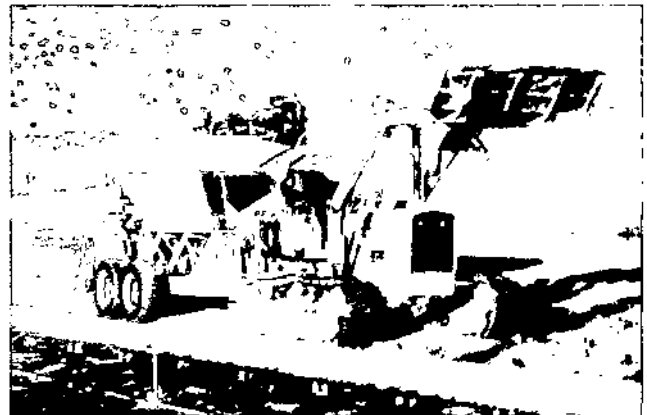
4.4 Seedbed Mulching and Stabilization



Some nurseries cover seedbeds with sand, sawdust, or mulch (See Section 3.5, Applying Soil Amendments Fertilization for Seeder Spreaders) for better seedling emergence. The recent emergence of vinyl polymer mulches that act as adhesives provides an additional use for spray rigs.

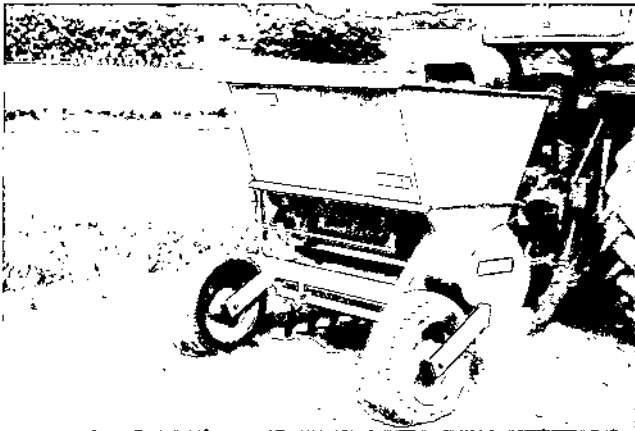
Spreaders

Spreaders are used at tree nurseries to protect newly-sown seed. Many are custom-built or modified for spreading sand and sawdust. Others that separate and blow solids or a liquid/solid mix onto the seedbed are commercially available.



Egedal Sand Spreader

This sand spreader consists of a spreading mechanism and a hopper that can hold 27 cubic feet of sand. A spiral at the bottom of the hopper spreads the sand. The machine can lay down different depths of sand covering. Because of a distributor plate, the machine can selectively apply sand only over the rows of seeds. The machine is available in various widths.

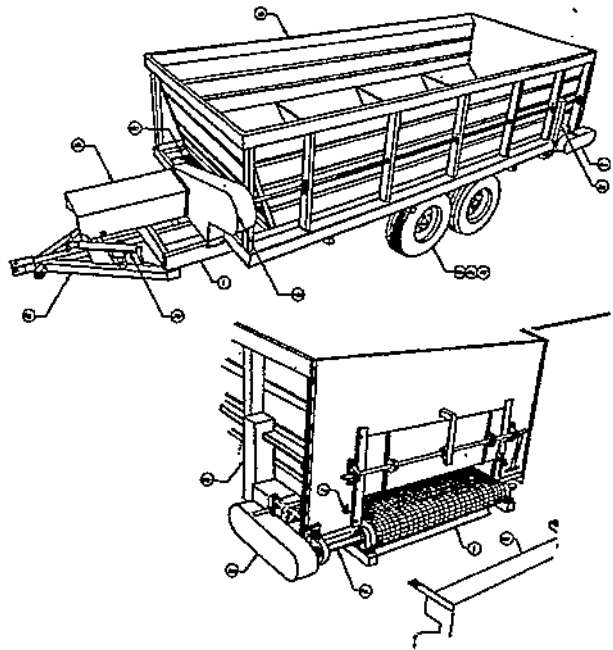


J. Herbert Stone Mulch Spreader

Personnel at USDA Forest Service J. Herbert Stone Nursery designed and built a sawdust, sand, or mulch spreader that has been well received by users. Plans are available upon request from:

J. Herbert Stone Nursery
2606 Old Stage Rd.
Central Point, OR 97502
(503) 776-4281

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula,
Missoula, MT 59801
(406) 329-3900



Egedal Sand-Spreader:

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

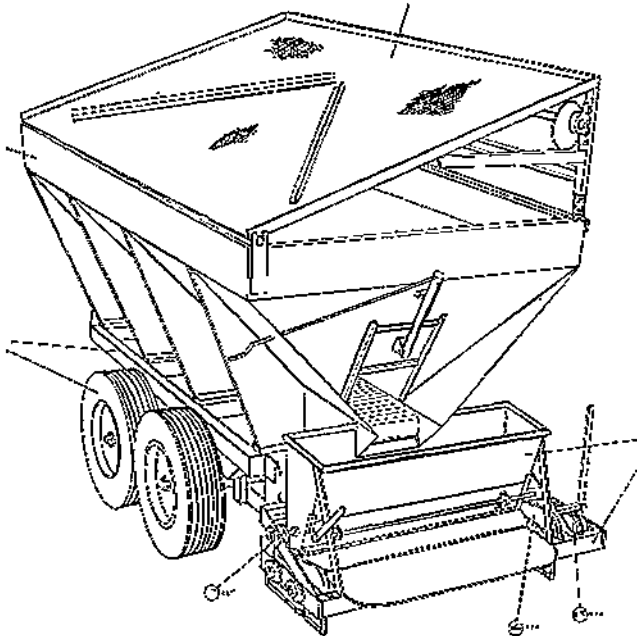
Coeur d'Alene Sander

Plans are available for this custom-built sand spreader from:

USDA Forest Service.
Coeur d'Alene Nursery
3600 Nursery Rd.
Coeur d'Alene, ID 38314
(208) 765-6365

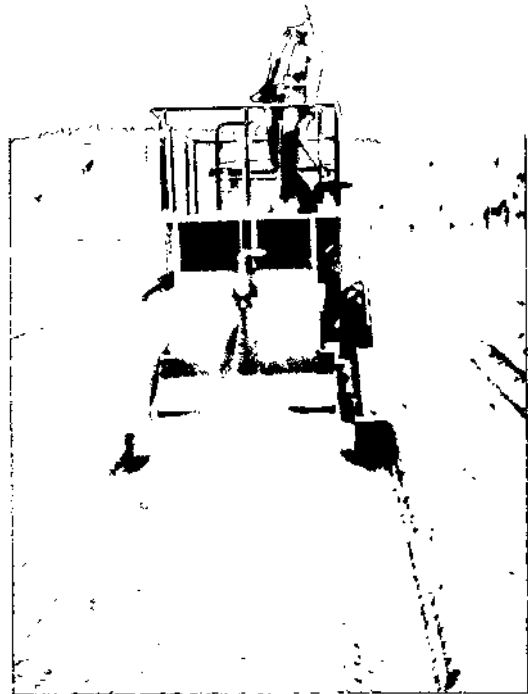
or

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



Mulch Stabilization Chemicals

Various compounds are available. Asphalt compounds are largely no longer in use and have been replaced by new compounds that are largely biodegradable. These are made up of large soluble starches and other natural polymers, or colloidal clay, gelling agents, and fertilizer.



Stabilization Chemicals:

American Excelsior Co.
609 S Front St.
Yakima, WA 98901
(509) 575-5794

Borden Chemical Co.
Adhesives & Graphics Div.
630 Glendale-Milford Rd.
Cincinnati, OH 45215
(513) 782-6200

Erosion Control Systems, Inc.
1800 McFarland Blvd. N
Suite 180
Tuscaloosa, AL 35406
(800) 942-1986

Golden Bear Div.
Witco Corp.
P.O. Box 456
Chandler, AZ 85244-0161
(601) 963-2267

Reclamare Co.
20727 7th Ave. S
Seattle, WA 98198
(206) 824-2385

Reinco, Inc.
P.O. Box 584
Plainfield, NJ 07061
(207) 755-0921

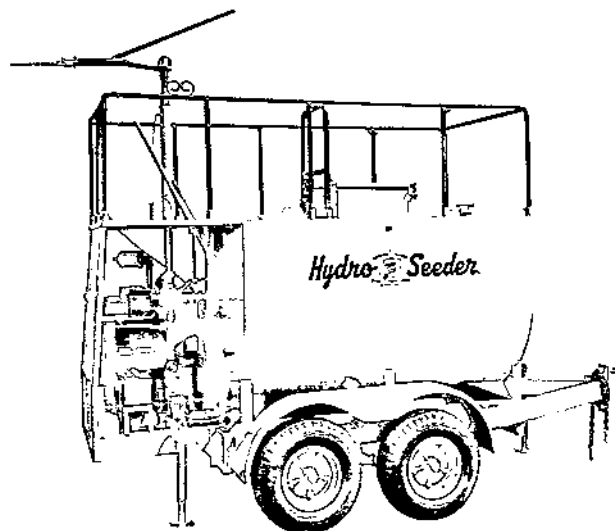
Sauze Technical Product Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Soil Stabilization Products Co.
P.O. Box 2779
Merced, CA 95344
(209) 383-3296

Southpine, Inc
P.O. Box 5301267
Birmingham, AL 35253
(205) 879-1099

Hydro Mulchers

Hydro mulchers apply a mixture of fibermulch and water and sometimes fertilizers on seedbeds. The mulchers consist of a mixing tank, a pump, and a nozzle that allows spraying in any direction. A useful attachment is the seedbed applicator pan. Paddle agitators mix the mulch. Some machines use a grinder/blender for mixing. Options include a separate pump for spraying. Sprayers are mounted on a truck bed or trailer. Sizes vary from tanks of 500 to 3,500 gallons.



Hydro Mulchers:

Bowie Industries
P.O. Box 931
Bowie, TX 76230
(817) 872-1106

Finn Corporation
9281 LeSaint Dr.
Fairfield, OH 45014
(513) 874-2818

Reinco, Inc.
P.O. Box 584
Plainfield, NJ 07061
(207) 755-0921

Estes Equipment, Inc.
Rt. 4, Bybee Rd.
Winchester, KY 40391
(606) 744-5900

Penn Line Service, Inc.
300 Scottsdale Ave.
Scottsdale, PA 15683
(412) 887-9110

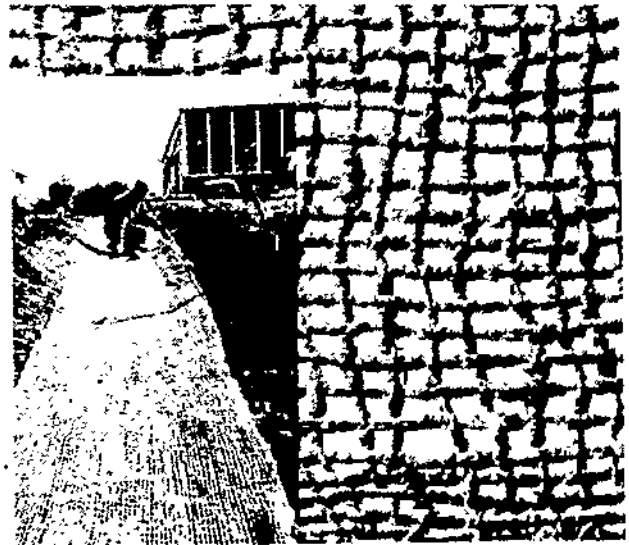
Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Miscellaneous

Numerous methods have been used to protect freshly sown seed. Under this section, we've included erosion netting as well as equipment to aid in installation of bird netting.

Erosion Netting

Various nettings and cloths are available to protect newly planted seed from erosion and wind and to fend off the depredations of birds and animals. Some nettings are made of natural materials designed to biodegrade in 1 to 2 years. They generally come in rolls 3 to 4 feet wide and 225 feet long. The netting must be tacked down.



Erosion Netting:

American Excelsior Co.
6475 N Franklin
Denver, CO 80229
(303) 287-3261

Hobbs and Hopkins, Ltd.
1712 SE Ankeny
Portland, OR 97214
(503) 239-7518

Ben Meadows Co.
3589 Broad St.
Chamblee, GA 30366
(800) 241-6401

PPS Pack Co.
204 N 7th St.
Fowler, CA 93625
(209) 834-1641

Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Terra Tech, Inc.
P.O. Box 5547
2100 W Broadway
Eugene, OR 97405
(503) 345-0597

Stake Driver

A tractor-mounted hydraulic stake driver was designed and built for use at USDA Forest Service Bend Pine Nursery. This system reduces the time required to drive stakes before applying bird netting and requires a tractor operator and a person to operate the machine. The stake driver production rate is about 1,800 stakes per hour. For information contact:

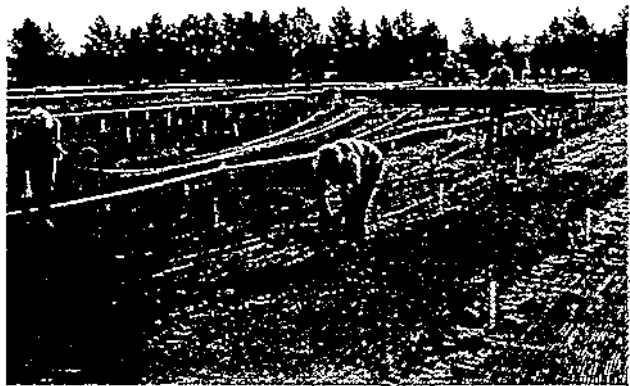
USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



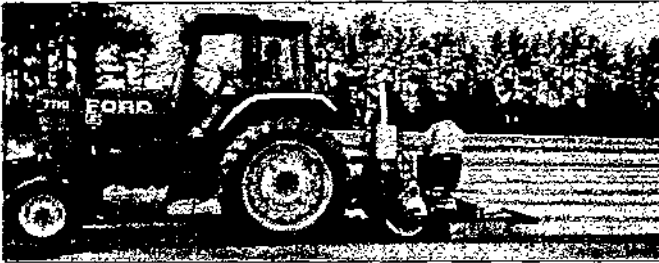
Netting Spreader Retrieval System

A hand-pulled cart was designed and built at the USDA Forest Service Bend Pine Nursery as an aid in bird netting application and removal. This improved efficiency by 50 percent over past practices. The stake driver and cart are combined as a system for application and removal of netting. For information, contact:

USDA Forest Service
Bend Pine Nursery
63095 Deschutes Market Rd.
Bend, OR 97701
(503) 382-6922



4.5 Transplanting

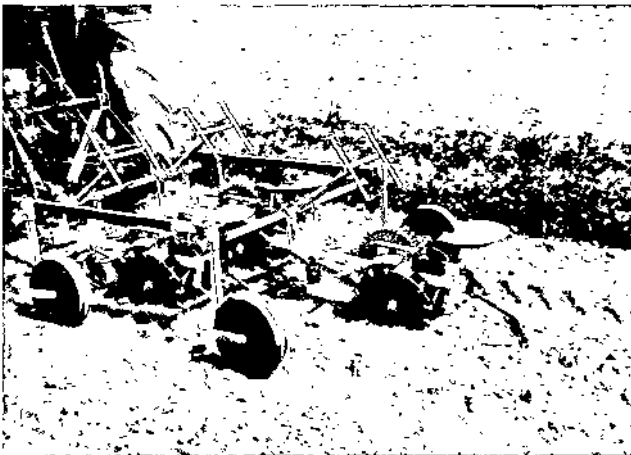


Transplanting is lifting seedlings from their original seedbed to plant in another location in the nursery. Seedling density in the transplant bed is lower than that in the original seedbed. Seedlings are normally transplanted to achieve specific morphological characteristics such as increased stem diameters, shoot heights, and root-and-shoot dry weights.

Transplanters

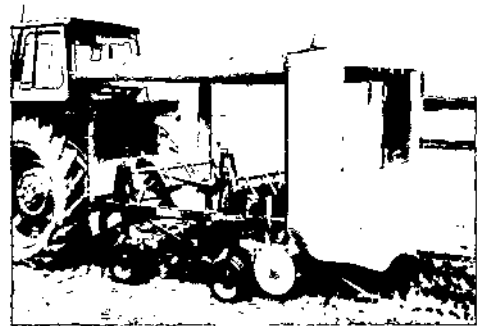
Transplanters are widely used in nurseries. They may be adjusted to provide the desired plant spacing, row width, and planting depth. Transplanters require a number of workers, one to drive the tractor, and one per row to manually feed seedlings into furrows. Transplanters are available to handle one to eight rows at a time.

Most transplanters have a similar design in which a coulter opens the ground, a chisel-type planting foot widens and deepens the furrow, and a scalper behind the coulter enlarges the furrow for the planting foot. Packing wheels firm the soil around the transplanted seedling. Tractors with 25 to 100 hp are needed for transplanting.



Egedal Transplanter

Egedal's two smallest transplanters are designed for one to two and three to five operators. The machines follow the basic transplanter design, although to dig furrows they use a wheel with spring-loaded projections that further scarify the earth. Transplanter parts are replaceable. Boxes allow extra weight to be added over the packing wheels. The distance between rows may be adjusted. A heavy-duty model that can be used in uncultivated reforestation work features a heavy-weight furrow share with moldboard. A cab covers the transplanter. Planters are spring-mounted to stay near the earth. Large transplanters hold up to eight people and are enclosed. For large transplanters, rows must be more than 10 inches wide.

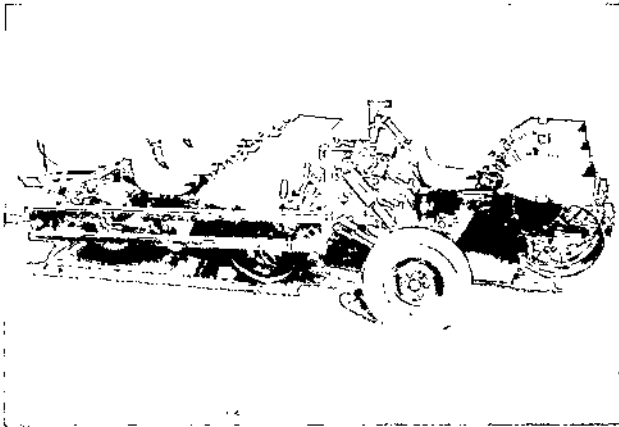


Egedal Transplanter:

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Mechanical Transplanter

Mechanical Transplanter Company makes planters suitable for both small and large seedlings. Planter shoes open a furrow 14 inches deep. The frame is spring-loaded to stay close to the earth. The coulter is 28 inches. The plant boxes are built for large seedlings and have built-in conveyors to bring plants close to the operator. Planting rates have reached 2,000 seedlings an hour.



Holland Transplanter

Holland Transplanter makes transplanters in light and heavyweight models. The tree transplanter has a 20-inch coulters and a 10-inch planting tool. Holland's Old Faithful handles seedlings up to 3 feet tall and plants roots to 15 inches deep. Holland's large transplanters seat up to 12 people. Each unit is set on its own flotation wheel. The transplanter will set seedlings 2-1/2 inches apart and as close as 9 inches between rows.



Mechanical Transplanter:

Mechanical Transplanter Co.
P.O. Box 1708
1150 S Central Ave.
Holland, MI 49422-1708
(616) 396-8738

Holland Transplanter:

Holland Transplanter Co.
P.O. Box 1527
510 E 16th St.
Holland, MI 49422-1527
(616) 392-3579

Hardwood Cuttings Transplanter

Canadian Forestry Service nurseries have developed a transplanter for hardwood cuttings. They invite inquiries for testing this transplanter in forest tree nurseries. The transplanter is similar in design to commercial planters. For information, contact:

PFRA Shelterbelt Centre
Agriculture Canada
Indian Head, Saskatchewan
Canada SOG 2K0

Plug Transplanters

Two new mini plug transplanters have recently emerged in tree nursery operations. For information on these, contact:

Weyerhaeuser Co.
Tacoma, WA 98401
(206) 924-3508

Or

Castle & Cooke
Techniculture, Inc.
P.O. Box 1759
Salinas, CA 93902
(408) 754-5278

Transplanters:

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

Castle & Cooke
Techniculture, Inc.
P.O. Box 1759
Salinas, CA 93902
(408) 754-5278

Holland Transplanter Co.
P.O. Box 1527
510 E 16th St.
Holland, MI 49422-1527
(616) 392-3579

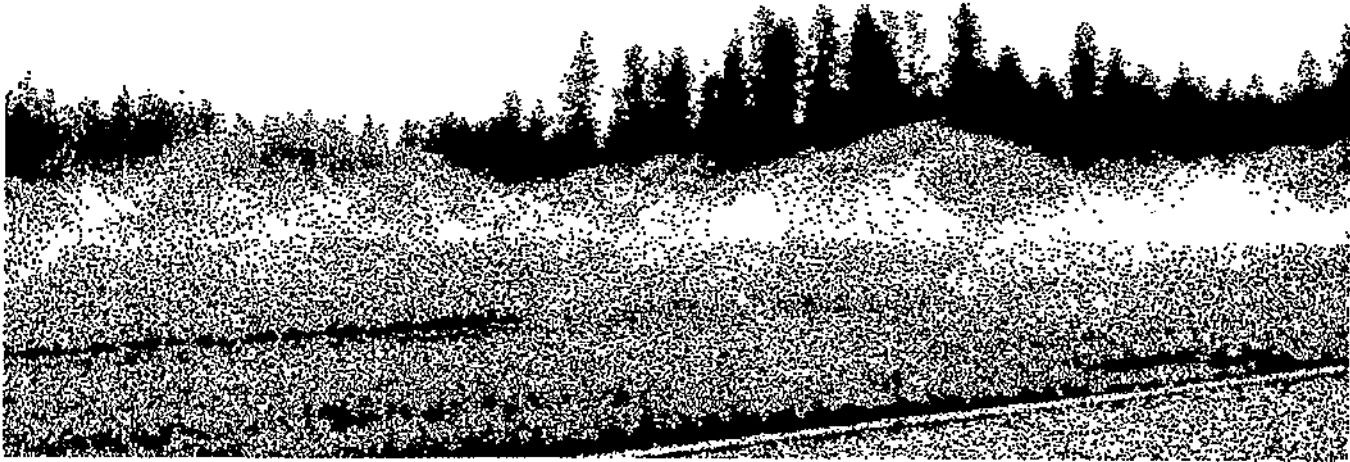
Mechanical Transplanter Co.
P.O. Box 1708
1150 S Central Ave.
Holland, MI 49422-1708
(616) 396-8738

Powell Mfg. Co., Inc.
P.O. Drawer 707
Bennettsville, SC 29512-0707
(803) 479-6231

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Weyerhaeuser Co.
Tacoma, WA 98401
(206) 924-3508

5.0 Cultural Practices



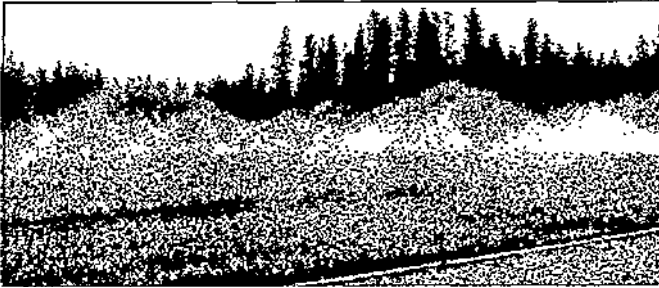
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This section deals with the various cultural activities that occur in nurseries from the time seed is sown to the time when the seedlings are ready for harvesting. The sown seedbeds should be lightly irrigated immediately after sowing to stimulate germination. Often, a pre-emergence herbicide is sprayed over the seedbeds at this time to kill weeds as they germinate. Tree seed will begin to germinate and emerge from the seedbed in 2 to 6 weeks, depending on species and soil temperature. Fertilization is not traditionally applied to seedbeds until a few weeks after emergence because high nitrogen is thought to encourage damping-off fungi.

During the spring and early summer, seedlings receive a series of cultural treatments to modify their growth as well as eliminate competing vegetation. Mechanical cultivation helps break up soil crusts and kill weeds. Young weeds can be removed manually or killed with herbicides. The seedling root system is cultured by undercutting, wrenching, and/or lateral pruning to promote fibrosity and control top height. Seedling height is controlled with mechanical top pruning on some species, but it is not a recommended practice.

Seedlings that are too small to be harvested must be protected during the winter season.

5.1 Irrigation



Because forest tree seedlings are grown in raised seedbeds and must be accessible to tractor-drawn equipment, they are irrigated with semi-permanent sprinkler irrigation systems (also called solid set systems). Water is pumped into a permanent under-ground irrigation system through the mainlines and sub-mains and then up through a vertical pipe to a permanent gate valve. From this valve, portable irrigation lines called laterals run parallel to the seedbeds. The distance between individual laterals and sprinkler heads on a lateral is determined by the water pressure and the performance specifications of the sprinkler head. The vertical pipe from the lateral to the sprinkler head is called a riser.

The lateral irrigation lines are set out during the bed forming operation so the sown seedbeds can be irrigated immediately. During the germination period, irrigations are light and frequent so the seedbed remains moist but not wet. These light mistings also help keep the surface soil temperatures cool so the stems of the succulent young germinants are not damaged. As the seedlings become larger, the frequency of irrigation decreases, whereas the amount of water applied per irrigation increases. Fertilizer top dressing and herbicide applications are also "watered-in" with irrigation. One of the cultural techniques used to harden seedlings in the later summer is called "drought-stressing." Water is withheld until the seedlings undergo a moderate stress. Seedling moisture stress can be measured directly with a pressure chamber (See Section 6.3) or indirectly from soil moisture measurements.

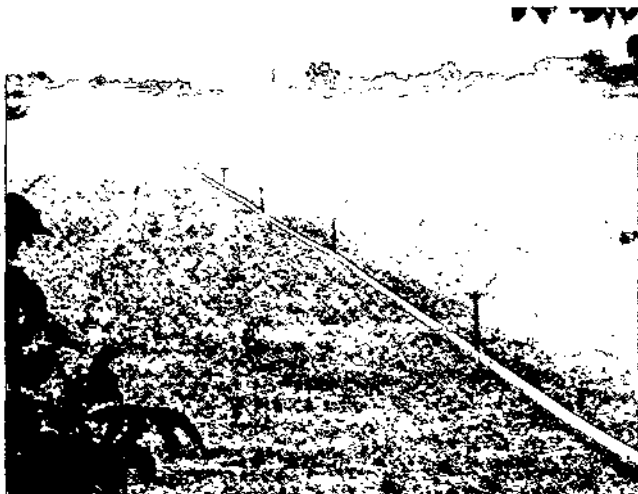
Irrigation Pumps

Two types of irrigation pumps are typically used in forest nurseries— centrifugal and deep-well turbine pumps. Although they are more expensive, turbine pumps must be used if the ground water level is below 6.1 m (20 ft), and they are effective down to depths of over 304.8 m (1,000 ft). Sprinkler irrigation pumps can be powered by either electricity or liquid fuels. Irrigation experts should be consulted to make certain that the type and size of the pump is adequate for the type and size of irrigation system.

Irrigation Pumps:			
Agri-Business International, Inc. P.O. Box 909 Villa Rica, GA 30180 (404) 459-4401	General Irrigation Co. P.O. Box 776 Carthage, MO 64836 (417) 358-8171	The KBH Corp. P.O. Box 670 Clarksdale, MS 38614 (601) 624-5471	Peerless Pump Co. 1441 Powerless Way Montebello, CA 90640-6310 (213) 726-1232
Amadas Industries 1100 Holland Rd Suffolk, VA 23434 (804) 539-0231	The Gorman-Rupp Co. P.O. Box 1217 Mansfield, OH 44901 (419) 755-1011	Kifco/Ag-Rain, Inc. P.O. Box 367 Havana, IL 62644 (309) 543-4425	Pumps & Softners, Ltd. P.O. Box 5332 London, Ontario Canada N6A 4N8
Burrows Enterprises, Inc. 6340 W Tenth St. Greeley, CO 80634 (303) 353-3769	Hale Pumps 700 Spring Mill Ave. Conshohocken, PA 19428 (215) 825-6300	Krueger Enterprises P.O. Box 234 Longmont, CO 80501 (303) 776-6140	Rainbow Irrigation Systems P.O. Box 70 Fitzgerald, GA 31750 (912) 423-4341
Consolidated Pipe & Tube Co. P.O. Box 5695 Lubbock, TX 79417 (806) 763-9591	Homelite Division of Textron, Inc. P.O. Box 7047 14401 Carowinde Blvd. Charlotte, NC 28217 (704) 588-3200	March Mfg., Inc. 1819 Pickwick Ave. Glenview, IL 60025 (312) 729-5300	Schumacher Irrigation, Inc. P.O. Box 218 Main St. Platte Center, NE 68650 (402) 246-3685
D.M.I.T. Moulton P.O. Box 280 Somerset, WI 54025 (715) 247-3321	House Mfg. Co., Inc. P.O. Box 214 Cherry Valley, AR 72324 (501) 588-3307	Marco Industrial Products 2300 W Commodore Way Seattle, WA 98199 (206) 285-3200	Shindaiwa, Inc. P.O. Box 1090 11975 SW Herman Rd. Tualatin, OR 97140 (503) 692-3070
Donward Pump Co. P.O. Box 4 Concord, CA 94522 (415) 432-3113	Hydro Engineering, Inc. P.O. Box 98 115 E Main St. Young America, MN 55397	Monarch Industries, Ltd. 8890 Erin St. P.O. Box 429 Winnipeg, Manitoba, Canada R3C 3E4 (204) 786-7961	Wacker Corp. P.O. Box 9007 N 92 W 15000 Anthony Ave. Memomonee Falls, WI 53052-9007 (414) 255-0500
Falkenberg, Inc. 8833 SE Janssen Clackamas, OR 97015 (503) 656-9511	Irridelco Corp. 440 Sylvan Ave. Englewood Cliffs, NJ 07632 (201) 569-3030	Nebraska Irrigation, Inc. 911 23 St. E Columbus, NE 68601 (402) 564-1514	Weir Pumps, Ltd. Cathcart Glasgow, Scotland G44 4EX 041-637-7141
Gator Pump, Inc. P.O. Box 57 Brownwood, TX 76804 (800) 735-9811	ITT Marlow Pumps P.O. Box 200 Midland Park, NJ 07432 (201) 444-6900	Pacer Pumps One Lark Ave. Leola, PA 175 40 (717) 656-2161	Western Land Roller Co. P.O. Box 668 Hastings, NE 68901 (402) 463-1306

Irrigation Accessories

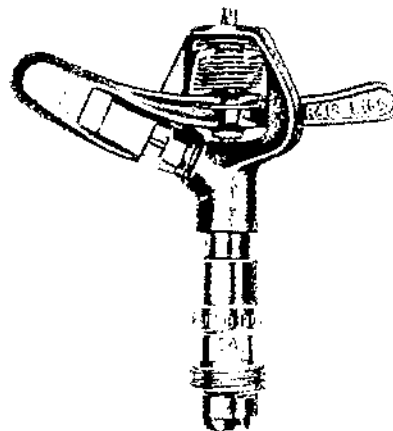
The sprinkler head controls the rate and pattern of water application and consists of the body and the nozzle. Nozzles come in a variety of sizes and are interchangeable. Although stationary heads are available, bareroot nurseries generally use rotary heads that move in a circular pattern and can throw water greater distances. Two basic types of rotary heads are used; impulse sprinklers and gear drive sprinklers. Gear drives are relatively new and are not widely used. Impulse sprinklers and gear drive sprinklers are available from the same commercial sources.



Impulse Sprinklers

Impulse sprinklers are widely used in forest nurseries and consist of individually rotating heads mounted on vertical risers. Impulse sprinklers project a circular stream of water that bumps a spring-loaded brass or plastic arm to distribute the spray within the circle and turn the head.

Individual sprinkler heads contain a nozzle, which comes in interchangeable sizes and has a spring-loaded arm. They can be set to provide different angles of spray and to cover partial or full circle patterns. Impulse sprinklers are relatively maintenance-free if the irrigation water is filtered and can be used with injected fertilizers or pesticides. Manufacturers will provide complete irrigation system designs and parts.



Irrigation Equipment:

Agri-Business International, Inc.
P.O. Box 9009
Villa Rica, GA 30180
(404) 459-4401

A & M Industries
3610 N Cliff
Sioux Falls, SD 57104
(800) 888-2615

Consolidated Pipe & Tube Co.
P.O. Box 5695
Lubbock, TX 79417
(806) 763-9591

D.M.I.T. Moulton
P.O. Box 280
Somerset, WI 54025
(715) 247-3321

General Irrigation Co.
P.O. Box 776
Carthage, MO 64836
(417) 358-8171

Iridelco Corp.
440 Sylvan Ave.
Englewood Cliffs, NJ 07632
(201) 569-3030

Irrigation Accessories Co.
P.O. Box 20176
Portland, OR 97220
(503) 255-0610

Kruegar Enterprises
P.O. Box 234
Longmont, CO 80501
(303) 776-6140

Lindsay Mfg. Co.
P.O. Box 156
Lindsay, NE 68644
(402) 428-2131

Nebraska Irrigation, Inc.
911 23 St. E
Columbus, NE 68601
(402) 564-1514

Nelson Irrigation Corp.
P.O. Box 169
Airport Rd.
Walla Walla, WA 99362
(509) 525-7600

Plainsmen Mfg., Inc.
P.O. Box 186
Plains, KS 67869
(316) 563-7233

Plummer Supply
P.O. Box 177
Bradley, MI 49311
(616) 792-2215

Rainbow Irrigation Systems
P.O. Box 70
Fitzgerald, GA 31750
(912) 423-4341

Schumacher Irrigation, Inc.
P.O. Box 218
Main St.
Platte Center, NE 68650
(402) 246-3685

Thompson Mfg. Co.
Dept. TR
P.O. Box 1500
Chino, CA 91710
(714) 591-4851

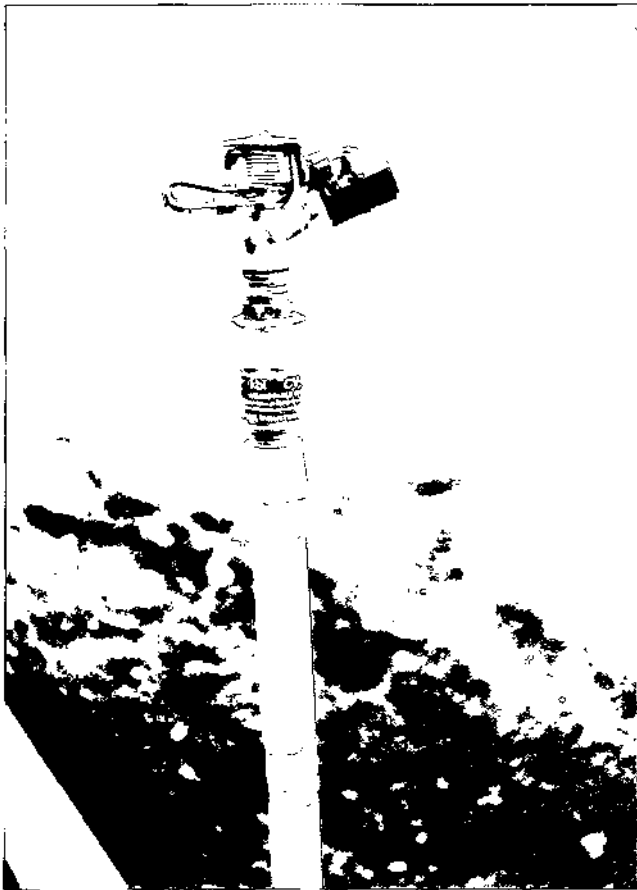
The Toro Co.
8111 Lyndale Ave. S
Minneapolis, MN 55420
(612) 887-8813

Valmont Industries, Inc.
Valley, NE 68064
(402) 359-2201

Wade Mfg. Co.
P.O. Box 23666
Portland, OR 97223
(503) 641-1865

Sprinkler Check Valves

These handy devices are installed between the sprinkler head and the standpipe and can be preset to open and close at specific water pressures. These check valves stop irrigation drip when sprinklers are starting and stopping.



Pipe Carriers

Pipe carriers are useful when initially placing lateral sprinkler pipes and also when picking them up before final crop harvest.



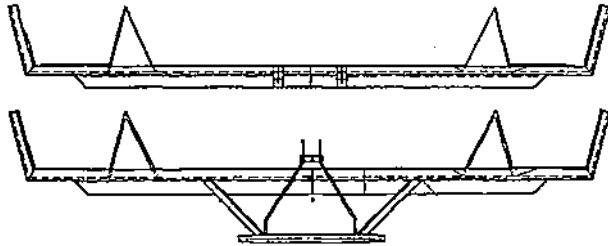
King Brothers Industries
27781 Hopkins Ave.
Valencia, CA 91384
(805) 257-3262

Lucky Peak Pipe Carrier

An irrigation pipe carrier has been designed by the Lucky Peak Nursery in Idaho. It consists of two wide steel racks that extend laterally past the wheels of the tractor. One rack attaches to the front of the tractor and the other rack mounts on a 3-point hitch. The pipes are carried lengthwise on either or both sides of the tractor. Drawings of the carrier are available from:

USDA Forest Service
Lucky Peak Forest Tree Nursery
% Idaho City Stage
Boise, Idaho 83701

A number of companies manufacture trailers for carrying irrigation pipe.



Pipe Carriers:	
Agri-Business International, Inc. P.O. Box 909 Villa Rica, GA 30180 (404) 459-4401	Liquid Waste Technology P.O. Box 250 Somerset, WI 54025 (715) 247-5464
General Irrigation Co. P.O. Box 776 Carthage, MO 64836 (417) 358-8171	Nebraska Irrigation, Inc. 911 23 St. E Columbus, NE 68601 (402) 564-1514
Kirchner Machine, Ltd. 2419 Second Ave. N Lethbridge, Alberta Canada T1H 0C1 (403) 328-5569	Plainsmen Manufacturing, Inc. P.O. Box 186 Plains, KS 67869 (316) 563-7233
	Rear's Mfg., Co. 2140 Prairie Rd Eugene, OR 97402 (503) 688-1002

Fallow Field Irrigation Equipment

These irrigation systems are generally larger and cover relatively more acreage than those in the seedbeds. They are used for cover crops or green manure crops during the fallow season.

Many times the same hand-line sprinkler system is used for fallow field irrigation. Fallow field irrigation can include wheel line and stationary gun irrigation systems.

Irrigation Systems:

Agri-Business International, Inc.
P.O. Box 9019
Villa Rica, GA 30180
(404) 459-4401

Consolidated Pipe & Tube Co.
P.O. Box 5695
Lubbock, TX 79417
(806) 763-9591

D.M.I.T. Moulton
P.O. Box 280
Somerset, WI 54025
(715) 247-3321

Decoto Mfg., Inc.
P.O. Box 44
Yakima, WA 98907
(509) 457-5167

General Irrigation Co.
P.O. Box 776
Carthage, MO 64836
(417) 358-8171

Iridelco Corp.
440 Sylvan Ave.
Englewood Cliffs, NJ 07632
(201) 569-3030

Krueger Enterprises
P.O. Box 234
Longmont, CO 80501
(303) 776-6140

Liquid Waste Technology
P.O. Box 250
Somerset, WI 54025
(715) 247-5464

Nebraska Irrigation, Inc.
911 23 St. E
Columbus, NE 68601
(402) 564-1514

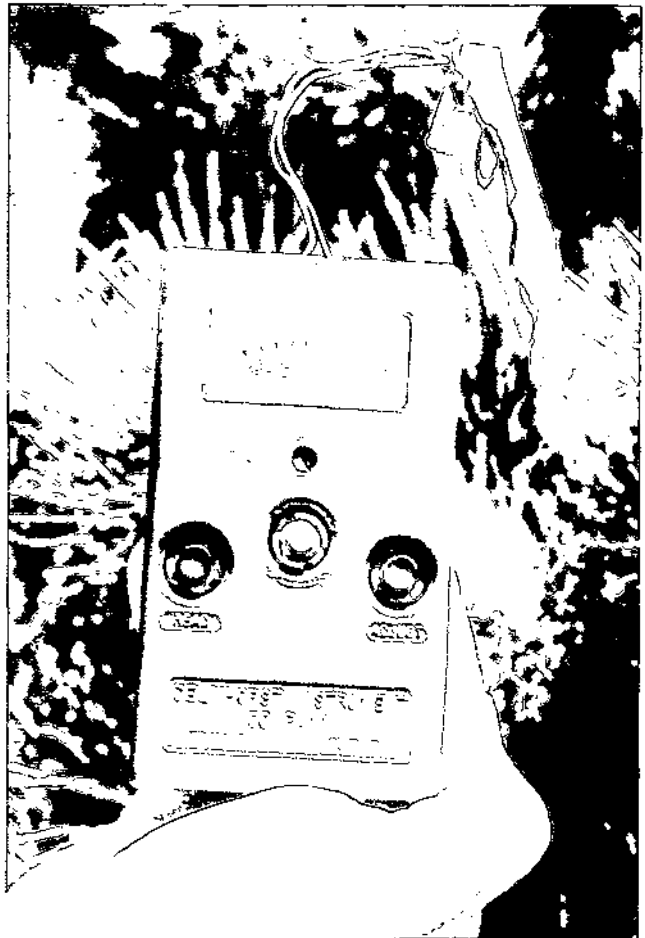
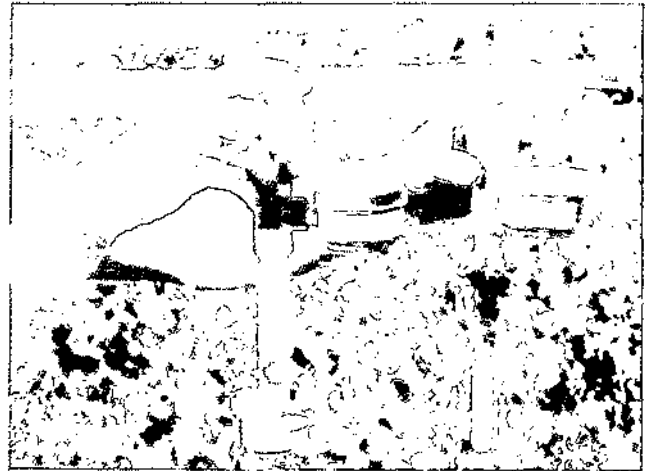
Rainbow Irrigation Systems
P.O. Box 70
Fitzgerald, GA 31750
(912) 423-4341

Schumacher Irrigation, Inc.
P.O. Box 218
Main St.
Platte Center, NE 68650
(402) 246-3685

Wade Mfg. Co.
P.O. Box 23666
Portland, OR 97223
(503) 641-1865

Soil Moisture Monitoring

Soil moisture testers determine when irrigation is required. By scheduling irrigation to meet seedling needs, growers save water and energy, produce better crops, and eliminate leaching of nutrients from the root zone. Some instruments measure water tension in the soil, whereas other models use electrical resistance to estimate relative water availability.



Soil Moisture Measuring Equipment:

Canadian Forestry Equipment, Ltd.
90 E Boul., Brunswick Blvd.
D.D.O., Quebec,
Canada H9B 2T5
(403) 484-2447

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

General Supply Corp.
P.O. Box 9347
303 Commerce Park Dr.
Jackson, MS 39286-9347
(601) 981-3382

Ironmeter Co.
P.O. Box 2424
Riverside, CA 92526-2424
(714) 689-1701

Nasco
901 Janesville Ave.
Ft. Atkinson, WI 58539
(414) 563-2446

PMS Instrument Co.
2750 NW Royal Oaks Dr
Corvallis, OR 97330
(503) 752-7926

Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

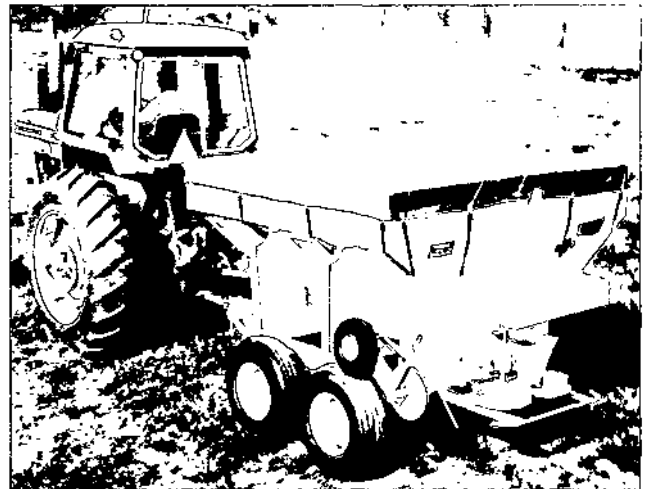
5.2 Applying Dry Fertilizers and Pesticides



Fertilizers and pesticides come in a variety of different formulations but can be categorized as "dry" (granules or powders) or "liquid" (liquids, wettable powders, or flowables). Equipment to apply the dry materials will be discussed in this section and liquid application techniques are covered in Section 5.3.

Broadcast Spreaders

Broadcast spreaders can be used to spread granular fertilizers or pesticides. They typically consist of a storage hopper and a distribution mechanism. Hoppers can hold from 4 to 9 cubic yards in volume or up to 5 tons in weight. A conveyor is sometimes used to feed the material in the spreader. A spinning fan can distribute the material in an arc. Broadcast spreaders can be controlled from the tractor and many models are adjustable for width and density. Although commonly used to apply material to fallow fields, broadcast spreaders can be used to apply to blocks of seedbeds if they can be precisely calibrated.



Broadcast Spreaders:

Ag-Chem Equipment Co., Inc.
Suite 100
5720 Smetana Dr.
Minnetonka, MN 55343
(612) 933-9006

A.T.I., Inc.
Advance Technical Implements
5338 Merriam Dr.
Merriam, KS 66203
(913) 384-5051

Barber Agricultural Sales
2904 Mission
Spokane, WA 99202
(509) 535-3051

BEFCO, Inc.
P.O. Box 6036
Rocky Mount, NC 2780
(919) 977-9920

Beline Mfg. Co., Ltd.
P.O. Box 1840
Kindersley, Saskatchewan
Canada SOL 150
(306) 463-6491

Bolinger Brothers
P.O. Box 277
Windfall, IN 46076
(317) 945-7181

Canadian Forestry Equipment, Ltd.
90 E Boul. Brunswick Blvd.
D.D.O., Quebec
Canada H9B2TS
(403) 484-2447

Centaur International, Ltd.
2501 E Waterloo Rd.
Edmond, OK 73034
(405) 341-7653

Central Tractor Farm &
Family Center
P.O. Box 3330
Des Moines, IA 50316
(515) 266-3101

Century Engineering
Division of Westeel Inc.
803 N 25th St.
Fargo, ND 58103-3112
(319) 364-4101

Chapin Equipment Co.
202 Fulton St.
Fresno, CA 93721
(209) 233-7141

Deere & Comp.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Degelman Industries, Inc.
P.O. Box 490
Minot, ND 58701
(701) 852-1876

Dempster Industries, Inc.
P.O. Box 848
711 S 6th St.
Beatrice, NE 68310
(402) 223-4026

Dyco Industries
2 Powder Mill Rd.
Maynard, MA 01754
(617) 897-6381

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

Broadcast Spreaders:

Gandy Co.
P.O. Box 528
Owatonna, MN 55060
(507) 451-5430

Garber Seeders
Division of Fibum, Inc.
P.O. Box 770
St. Paris, OH 43072
(513) 663-4865

Hahn, Inc.
1625 N Garvin St.
Evansville, IN 47711
(812) 428-2020

Hege Equipment, Inc.
P.O. Box 34A
Rt. 1
Coiwich, KS 67030
(316) 796-0992

Henderson Mfg.
P.O. Box 40
1085 S 3rd St.
Manchester, IA 52057
(319) 927-2828

Herd Seeder Co., Inc.
P.O. Box 448
Logansport, IN 46947
(219) 753-6311

Highway Equipment Co.
616 D Ave. NW
Cedar Rapids, IA 52805
(319) 363-8281

Holland Hitch Western, Ltd.
17909 Roam Place
Surray, British Columbia
Canada V36 5K1

Jet Co., Inc.
Highway 169 N
Humboldt, IA 50548
(515) 332-3117

Joseph Swantak, Inc.
P.O. Box 93
H.C. 64
Delhi Stage
Oneonta, NY 13820
(607) 432-0891

Kirby Mfg., Inc.
P.O. Box 989
Merced, CA 95341
(209) 723-0778

Kuhn Farm Machinery, Inc.
P.O. Box 224
Vernon, NY 13476
(315) 829-2620

Lakeside Truck Body &
Equipment Co.
P.O. Box 1104
South Golden State Blvd.
Turlock, CA 95381

The Lely Corp.
P.O. Box 1060
Wilson, NC 27894-1060
(919) 291-7050

Lightfoot Mfg., Inc
1526 Marlin Rd.
Bloomer, WI 54724
(715) 568-2333

Lor-Al, Inc.
P.O. Box 265
Benson, MN 56215
(612) 843-4161

Nibex Inc.
P.O. Box 8585
Emeryville, CA 94662
(415) 428-0871

Off-Road Floater Equipment Co.
627 Adena Rd.
Chillicothe, OH 45601
(614) 775-2666

Olathe Mfg., Inc.
100 Industrial Parkway
Industrial Airport, KS 66031
(913) 782-4396

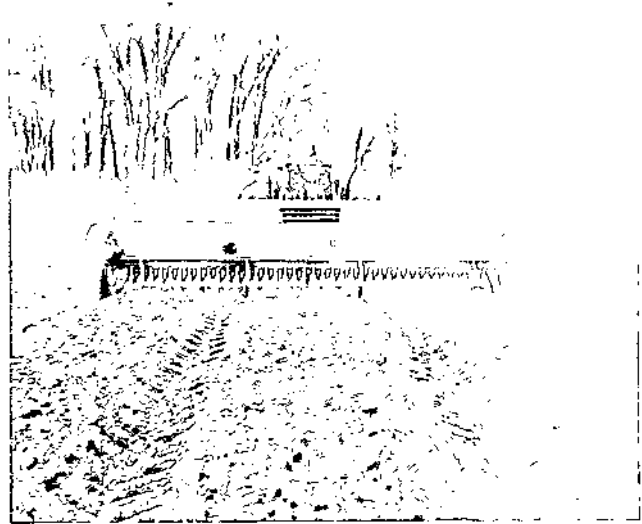
P.&H. Mfg. Co.
P.O. Box 549
Shelbyville, IL 62565
(217) 774-2123

Rokon International, Inc.
P.O. Box 189
Jaffrey, NH 03452
(800) 632-2481

Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Band Applicators

Some nurseries apply fertilizer in bands between the seed rows to make the material more available to the seedling root system. Phosphorus and other elements that are not mobile in the soil cannot be applied as top dressings and therefore should be incorporated into the soil. Band applicators can also be used to apply granular pesticides or mycorrhizal inoculum within the seedbed. Although some commercial models are available, many nurseries build their own band applicators.



Band Applicators:

Ag-Chem Equipment Co., Inc.
4900 Viking Dr
Minneapolis, MN 55435
(612) 835-2476

Agri-Fab, Inc.
P.O. Box 903
Sullivan, IL 61951
(217) 728-8388

ATI, Inc.
Advanced Technical Implements
5338 Merriam Dr.
Merriam, KS 66203
(913) 384-5051

Beaver Valley Supply
Atwood, KS 67730
(913) 626-3251

BEFCO, Inc.
P.O. Box 6036
Rocky Mount, NC 27801
(919) 977-9920

Beline Mfg. Co., Ltd.
P.O. Box 1840
Kindersley, Saskatchewan
Canada S0L 1S0
(306) 463-6491

Big A Equipment Co., Inc.
Industrial Rd.
Jackson, MN 56143
(913) 825-1631

Blanchard Co.
P.O. Box 1607
Minot, ND 58702
(701) 852-1924

Bolinger Brothers
P.O. Box 277
Windfall, IN 46076
(317) 945-7181

Buffalo Turbine Agriculture
Equipment Co., Inc.
P.O. Box 150
Gowanda, NY 14070
(716) 532-2272

Century Engineering
Div. of Westeel, Inc.
803 N 25th St.
Fargo, ND 58103-3112
(319) 364-4101

DavSon Mfg., Inc.
33 S Belmont Ave.
Springfield, OH 45505
(513) 834-3590

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Degelman Industries, Inc.
P.O. Box 830
Regina, Saskatchewan
Canada S4P 3B1
(306) 543-4447

Dempster Industries, Inc.
P.O. Box 848
711 S 6th St.
Beatrice, NE 68310
(402) 223-4026

Dethmers Mfg. Co.
P.O. Box 189
Boyden, IA 51234
(712) 725-2311

Dyco Industries
2 Powder Mill Rd
Maynard, MA 01754
(617) 897-6381

Gandy Co
P.O. Box 528
Owatonna, MN 55060
(507) 451-5430

Garber Seeders
Div. of Riburn Industries, Inc.
P.O. Box 770
St. Paris, OH 43072
(513) 663-4865

GIMCO
1276 Abbott St.
Salinas, CA 93901
(408) 424-0508

Harmon International Industries, Inc.
P.O. Box 1444
2401 Millar Ave.
Saskatoon, Saskatchewan
Canada S7K 3P7
(306) 931-1161

Band Applicators:

Henderson Mfg.
P.O. Box 40
1085 S 3rd St.
Manchester, IA 52057
(319) 927-2828

Herd Seeder Co., Inc.
P.O. Box 448
Logansport, IN 46947
(219) 753-6311

Highway Equipment Co., Inc.
626 D Ave. NW
Cedar Rapids, IA 52805
(319) 363-8281

Holland Hitch Western, Ltd.
17909 Roam Pt.
Surray, British Columbia
Canada V36 5K1

Jet Co., Inc.
Highway 169 N
Humbolt, IA 50548
(515) 332-3117

Keo Industries, Ltd.
P.O. Box 395
Kerrobart, Saskatchewan
Canada S0L 1R0
(306) 834-5353

Kirby Mfg., Inc.
P.O. Box 989
Merced, CA 95341
(209) 723-0778

Kuhn Farm Machinery, Inc.
P.O. Box 224
Vernon, NY 13476
(315) 829-2620

Lakeside Truck Body
& Equipment Co.
P.O. Box 1104
S Golden State Blvd.
Turlock, CA 95381

The Lely Corp.
P.O. Box 1060
Wilson, NC 27894-1060
(919) 291-7050

Lighfoot Mfg., Inc.
1526 Marlin Rd.
Bloomer, WI 54724
(715) 568-2333

Lor-Al, Inc.
P.O. Box 265
Benson, MN 56215
(612) 843-4161

Nibex, Inc.
P.O. Box 8585
Emeryville, CA 94662
(415) 428-0871

Noble
P.O. Box 1030
Wahpeton, ND 58074
(701) 642-2621

Off-Road Floater Equipment Co.
627 Adena Rd.
Chillicothe, OH 45601
(614) 775-2666

Olathe Mfg., Inc.
100 Industrial Parkway
Industrial Airport, KS 66031
(913) 782-4396

Overrun Farm Machinery Inc.
866 Langs Dr.
Cambridge, Ontario
Canada N3H 2N7
(519) 653-8880

P&H Mfg., Co.
P.O. Box 549
Shelbyville, IL 62565
(217) 774-2123

Powell Mfg. Co., Inc.
P.O. Drawer 707
Bennettsville, SC 29512
(803) 479-6231

Remcar Inc.
P.O. Box 717
Howe, TX 75059
(214) 532-6214

Rokon International, Inc.
P.O. Box 189
Jaffrey, NH 03452
(800) 632-2481

Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Simonsen Mfg., Co.
P.O. Box 247
Quimby, IA 51049
(712) 445-2211

Solo, Inc.
P.O. Box 5030
Newport News, VA 23605
(804) 245-4228

Stoltzius Spreaders
Morgan Way
P.O. Box 527
Morgantown, PA 19543
(215) 286-5146

Taylor/Pittsburgh Implements
P.O. Box 769
Athens, TN 37303
(615) 745-3110

Tryco Mfg. Co., Inc.
P.O. Box 1277
Decatur, IL 62525
(217) 428-0901

The Tye Co.
P.O. Box 218
Lockney, TX 79241
(806) 652-3367

Tyler
E Highway 12
Benson, MN 56215
(612) 843-4000

Valmar Airflow, Inc.
P.O. Box 100
Elie, Manitoba
Canada R0H 0H0
(204) 353-2782

Vandermolen Corp.
119 Dorsa Ave.
Livingston, NJ 07039
(201) 992-8506

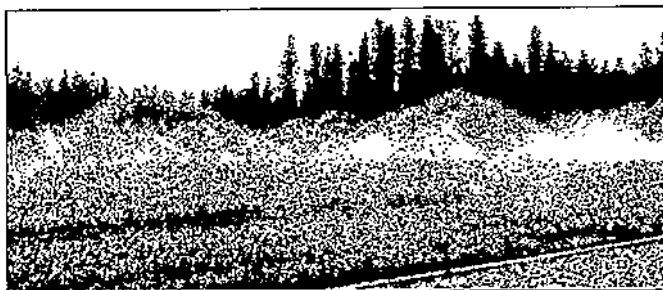
Vicom Farm Machines, Inc.
2885 Charlestown Rd.
Lancaster, PA 17603
(717) 872-8661

Willmar Mfg. Co.
P.O. Box 957
Willmar, MN 56201
(612) 235-0767

Wylie Mfg., Co.
P.O. Box 100
Petersburg, TX 79250
(800) 722-4001

Yielder Drill, Inc.
S 4305 University Rd.
Spokane, WA 99206
(509) 922-2958

5.3 Liquid Chemical Applicators



Various liquids or suspensions can best be applied by spraying. Selective herbicides, insecticides, and fungicides are typically sprayed directly on the seedbeds. Non-selective herbicides are used to control weeds on irrigation pipelines and border areas. Foliar fertilizers are also applied by spray when a definite deficiency has been identified.

Sprayers can be discussed by type of spray mechanism or by method of application. This section uses method of application. Sprays can be generated by several different types of equipment including pumps or mist blowers. Any anti-corrosive pump can be used for spraying fertilizer or herbicides, but centrifugal and diaphragm pumps are the most popular. In mist sprayers, a polypropylene roller pump feeds chemicals to the nozzles. The nozzles inject chemicals into the air-stream produced by the centrifugal fan and the mist is discharged into the air over the target area.

Hand-Held Applicators

Hand sprayers are designed to apply small quantities of concentrated spray. They are used mainly for spot-treating individual plants or small areas of a seedbed. Portable conventional sprayers powered by diaphragm pumps disperse chemicals mixed with water. The operator carries the sprayer and operates the pump with one hand and directs the spray with the other. Some pumps are operated by batteries. Hand-held sprayers with wands may hold 1 to 5 gallons and have a spray range of 20 feet. Backpack sprayers with a harness typically hold 5 gallons and spray 25 to 30 feet. Some nozzles adjust from mist to concentrated spray. Relatively small capacity limits use and requires frequent refilling.



Ultra-Low Volume Spray Applicators

Hand-held ULV applicators are economical and precise in applying herbicides to small selected areas. A spinning disk in the applicator breaks up the spray into small droplets so less herbicide is needed than in conventional sprayers. Liquid is fed to the disk by gravity from a liquid container near the applicator's handle.

For application, the opening is generally held 4 to 6 inches above the target. The applicator sprays in a circular hollow-cone pattern. Droplet size is 200 to 300 microns for a close operation and 50 to 150 microns for controlled drift spraying. In this application, the wand is held 3 to 4 feet above the crop to be treated.

Because the spray mix is more concentrated than conventional sprayers, this sprayer must be calibrated before use. In very hot or dry conditions, the herbicide must be mixed with oil to minimize evaporation.



Hand-Held Applicators:

Ace Supply
P.O. Box 1098
315 N Kit Ave.
Caldwell, ID 83606-1098
(208) 459-0731

Ames Lawn & Garden Tools
P.O. Box 1774
Parkersburg, WV 26102
(304) 424-3288

Arimitsu Industrial Co., Ltd.
3-21 Fukae Kita 2 Chome
Higashinari-ku, Osaka
537-Japan

Bartlett Mfg., Co.
3003 E Grand Blvd.
Detroit, MI 48202
(313) 873-7300

Ben Meadows Co.
3589 Broad St.
Chamblee, GA 30366
(800) 241-6401

The Broyhill Co.
N Market Square
Dakota City, NE 68731
(402) 987-3412

Canadian Forestry Equipment, Ltd.
90 E Boul. Brunswick Blvd.
D.D.O., Quebec
Canada H9B 2T5
(403) 484-2447

R.E. Chapin Mfg. Works, Inc.
P.O. Box 549
700 Ellicott St.
Batavia, NY 14020
(716) 343-3140

Cooper, Pegler & Co., Ltd.
2 Victoria Gardens
Burgess Hill
West Sussex RH159LA
England

Fimco, Inc.
First and Courts Sts.
Sioux City, IA 51101
(712) 258-0171

Forestry Suppliers, Inc.
205 W Rankin St.
P.O. Box 8397
Jackson, MS 39284-8397
(800) 647-3382

General Supply Corp.
P.O. Box 9347
303 Commerce Park Dr.
Jackson, MS 39286-9347
(601) 981-3882

Hardi, Inc.
477 Exeter Rd.
London, Ontario
Canada N6E 2Z3
(519) 685-6730

Homelite
Div. of Textron, Inc.
P.O. Box 7047
14401 Carowinde Blvd.
Charlotte, NC 28217
(704) 588-3200

H.D. Hudson Mfg., Co.
500 N Michigan Ave.
Chicago, IL 60611
(312) 644-2830

Lannel Tehtaat
Plant Systems Div.
SF-27820 Iso-Vimma (Sakyla)
Finland
(938) 70 300

A.M. Leonard, Inc.
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Marunaka, Ltd.
11, Mukaidanishi-ku
Kyoto, Japan 601
(075) 321-1901

Micron Agri Sprayers Canada, Inc.
Rt. 3
Walkerton, Ontario
Canada N0G 2V0
(519) 882-3602

Nasco
901 Janesville Ave.
Ft. Atkinson, WI 58538
(414) 563-2446

North American Micron
P.O. Box 1227
Reedley, CA 93654
(209) 638-4252

Pacific Stihl, Inc.
11096 Midway
Chico, CA 95928-9562

Reddick Equipment Co., Inc.
P.O. Box 72
Williamston, NC 27892
(919) 792-1191

Root Lowell Corp.
1000 Foreman Rd.
Lowell, MI 49331
(616) 879-9212

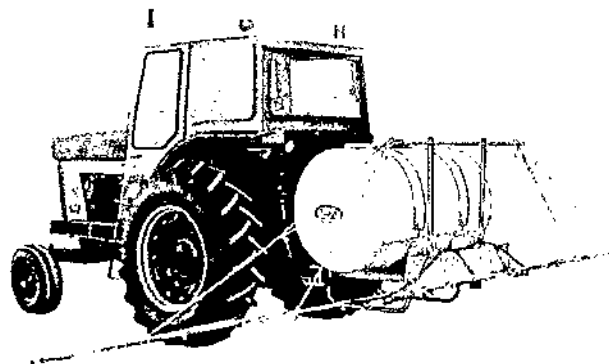
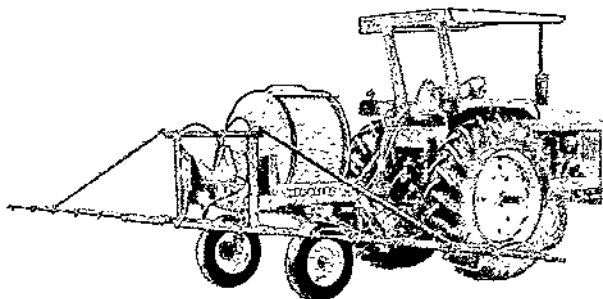
Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Solo, Inc.
P.O. Box 5030
5100 Chestnut Ave.
Newport News, VA 23605
(804) 245-4228

Boom Sprayers

Large sprayers may be mounted with a boom or may discharge their contents through a broadjet spray at the rear of the sprayer unit. Tractor-drawn sprayers may be used to apply liquid fertilizers, herbicides, and pesticides. Boom spraying is most common.

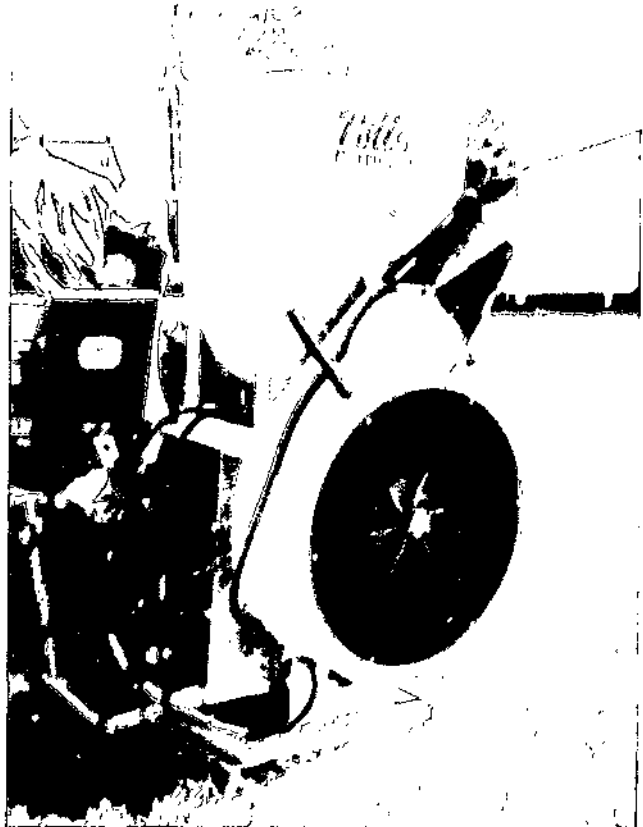
Boom sprayers may be used to apply liquid fertilizers, herbicides, and pesticides. A sprayer consists of a tank, a pump, and a boom, with accompanying hoses and nozzles. The booms are usually positioned horizontally to apply the spray directly on the desired area. The newer sprayers have a separate tank for chemical storage and meter the chemical directly into the spray line. This improves safety.



<p>Boom Sprayers:</p> <p>Ace Supply P.O. Box 1098 315 N Kit Ave. Caldwell, ID 83606-1098 (208) 459-0731</p> <p>Ag-Chem Equipment Co., Inc. Suite 100 5720 Santana Dr. Minnetonka, MN 55343 (612) 933-9006</p> <p>Agrotec, Inc. P.O. Box 49-T Highway 35 N Pendleton, NC 27862 (919) 585-1222</p> <p>The Broyhill Co. N Market Square Dakota City, NE 68731 (402) 987-3412</p> <p>Chem-Farm, Inc. P.O. Box 6510 4901 N St. Joseph Ave. Station B Evansville, IN 47719-0510</p>	<p>Continental Belton Co. P.O. Box 660 920 E 6th St. Belton, TX 76513 (817) 939-3731</p> <p>Dempster Industries, Inc. P.O. Box 848 711 S 6th St. Beatrice, NE 68310 (402) 223-4026</p> <p>Durland-Wayland, Inc. P.O. Box 1404 Lagrange, GA 30241 (404) 882-8161</p> <p>Fimco, Inc. First and Court Sts. Sioux City, IA 51101 (712) 258-0171</p> <p>Forestry Suppliers, Inc. P.O. Box 8397 205 W Rankin St. Jackson, MS 39284-8397 (800) 647-5368</p> <p>General Supply Corp. P.O. Box 9347 303 Commerce Park Dr. Jackson, MS 39286-9347 (601) 981-3382</p>	<p>John Blue Co. P.O. Box 1607 Huntsville, AL 35807 (205) 721-9090</p> <p>KBH Corp. P.O. Box 670 Clarksdale, MS 38614 (601) 624-5471</p> <p>Raven Industries, Inc. Plastics Div. P.O. Box 1007 205 E 6th St. Sioux Falls, SD 57117 (605) 336-2750</p> <p>Rears Mfg., Co. 2140 Prairie Rd. Eugene, OR 97402 (503) 688-1002</p> <p>Reddick Equipment Co., Inc. P.O. Box 71 Williamston, NC 27892 (919) 792-1191</p> <p>Rickel, Inc. P.O. Box 626 Salina, KS 67401 (913) 823-6222</p>	<p>Side Winder P.O. Box 818 Minden, LA 71058-0818 (501) 935-1970</p> <p>Summers Mfg. Co. 3338 Railway Ave. Maddock, ND 58348 Devils Lake, ND 58301 (701) 498-2855</p> <p>Tyler E Highway 12 Benson, MN 56215 (612) 843-4000</p> <p>Wilmar Mfg., Co. P.O. Box 957 Wilmar, MN 56201 (612) 235-0767</p> <p>Tanks and Accessories:</p> <p>Raven Industries, Inc. Plastics Div. P.O. Box 1007 205 E 6th St. Sioux Falls, SD 57117 (605) 336-2750</p>
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Mist Blowers

Mist blowers are useful for treating small acreages and have a general tank capacity of about 30 gallons with an application range of 16 feet to either side. Attachments are available to direct the spray and booms may be attached to the sprayer. The tanks may be mounted to all tractors and are operated by a PTO.



Mist Blowers:

Arimitsu Industry Co., Ltd.
3-21 Fakaekita 2 Chome
Higashinari-ku, Osaka
537-Japan

Automatic Equipment Mfg., Co.
One Mill Rd.
Pender, NE 68047
(402) 385-3051

Beecomist Systems, Inc.
31 Meetinghouse Rd.
Telford, PA 18969
(215) 721-0751

Chem-Farm, Inc.
P.O. Box 6510
Evansville, IN 47719
(812) 423-8017

Durland-Wayland, Inc.
P.O. Box 1404
Lagrange, GA 30241
(404) 882-8161

Flame Engineering, Inc.
P.O. Box 577
W Highway 4
LaCrosse, KS 67548
(800) 255-2469

Hanson General Products
Div. of Accra Plastics Tooling, Inc.
238 Charles St.
South Beloit, IL 61080
(815) 389-5100

Hardi, Inc.
477 Exeter Rd.
London, Ontario
Canada N6E 2Z3
(519) 685-6730

Side Winder
P.O. Box 818
Minden, LA 71058-0818
(501) 935-1970

Solo, Inc.
P.O. Box 5030
5100 Chestnut Ave.
Newport News, VA 23605
(804) 245-4228

ATV Sprayers

These sprayers can apply chemical to non-crop or nursery border areas. Mixtures of chemical and water can be carried in 15 to 100 gallon tanks mounted on or pulled by ATVs. Pumps are typically operated by a 12-volt motor and spray up to 125 feet. Sprayers usually come with a spotting gun and 6 feet of hose. Booms may be in lengths up to 30 feet.

ATV Sprayers:			
Arimitsu Industrial Co., Ltd. 3-21 Fukaekita 2 Chome Higashinari-ku, Osaka 537 Japan	Cooper, Pegler & Co., Ltd. 2 Victoria Gardens Burgess Hill, West Sussex RH159LA, England	Hardi, Inc. 477 Exeter Rd. London, Ontario Canada N6E 2Z3 (519) 685-6730	Robert H. Laning and Sons, Ltd. 289 Lemon St. Waterford, Ontario Canada N0E 1Y0 (518) 443-8601
The Broyhill Co. N Market Square Dakota City, NE 68731 (402) 987-3412	Edwards Equipment Co., Inc. 4312 Main St. Yakima, WA 98903 (509) 248-1770	H.D. Hudson Mfg., Co. 500 N Michigan Ave. Chicago, IL 60611 (312) 644-2830	Sauze Technical Products Corp. 212 Oak St. Ext. Plattsburgh, NY 12901 (518) 561-6440
Canadian Forestry Equipment, Ltd. 90 E Boul. Brunswick Blvd. D.D.O., Quebec Canada H9B 2T5 (403) 484-2447	Fimco, Inc. First and Court St. Sioux City, IA 51101 (712) 258-0171	Nasco 901 Janesville Ave. Fort Atkinson, WI 58538 (414) 563-2446	Side Winder P.O. Box 818 Minden, LA 71058-0818 (501) 935-1970
Continental Belton Co. P.O. Box 660 920 E 6th St. Belton, TX 76513 (817) 939-3731	Forestry Suppliers P.O. Box 8397 205 W Rankin St. Jackson, MS 39284-8397 (800) 647-5368	Rears Mfg. Co. 2140 Prairie Rd. Eugene, OR 97402 (503) 688-1002	Summers Mfg. Co. 103 Summers St. Devils Lake Industrial Park Devils Lake, ND 58301 (701) 438-2855

Agricultural Spray Nozzles

Many types of spray nozzles for applying liquid chemicals are available and can be obtained with different flow rates, droplet size, and spray patterns. The best type of nozzle for a particular application will vary with the type of chemical and the desired coverage. Because the orifice of the nozzle gradually wears and enlarges, spray nozzles should be changed regularly, especially when wettable powders (WP) are used.

Spraying Accessories

Pak-Mark is a foam system that marks borders on the path of spraying. It can be used as a guide when spraying to prevent overlapping or misses.

Spray Nozzles:

Ace Supply
P.O. Box 1098
315 N Kit Ave.
Caldwell, ID 83606-1098
(208) 459-0731

Cooper-Pegler & Co., Ltd.
2 Victoria Gardens
Burgess Hill, West Sussex
RH15 9LA, England

Delavan, Inc.
Gas Turbine Products Div.
P.O. Box 100
West Des Moines, IA 50265-0100
(515) 274-1561

Reddick Equipment Co., Inc.
P.O. Box 71
Williamston, NC 27892
(919) 792-1191

Spraying Systems Co.
North Ave. & Schmale Rd.
Wheaton, IL 60188
(312) 665-5000

Uittokalusto Oy
Fredrikinkatu 61 PL 455
00101 Helsinki, Finland
(90) 694-2400

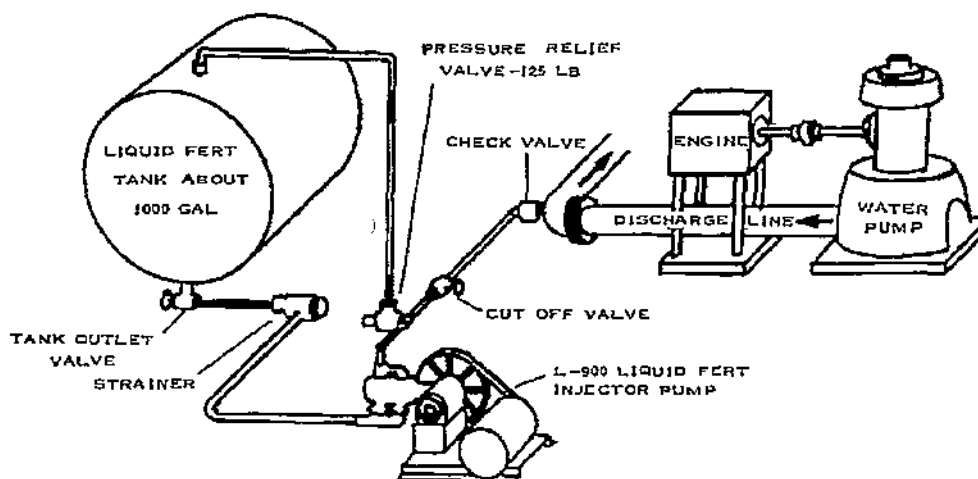
Weather-Matic
Div. Telsco Industries
P.O. Box 180205
3301 W Kingsley Rd.
Garland, TX 75041-2207
(214) 278-6131

Spraying Accessories:

Rears Manufacturing Co.
2140 Prairie Rd.
Eugene, OR 97402
(503) 688-1002

Liquid Injection Equipment

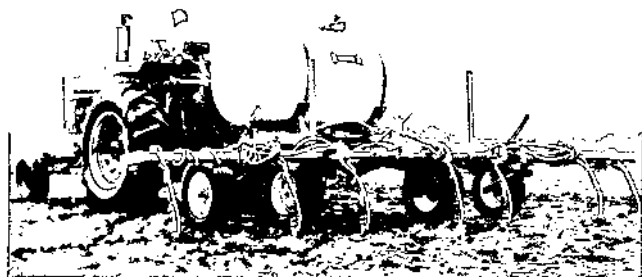
Some nurseries use irrigation injector systems to apply fertilizers, herbicides, and other pesticides to crops. Liquid formulations are commercially available, or water-soluble chemicals can be used to make a concentrated fertilizer solution. Injection systems usually consist of a large tank with a mixing agitator, a pump, and plumbing that connects the system to the main irrigation discharge line. The fertilizer or pesticide is mixed with water in the tank, then pumped at the desired injection ratio into the main irrigation system. Positive displacement and diaphragm pumps are recommended and they must be resistant to corrosion. The injection pump should be interlocked with the main irrigation pump and outfitted with anti-siphon valves so the chemicals cannot accidentally enter the main water system.



Injection Equipment:	General Irrigation Co. P.O. Box 776 Carthage, MO 64836- (417) 358-8171	Lindsay Mfg. Co. P.O. Box 156 Lindsay, NE 68644 (402) 428-2131	Rainbow Irrigation Systems P.O. Box 70 Fitzgerald, GA 31750 (912) 423-4341
Big John Mfg., Co., Inc. P.O. Box 456 Osmond, NE 68765 (402) 748-3868	The Gorman-Rupp Co. P.O. Box 1217 Mansfield, OH 44901 (419) 755-1011	Liquid Waste Technology P.O. Box 250 Somerset, WI 54025 (715) 247-5464	Smith Precision P.O. Box 276 Newbury Park, CA 91320 (805) 498-6616
John Blue Co. P.O. Box 1607 Huntsville, AL 35807 (205) 721-9090	Hydroflo Corp. Easton Rd. Rt. 611 N Plumsteadville, PA 18949 (215) 766-6867	Nebraska Irrigation, Inc. 911 23 St. E Columbus, NE 68601 (402) 564-1514	Valmont Industries, Inc. Valley, NE 68064 (402) 359-2201
BrushKing 4173 Domestic Ave. Naples, FL 33942 (813) 643-6368	Injecto-O-Meter Mfg. Co., Inc. 820 Thornton Clovis, NM 88101 (505) 763-4461	Off-Road Floater Equipment Co. 627 Adena Rd. Chillicothe, OH 45601 (614) 775-2666	Wade Mfg. Co. P.O. Box 23666 Portland, OR 97223 (503) 641-1865
Cat Pumps Corp. 1681 94th Lane NE Minneapolis, MN 55434 (612) 780-5440	Iridelco Corp. 440 Sylvan Ave. Englewood Cliffs, NJ 07632 (201) 569-3030	Pickle Creek Mfg. P.O. Box 9 Larned Industrial Park Larned, KS 67550 (316) 285-6965	Wylie Mfg. Co. P.O. Box 100 Petersburg, TX 79250 (800) 722-4001
D.M.I.T. Moulton P.O. Box 280 Somerset, WI 54025 (715) 247-3321			

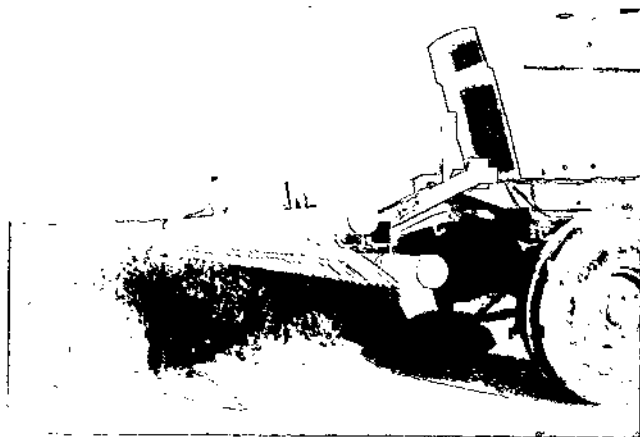
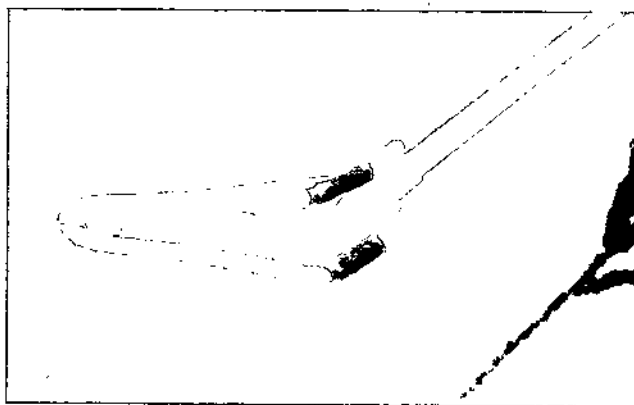
Liquid Fertilizer Injectors

Soil injection systems may apply liquid fertilizers or fumigants. They save money by allowing non-specific herbicides to be used. They consist of a tank for the liquid, a pump, and a soil-penetrating device. The liquid is usually applied by attached tubing directly behind the shank. Egedal uses a roller to incorporate the chemical. Certain distributors supply the whole system; however, parts of the system may have to be assembled from various manufacturers.



Wick Applicators

These applicators use pressure and natural capillary action to wet wicks or ropes with contact herbicides, and are then brushed over a field to selectively kill the weeds. Both hand-held and tractor-drawn wick applicators are available. With the mechanical models, the ropes are kept wet with herbicide by the combination of pressure applied by a pump and downward-angled ropes. Larger models feature booms from 10 to 30 feet.



Liquid Fertilizer Injectors:

Minnesota Wanner Co.
5145 Eden Ave. S
Minneapolis, MN 55436
(612) 929-1070

Smith Precision
P.O. Box 276
Newbury Park, CA 91320
(805) 498-6626

The KBH Corp.
P.O. Box 670
Clarksdale, MS 38614
(601) 624-5471

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Wick Applicators:

Bowman Mfg. Co., Inc.
Specialized Farm Equipment
P.O. Box 705
Rt. 3
Newport, AK 72112
(501) 523-2785

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

Reddick Equipment Co.
P.O. Box 71
Williamston, NC 27892
(919) 792-1191

5.4 Cultivation and Mechanical Weed Control



Weeds competing for soil nutrients and moisture restrict the growth of tree seedlings and other crops. Cultivators and weeders are commonly used by nurseries to temporarily eradicate weeds. Crops usually require several cultivations during a growing season.

Row and path cultivators are used by most nurseries. Row cultivators cultivate between the rows of the crop or seedlings. They are widely distributed and readily available in a variety of designs.

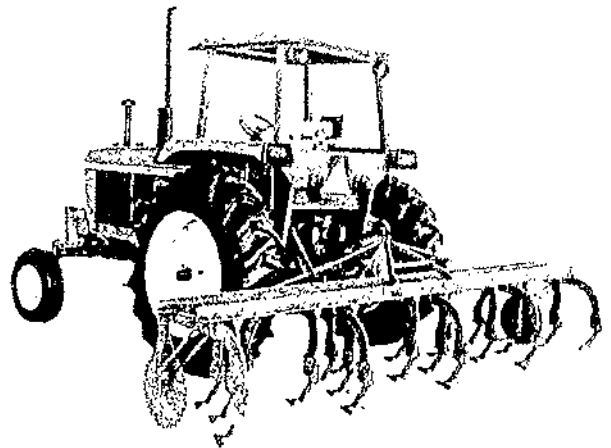
Path cultivators cultivate the paths between seedbeds. Modified row cultivators, garden rototillers, or custom-built path cultivators are used by most nurseries for path cultivation. Some row cultivators with shanks or blades removed may suffice as path cultivators.

Seedbed Cultivators

Weed control and soil surface preparations are considered the primary purposes for cultivation on tree nurseries. Cultivation helps to control weeds as well as break up the soil crust to improve aeration and moisture absorption. A variety of implements are used at bareroot tree nurseries for cultivation. They include shovel, rotary, rotary hoe, and sweep cultivators as well as specific weeding implements.

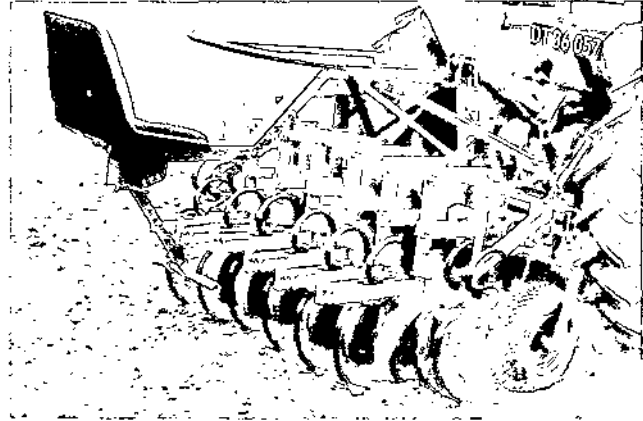
Shank Shovel Row Cultivators

Shank shovel row cultivators penetrate the soil up to 5 inches to uproot and bury weeds. They are manufactured in widths ranging from 5-1/2 to 10 feet and are tractor-mounted on a 3-point hitch. Row width is adjustable.



Egedal Bed Cleanser

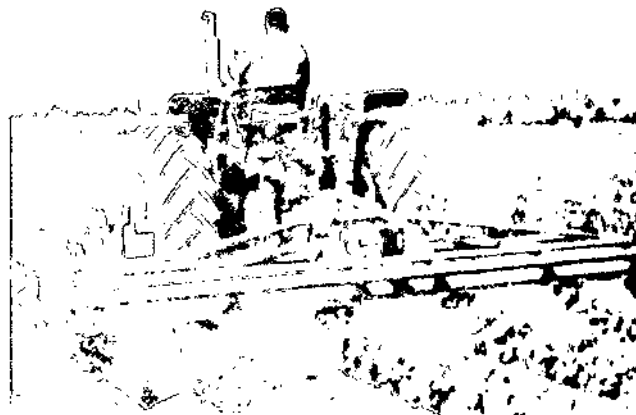
The Egedal Bed Cleanser removes weeds with vibrating spring tines that end at duck-foot shares. The tines may be spaced for any row width. An operator rides on the cultivator and manually guides the cultivator teeth between rows. Spraying and fertilizing equipment may be attached. The cultivator is available in 2- to 6-row models with variable row widths. Many other attachments are available, such as triple shares and bed rollers.



<p>Shank Cultivators</p> <p>Ace Supply, Inc. P.O. Box 1098 Caldwell, ID 83606-1098 (208) 459-0731</p> <p>Agrico Machinery (Pty), Ltd. P.O. Box 211 Lichtenburg 2740 Republic of South Africa 01441-26068</p> <p>Alloway Mfg. & Distributors Co. P.O. Box 2825 Fargo, ND 58108 (701) 282-7014</p> <p>Argis, Ltd. P.O. Box 154 Listowel, Ontario Canada N4W 3H2 (519) 291-4205</p> <p>BEFCO, Inc. P.O. Box 6036 Rocky Mount, NC 27801 (919) 977-9920</p> <p>Ber-Vac, Inc. 2835 Chemin Del'Aeroport Thetford Mines, Quebec Canada G6G 5R7 (418) 338-4290</p> <p>Bigham Brothers, Inc. P.O. Box 3338 Lubbock, TX 79452 (806) 765-8201</p>	<p>Blessent Mfg. Co. 5 Triumph Dr. Urbana, IL 61801 (217) 367-3636</p> <p>Brillion Iron Works, Inc. 220 Park Ave. Brillion, WI 54110 (414) 756-2121</p> <p>Brown Mfg. Corp. P.O. Box 339 Rt. 3 Highway 27E Ozark, AL 36360 (205) 795-6603</p> <p>Bryan Co. Salinas Farm Implements P.O. Box 1196 Salinas, CA 93902 (408) 754-6674</p> <p>Buckeye Tractor Co. P.O. Box 123 Columbus Grove, OH 45830 (419) 659-2162</p> <p>Bush Hog Division Allied Products Corp. P.O. Box 1039 Selma, AL 36702-1039 (205) 872-6261</p> <p>J.I. Case A Tenneco Co. 700 State St. Racine, WI 53404 (414) 636-5399</p>	<p>Deere & Co. John Deere Rd. Moline, IL 61265 (309) 765-5678</p> <p>Dickey Machine Works P.O. Box 5610 Pine Bluff, AR 71611 (501) 536-1300</p> <p>Miller-St. Nazianz, Inc. 511 E Main St. St. Nazianz, WI 54232 (414) 773-2121</p> <p>The Murray Ohio Mfg. Co. P.O. Box 268 Brentwood, TN 37027 (615) 373-6500</p> <p>Noble P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621</p> <p>Norcan Farm Equipment, Ltd. P.O. Box 1237 Cambridge, Ontario Canada N1R 6C9 (519) 623-8261</p> <p>Northwest-Tillers, Inc. P.O. Box 10932 Yakima, WA 98909 (509) 575-1950</p>	<p>Orthman Mfg., Inc. P.O. Drawer B Lexington, NE 68850 (308) 324-4654</p> <p>Pepin Farm Implements P.O. Box 158 610 Pine St. Pepin, WI 54759 (715) 442-2111</p> <p>Portable Elevator Div. 920 E Grove St. Bloomington, IL 61701 (309) 329-1235</p> <p>Remlinger Mfg. Co., Inc. P.O. Box 299 Kalida, OH 45853 (419) 532-3647</p> <p>Rome Industries P.O. Box 48 Cedartown, GA 30125 (404) 748-4450</p> <p>Sprayrite Mfg. Co. P.O. Box 3289 West Helena, AR 72390 (501) 572-6737</p> <p>Standen Engineering, Ltd. Station Rd. Ely Combs England CB7 4BP (035) 361111</p>
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Rotary Powered Cultivators

Rotary power row cultivators are commonly used and are available in widths of 12 to 60 inches. Row shields are usually attached to protect the seedlings.



Shank Cultivators:

Sukup Mfg. Co.
P.O. Box 677
Sheffield, IA 50475
(515) 892-4222

Taylor/Pittsburgh Implements
P.O. Box 769
Athens, TN 37303
(615) 745-3110

Tebben Mfg.
P.O. Box 140
Rt. 2
Clara City, MN 56222
(612) 847-2200

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

United Farm Tools, Inc.
P.O. Box 4026
Glasgow, KY 42142
(502) 651-7121

The Vassar Co.
P.O. Box 609
207 N Main
Perkins, OK 74059
(405) 547-2454

Vicom Farm Machinery, Inc.
2885 Charlestown Rd.
Lancaster, PA 17603
(717) 872-8661

White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Wil-Rich
P.O. Box 1030
Wahpeton, ND 58074
(701) 642-2621

Worksaver, Inc.
P.O. Box 1000
S State St.
Litchfield, IL 62056
(217) 324-5973

Yetter Mfg. Co., Inc.
P.O. Box 358
Cochester, IL 62326
(309) 776-4111

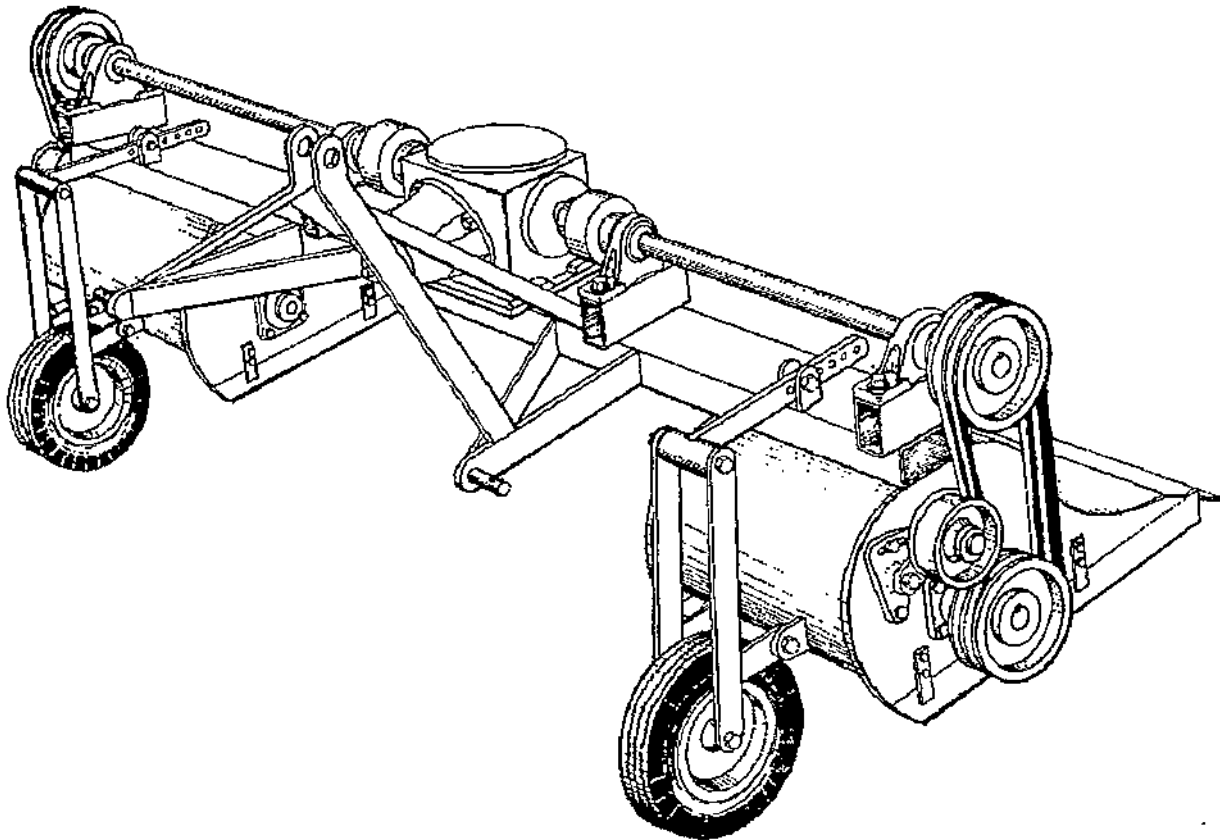
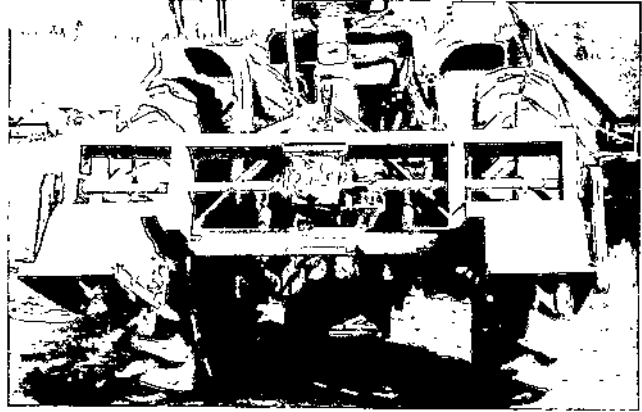
Coeur d'Alene Path Cultivator

This cultivator cultivates paths between seedbeds. It consists of rototillers mounted on a frame. The rototillers are power-takeoff driven and attach to a tractor by a 3-point hitch. Plans are available from:

USDA Forest Service
Coeur d'Alene Nursery
3600 Nursery Rd.
Coeur d'Alene, ID 38314
(208) 765-6365

Or

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900

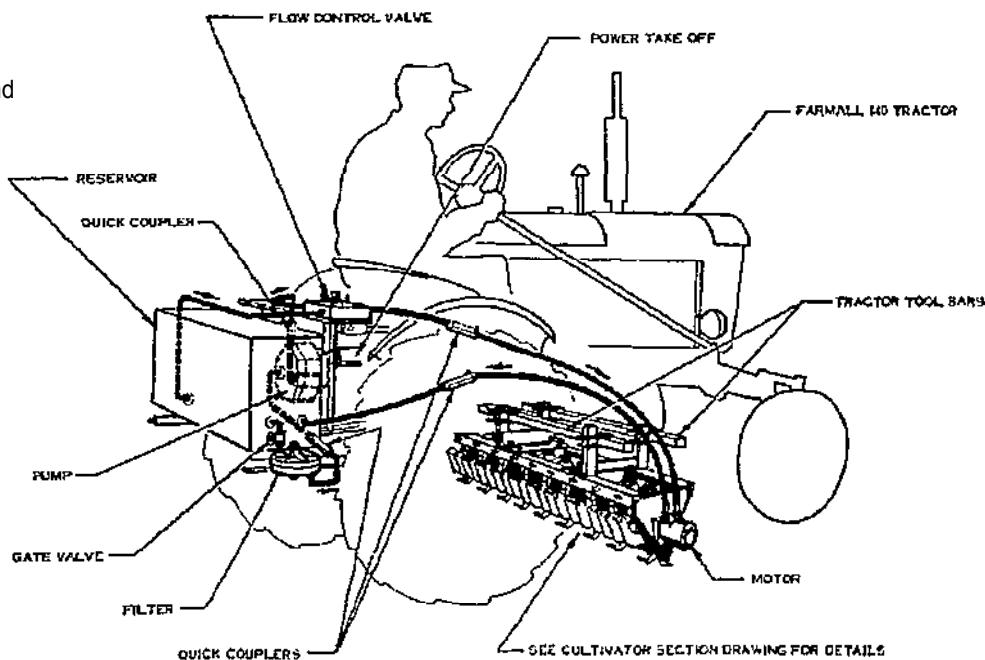


MTDC Nursery Bed Cultivator

The nursery bed cultivator was designed in the late 1960's to cultivate between the rows of nursery stock. The cultivator consists of rototiller-type blades and metal shields that protect the rows of seedlings. It is tractor-mounted and may be used with a hydraulic motor and a power-takeoff pump. The cultivator is effective in hard soils with excessive weeds.

Plans can be requested from:

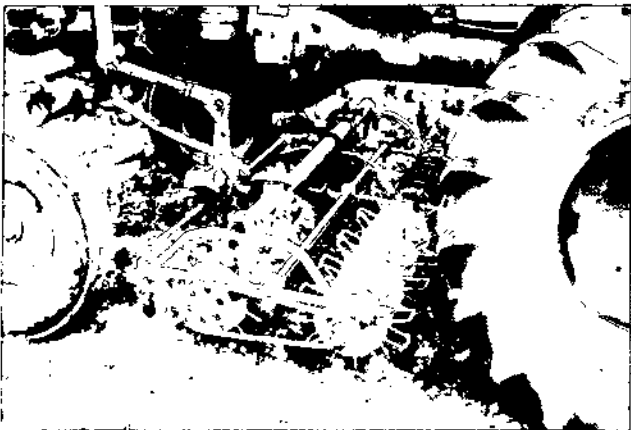
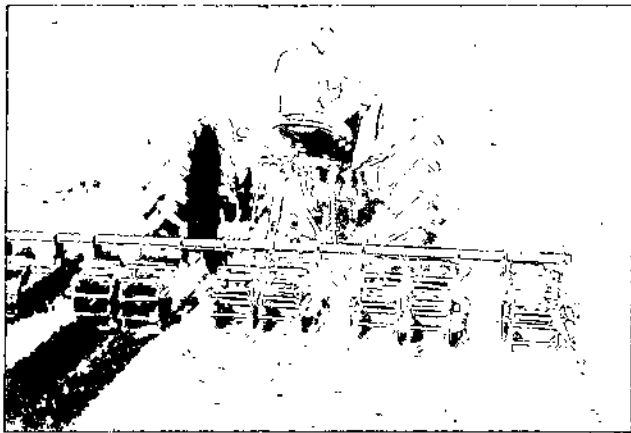
USDA Forest Service
Missoula Technology and
Development Center
Building 1 Fort Missoula
Missoula, MT 59801
(406) 329-3900



<p>Rotary Powered Cultivators:</p> <p>Alloway Mfg. and Distributing Co. P.O. Box 2825 Fargo, ND 58108 (701) 282-7014</p> <p>Ariens Co. 655 W Ryan St. Brillion, WI 54110 (414) 756-2141</p> <p>Bomford & Evershed, Ltd. P.O. Box 18 Salford Priors Evesham, Worcester England WR11 5SW 0789-773383</p> <p>The Ferguson Mfg. Co., Inc. P.O. Box 1098 Suffolk, VA 23434 (804) 539-3409</p>	<p>Geest Overseas Mechanisation, Ltd. White House Chambers Spalding Lines England PE11 2AL (0775) 761111</p> <p>General Irrigation Co. P.O. Box 776 Carthage, MO 64836 (417) 358-8171</p> <p>The Green Hoe Co., Inc. W Main Rd. Portland, NY 14769 (716) 792-9433</p> <p>Haffco, Inc. 358 NW F St. Richmond, IN 47374 (317) 966-8161</p>	<p>HCC, Inc. 1501 First Ave. Mendota, IL 61342 (815) 539-9371</p> <p>Hester Plow Co., Inc. P.O. Box 340 Lake City, FL 32056-0340 (904) 755-0960</p> <p>Kelley Mfg. Co. P.O. Drawer 1467 Tifton, GA 31793-1467 (912) 382-9393</p> <p>KMN Modern Farm Equipment, Inc. P.O. Box 1896 West Memphis, AR 72301 (501) 732-4270</p> <p>Marvin Landplane P.O. Box 1880 Woodland, CA 95695 (916) 662-2871</p>	<p>Nichols Tillage Tools, Inc. 312 Hereford Ave. Sterling, CO 80751 (303) 522-8676</p> <p>Northwest-Tillers, Inc. P.O. Box 10932 Yakima, WA 98909 (509) 575-1950</p> <p>Timm Enterprises, Ltd. P.O. Box 157 5204 Trafalgar Rd. Oakville, Ontario Canada L6J 4Z5 (416) 878-4244</p> <p>Utility Tool & Body Co., Inc. P.O. Box 360 Clintonville, WI 54929 (715) 823-3167</p>
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Budding Wheel Hoe

The Budding Wheel Hoe uses mounted rows of wire wheels to uproot weeds without throwing dirt on plants. It is most suited for narrow rows of 6 to 18 inches, but also works for wider rows. The cultivator comes in 1 to 8 row models, and the wire wheels can be made in a wide variety of sizes.



Budding Weeder Co.
7015 Hammond Ave.
Dutton, MI 49316
(616) 698-8613

Budding In-Row Weeders

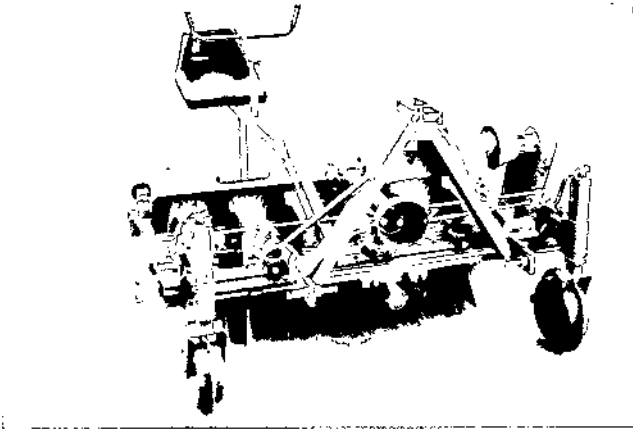
These in-row weeders are designed for cultivating wide rows. The rotating wire-teeth wheels rotate on a bias from 1/2-inch to 3/4-inch deep to loosen the soil and remove weeds. The open wheels keep the soil even between rows. The wheels may be spaced 2 to 5 inches apart. This weeder is most commonly used in hardwood nurseries.



Budding Weeder Co.
7015 Hammond Ave.
Dutton, MI 49316
(616) 698-8613

Frobro Brush Hoe

The Frobro Brush Hoe is useful for close-set, delicate crops. It operates without damage in rows less than 5 inches apart. The cultivator doesn't mix or move soil. Instead, the bristles rub the surface and lift out weeds. Plants are protected by adjustable barriers. Tension springs allow the brush hoe to hug the earth. A fertilizer applicator may be added. Row widths are adjustable.

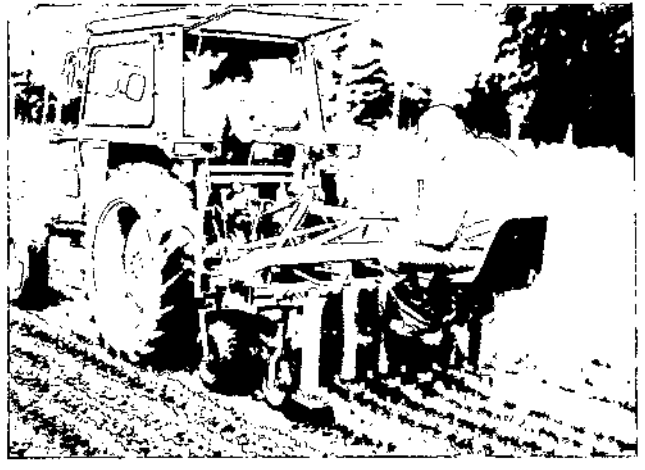


Frobro Brush Hoe

Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Egedal Row Master

The Egedal Row Master cultivates between rows to a depth of about 4 inches. Each section is independently spring-mounted. Each pruning head is equipped with three teeth that rotate from side-to-side. The width of the rotation can be adjusted to prevent root damage. Vertical and horizontal root pruners may be attached to the cultivator. The cultivator is equipped for 4 to 6 rows, which can be spaced 9 to 12 inches apart.



Egedal Row Master:

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Clements All-Around Weeder

This cultivator consists of tines in the rear and two long flails in the front that pass under the soil to slash weed roots. The flails are equipped with a sensing bar. The flails rotate out of the way when the sensors encounter a tree trunk. The unit may be mounted to the front, side, or rear of a tractor. A tiller or chopper may be mounted to the rear of the unit.

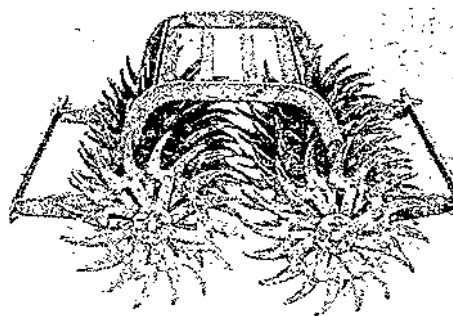


Clements All-Around Weeder:

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Rotary Hoes

A rotary hoe is a tractor-drawn secondary tillage and/or cultivation implement. It may be used to weed new seedbeds and/or to break up crusty surface soil. It consists of tandem multiteeth wheels that penetrate the soil to a maximum depth of 2 inches. Rotary hoes are available in widths from 4 to 20 feet for all categories of tractors.



Rotary Hoes:

Beaver Valley Supply
Atwood, KS 67730
(913) 626-3251

J.I. Case
A Tenneco Co.
700 State St.
Racine, WI 53404
(414) 636-5399

Crust Buster/Speed King, Inc.
P.O. Box 1438
Fort Dodge Rd.
Dodge City, KS 67801
(316) 227-7108

Deere and Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

The Green Hoe Co., Inc.
W Main Rd.
Portland, NY 14769
(716) 792-9433

Hester Plow Co., Inc.
P.O. Box 340
Lake City, FL 32056-0340
(904) 755-0960

M & W Gear Co.
Route 47 S
Gibson City, IL 60936
(217) 784-4261

Nichols Tillage Tools, Inc.
312 Hereford Ave.
Sterling, CO 80751
(303) 522-8676

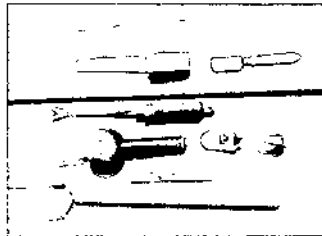
Northwest-Tillers, Inc.
P.O. Box 10932
Yakima, WA 98909
(509) 575-1950

Orto Lan
Via Lungochiampo, 90
Montebellon (Vicenza)
Italy 36054
(0444) 649565

J.T. Parkes & Sons, Ltd.
Northfield Rd.
Netherton, Dudley
West Midland
England DY29JQ
0384-237387

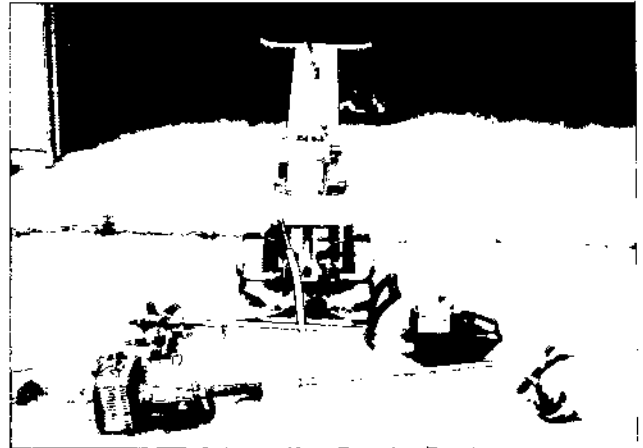
Hand Weeding Equipment

Bareroot nurseries use both commercial and homemade implements and equipment to hand weed seedbeds. The weeds are generally uprooted, placed in buckets or tubs and removed from the seedbeds because some species will continue to distribute seed after they have been removed. Unwanted vegetation in non-crop areas is usually trimmed close to the ground, because digging it up exposes new soil and stimulates dormant weed seeds to germinate. Commercial equipment can be found at your local lawn and garden stores.



Weed Eaters

Grass and weeds around fences and trees can be trimmed with portable weed eaters. These consist of a gas engine attached by a long shaft to a rotary wheel. Nylon string attaches to the wheel. Saw attachments generally are available to allow the weed eater to cut small trees and brush.



Weed Eaters:

Ben Meadows Co.
P.O. Box 80549
3589 Broad St.
Chamblee, GA 30366
(800) 241-6401

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

General Supply Corp.
P.O. Box 9347
303 Commerce Park Dr.
Jackson, MS 39286-9347
(601) 981-3382

Homelite
Div. of Textron, Inc.
P.O. Box 7047
14401 Carowinde Blvd.
Charlotte, NC 28217
(704) 588-3200

A.M. Leonard, Inc.
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Seymour Mfg. Co.
500 N Broadway
Seymour, IN 47272
(812) 522-2900

Shindaiwa, Inc.
P.O. Box 1090
11975 SW Herman Rd.
Tualatin, OR 97062
(503) 692-3070

Snapper Power Equipment
P.O. Box 777
Dept. B
McDonough, GA 30253
(402) 957-9141

Stanley Hydraulic Tools
Div. of the Stanley Works
3810 SE Naef Rd.
Milwaukee, OR 97222
(505) 659-5660

Stihl, Inc.
536 Viking Dr.
Virginia Beach, VA 23452
(804) 486-8444

Zip-Penn
P.O. Box 1779
2008 E 33rd St.
Erie, PA 16512
(814) 898-2008

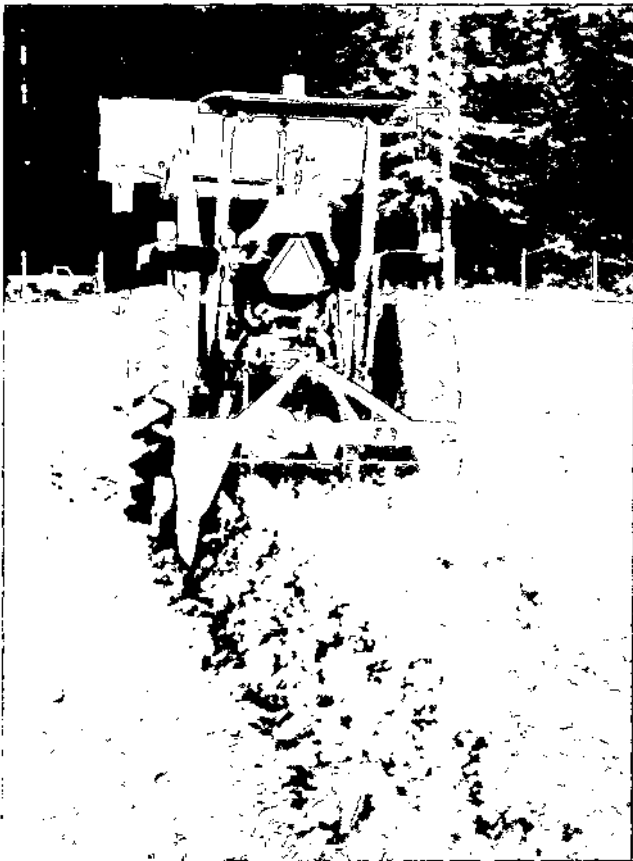
5.5 Root Culturing



Root culturing is extensively used for checking top growth and developing more fibrous roots of nursery stock. The timing and frequency of root culturing depends on factors like the species of the stock, the size and type of stock desired, and the stage of development of the stock. Most root culturing equipment is tractor-mounted and adjustable for depth. A limited number of horizontal and lateral root root pruner manufacturers are available. Some nurseries use custom-built pruners.

Undercutting Equipment

Undercutting, also called horizontal root pruning, consists of severing the tap root and other vertically oriented roots several inches below the ground surface. Undercutting is usually accomplished by a tractor-mounted horizontal blade adjustable to a maximum depth of 10 inches. Some equipment is designed to move the blade back and forth through the soil which aids in the cutting action and reduces soil drag. Most undercutters mount directly to the 3-point hitch. Although several types of undercutters are commercially available, many nurseries use custom-built equipment.

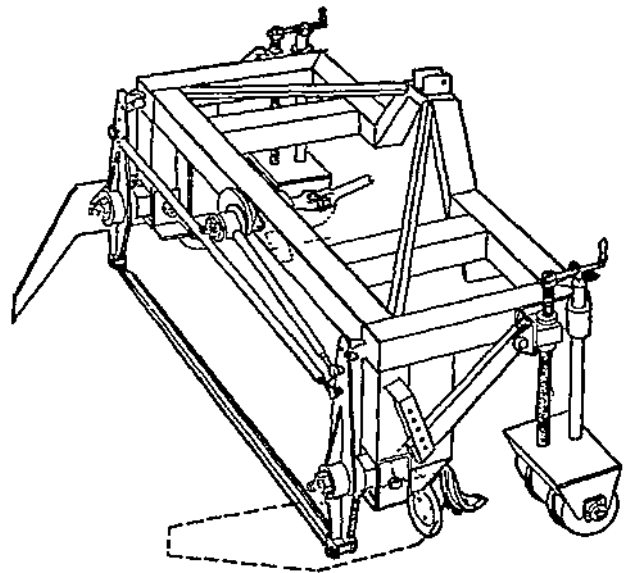


MTDC Reciprocating Root Pruner

The Technology and Development Center at Missoula redesigned a reciprocating root pruner for category H 3-point hitch tractors in 1972. The pruner is power takeoff-driven and adjustable to a maximum depth of 10 inches. An optional reciprocating speed increase is allowed by the design. A soil-penetrating chisel point and coulter remove rocks and soil from the path of the rocker arms. For more information, see MTDC Report, *Redesign of Horizontal Root Pruner* (7424-2205), July 1973.

Drawings are available from:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900

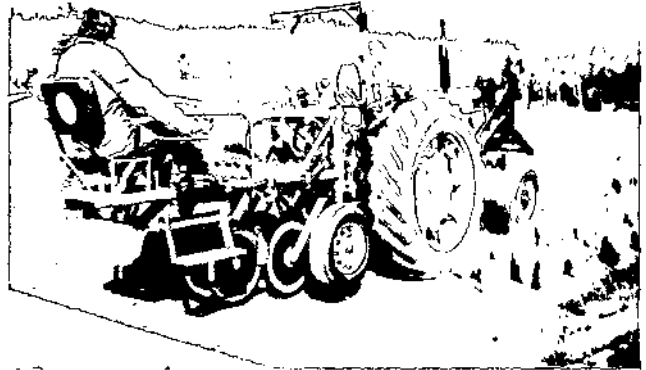


Wrenching Equipment

The terms wrenching and undercutting are often used interchangeably, but they are distinctively different operations with different objectives. Wrenching is primarily employed to fracture the soil profile and the blade is set much deeper than for undercutting, often at 10 to 12 inches. Nurseries wrench their seedbeds when surface soil crusts inhibit water infiltration or to generate better air exchange or leaching within the root zone. Wrenching is commonly done late in the growing season to induce seedling moisture stress that arrests terminal height growth and helps wet a dormant bud. Although some nurseries use undercutting equipment, wrenching blades are generally thicker and are drawn through the soil at a slight angle which produces the desired soil disturbance.

Lateral Pruning

Lateral pruning cuts the horizontal roots of the seedling several inches from the stem. Pruning is usually accomplished with tractor-mounted vertical blades or coulters. These are adjustable to a maximum depth of 12 inches. Lateral pruning and root pruning are often done together. Vertical and horizontal root pruners may be attached to the Egedal Row Master Cultivator (see *Seedbed Cultivation*). Few commercial lateral pruners are available and so most nurseries build their own.



Undercutting/Wrenching Equipment:

Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Grayco Potato Harvesters, Ltd.
Heidelberg, Ontario
Canada N0B 1Y0
(519) 699-5372

Lundebj Mfg.
P.O. Box 136
Rt. 1
Tolna, ND 58380
(701) 262-4721

Silver Mountain Equipment, Inc.
4672 Drift Creek Rd. SE
Sublimity, OR 97385
(503) 769-7127

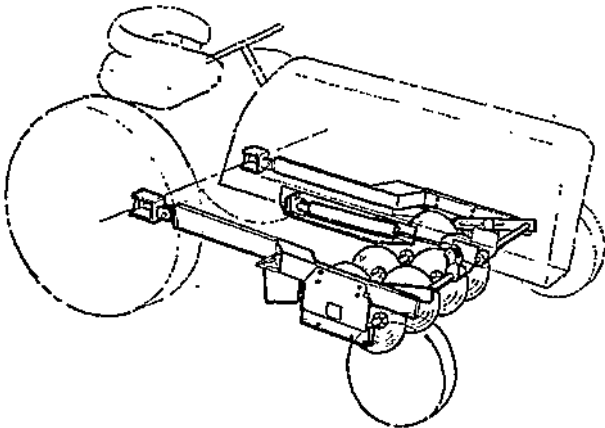
Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

R.A. Whitfield, Mfg. Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

Lucky Peak Lateral Pruner

Lucky Peak has plans available for a lateral pruner attached to the underside of a tractor. It consists of coulters alternated on tandem axles. The pruning depth is adjustable hydraulically. Plans may be obtained from:

USDA Forest Service
Lucky Peak Forest Tree Nursery
P.O. Box 1085
HC 33
Boise, ID 83706
(206) 343-1977



Lateral Pruners:

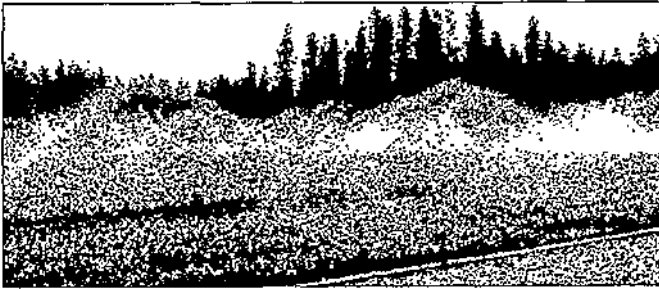
Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

HMS Soil Fumigation
7610 Highway 41 N
Palmetto, FL 33561
(813) 722-5587

Silver Mountain Equipment, Inc.
4672 Drift Creek Rd. SE
Sublimity, OR 97385
(503) 769-7127

R.A. Whitfield Mfg. Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

5.6 Top Pruning



Top pruning involves clipping off the upper portion of the shoot and is usually done to help control top height and produce a better shoot-to-root ratio. The time of top pruning is extremely critical and should only be done when the shoot is still expanding and before it has become too woody. If the pruning blade cuts into woody tissue, the stem often splits and a good terminal bud is never developed. Some species respond better to top pruning than others.

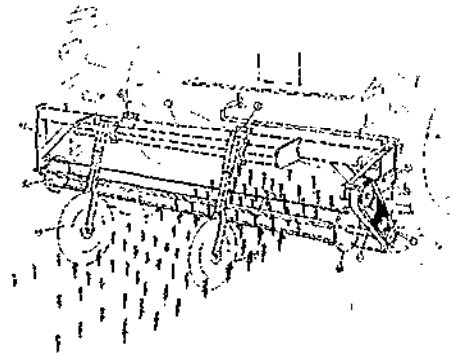
Top Pruners

Nurseries use a variety of equipment that is modified for top pruning tree seedlings. Most common equipment includes rotary mowers, flail mowers or sickle bar mowers. Custom-built top pruners and silage cutters are also being used. Rotary and flail mowers are not ideal because they do not cut seedling tops as cleanly as desired. Also, the tops are scattered within the seedbed. Many nurseries catch the cut tops and remove this material from their seedbeds.

Hammermill Paper Company Top Pruner

Hammermill Paper Company designed and fabricated a unique seedling top pruner for their nursery in Alabama. Drawings are available upon request from:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



Whitfield Top Pruner

Whitfield top pruner consists of a 50-inch cutter-bar driven by a hydraulic motor similar to the Hammermill Paper Company top pruner. The seedling tops drop into a receiver bin, which can be emptied after use. The height of the cutting bar is regulated by a hydraulic cylinder. The machine itself is 7.3 feet wide.

Whitfield Top Pruner:

R. A. Whitfield Forestry Equipment
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

Rotary Mowers

Rotary mowers are widely used for top pruning. Tree seedlings are pruned by one or more power takeoff-driven steel blades that rotate horizontally above the ground. Most rotary mowers are tractor-mounted and adjustable to cut 1 to 18 inches above the ground. For every foot of width to be cut, 5 plus hp is recommended.

Heavy-duty rotary mowers may be used to cut brush or weeds. Smaller mowers are able to handle tangled grass. Mowers are available in a wide range of sizes for all categories of tractors.



Rotary Mowers:

Agridisc & Implements Corp.
5502 NW 72nd Ave.
Miami, FL 33166
(305) 884-6100

Alamo Group
P.O. Box 549
Sequin, TX 78156-0549
(512) 379-1480

Arts-Way Mfg. Co.
P.O. Box 288
Armstrong, IA 50514
(712) 864-3131

Auburn Constructions Industries, Inc.
P.O. Box 350
Auburn, NE 68305
(402) 274-4911

BEFCO, Inc.
P.O. Box 6036
Rocky Mount, NC 27801
(919) 977-9920

BMB Co., Inc.
N Vermont & Ninth
Holton, KS 66436

Brown Mfg., Corp.
P.O. Box 339
Rt. 3
Highway 27 E
Ozark, AL 36360
(205) 795-6603

Bush Hog Div.
Allied Products Corp.
P.O. Box 1039
Selma, AL 36702-1039
(205) 872-6261

J.I. Case
A Tenneco Co.
700 State St.
Racine, WI 53404
(414) 636-5399

Central Tractor Farm & Family
Center
P.O. Box 3330
Des Moines, IA 50316
(515) 266-3101

Chapin Equipment Co.
202 Fulton St.
Fresno, CA 93721
(209) 233-7141

Continental Belton Co.
P.O. Box 660
920 E 6th St.
Belton, TX 76513
(817) 939-3731

Corsicana Grader & Machine Co.
P.O. Box 1699
Corsicana, TX 75110
(214) 872-1241

Crandell-Hicks Co.
P.O. Box 5012
30 Oak St.
Westboro, MA 01581
(508) 898-2808

CrustBuster/Speed King, Inc.
P.O. Box 1438
Fort Dodge Rd.
Dodge City, KS 67801
(316) 227-7106

Cushman, Inc.,
P.O. Box 82409
Lincoln, NE 68501
(402) 475-9581

Rotary Mowers:

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Edwards Equipment Co.
4312 Main St.
Yakima, WA 98903
(509) 248-1770

Farm King Allied, Inc.
P.O. Box 1003
Winnipeg, Manitoba
Canada R3C 2W5
(204) 661-8711

Ford New Holland, Inc.
500 Diller Ave.
New Holland, PA 17557
(717) 355-1121

Graham-Hoeme
P.O. Box 3779
Amarillo, TX 79106
(214) 475-0405

Gravely International, Inc.
P.O. Box 5000
1 Gravely Lane
Clemmons, NC 27012
(919) 766-4721

Great Bend Mfg. Co., Inc.
P.O. Box 829
Great Bend, KS 67530
(316) 792-1701

Great Plains Mfg., Inc.
P.O. Box 218
Assaria, KS 67416
(913) 667-4755

Haban Mfg. Co.
2100 Northwestern Ave.
Racine, WI 53404
(414) 637-8388

Hardee Mfg., Inc.
P.O. Box 232
Rt. 4
Loris, SC 29569
(803) 756-4051

Hester Plow Co., Inc.
P.O. Box 340
Lake City, FL 32056-0340
(904) 755-0960

Howard Price Turf Equipment
18155 Edison Ave.
Chesterfield, MO 63005
(314) 532-7000

Howse Implement Co., Inc.
P.O. Box 86
Laurel, MS 39441
(601) 428-0841

Impex International, Inc.
115/A Belton Dr.
Spartanburg, SC 29304
(800) 274-4410

Interstate Equipment & Mfg. Corp.
P.O. Box 70296
Bakersfield, CA 93387
(805) 322-6659

Jacobsen
Div. of Textron, Inc.
1721 Packard Ave.
Racine, WI 53402-2561
(414) 637-6711

C.C. Kelley & Son
61501 Bremen NW
Misawaka, IN 46544
(219) 255-4746

King Plow Co.
P.O. Box 93009
Atlanta, GA 30377
(404) 876-4476

Kut-Kwick Corp.
1927 Newcastle St.
Brunswick, GA 31521
(912) 265-1630

Land Pride
P.O. Box 218
Assaria, KS 67416
(913) 667-4755

Long Mfg. N.C., Inc.
P.O. Box 1139
Tarboro, NC 27886
(919) 823-4151

M & W Gear Co.
Rt. 47 S
Gibson City, IL 60936
(217) 784-4261

Massey-Ferguson, Inc.
1901 Bell Ave.
Des Moines, IA 50315
(515) 247-2011

Mitchell, Lewis, & Staver Co.
9925 SW Commerce Circle
Wilsonville, OR 97070
(503) 682-0991

Modern, Inc.
P.O. Box 790
Beaumont, TX 77704
(409) 833-2665

Mohawk Equipment Co.
P.O. Box 3605
Temple, TX 76505
(817) 778-1631

Motrim, Inc.
240 Steubenville Ave.
Cambridge, OH 43725
(614) 439-2725

Nicholls Farm Equipment
Rt. 3
Wainfleet, Ontario
Canada L0S 1V0
(416) 732-2000

The Perry Co.
P.O. Box 7187
Waco, TX 76714
(817) 756-2137

Priefert Mfg. Co., Inc.
P.O. Drawer 2540
Mt. Pleasant, TX 75455
(800) 527-8616

Rotech, Inc.
P.O. Box 31
Olathe, KS 66061
(913) 782-3456

Schulte Industries, Ltd.
P.O. Box 70
Englefeld, Saskatchewan
Canada S0K 1N0
(306) 287-3715

Seppi M.
% Paul Fellin
N 56 W 35700 Lisbon Rd.
Oconomowoc, WI 53066
(414) 546-0473

Servis-Rhino, Inc.
P.O. Box 712
Sequin, TX 78156-0712
(512) 379-1480

Side Winder
P.O. Box 818
Minden, LA 71058-0818
(501) 935-1970

Sukup Mfg. Co.
P.O. Box 677
Sheffield, IA 50475
(515) 892-4222

Taylor/Pittsburgh Implements
P.O. Box 769
Athens, TN 37303
(615) 745-3110

Tiger Corporation
3301 N Louise Ave.
Sioux Falls, SD 57107
(605) 336-7900

G.L. Turner Co.
P.O. Box 5652
North Little Rock, AR 72119
(501) 375-0297

United Farm Tools, Inc.
P.O. Box 4028
Glasgow, KY 42142
(502) 651-7121

White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

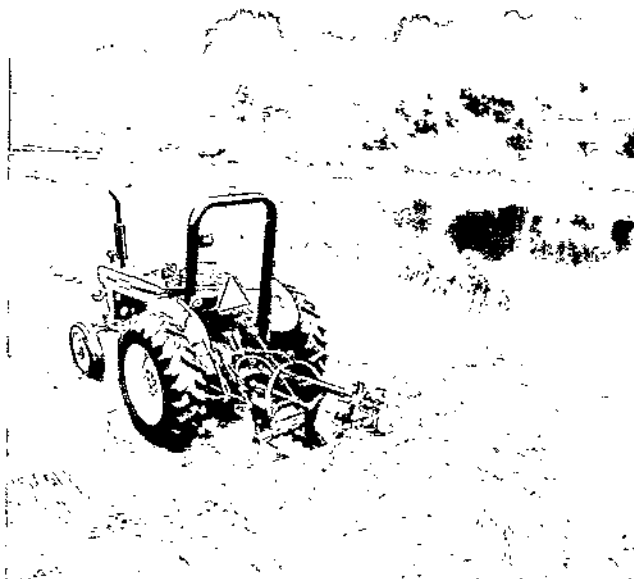
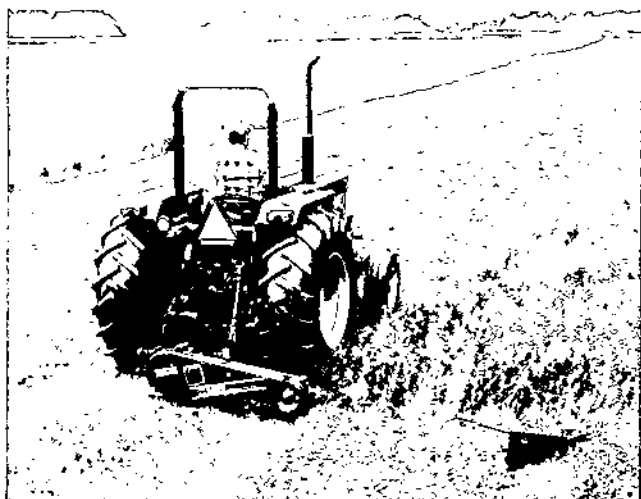
Woods
Div. of Hesston
P.O. Box 1000
Oregon, IL 61061
(815) 732-2141

Yamaha Motor Corp.
6555 Katella Ave.
Cypress, CA 90630
(714) 761-7605

Sickle Bar Mowers

Sickle bar mowers are used by some nurseries for top pruning. They may also be used to mow hay or weeds. They consist of a power takeoff-driven reciprocating sickle within a bar. Most mowers are tractor-mounted, while some are mounted on trailers. Most have mowing bars that may be raised or lowered hydraulically. Some have cutting bars that can operate at angles down to 55 degrees and up to 90 degrees. Cutting bars vary from 5-1/2 feet to 9 feet and require 30 to 45 hp. Top pruning with this mower may be limited by the stability and rigidity of the mowing bar.

Attachments to support the distal end of the sickle bar are available from most manufacturers. They are usually adjustable for various heights and increase the stability of the sickle bar significantly.



Sickle Bar Mowers:

Alamo Group
P.O. Box 549
Sequin, TX 78156-0549
(512) 379-1480

BCS America, Inc.
P.O. Box 1739
Matthews, NC 28105
(704) 846-1040

Busatis Corp.
1813 Linn St.
North Kansas City, MO 64116-3626

Cartner Corp.
P.O. Box 262
Cambridge, OH 43725
(614) 439-2725

J.I. Case
A Tenneco Co.
700 State St.
Racine, WI 53404
(414) 636-5399

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 765-5678

Ford New Holland, Inc.
500 Diller Ave.
New Holland, PA 17557
(717) 355-1121

Haban Mfg. Co.
2100 Northwestern Ave.
Racine, WI 53404
(404) 637-8388

Kosch Co.
P.O. Box 707
Columbus, NE 68602
(402) 564-7161

Kuhn Farm Machinery, Inc.
P.O. Box 224
Vernon, NY 13476
(315) 829-2620

New Idea Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

Rowse Hydraulic Rakes Co., Inc.
P.O. Box 42
HC 80
Burwell, NE 68823
(308) 348-2276

Side Winder
P.O. Box 818
Minden, LA 71058-0818
(501) 935-1970

Stocker & Son, Inc.
P.O. Box 749
Bayport, NY 11705
(516) 472-1881

Tarver Sales Corp.
84636 Highway 25
Folsom, LA 70437

Turner International, Ltd.
Div. of Elswick PLC
Dept. M-10
1360 Business Center Dr.
Conyers, GA 30207
(404) 922-1154

Flail Mowers

Flail mowers have swinging pyramid-shaped flail knives mounted on a cylinder. Flail mowers come in various widths. They require a 540k power-takeoff hitch or can be hydraulically driven. Some may be mounted on an extendable boom.



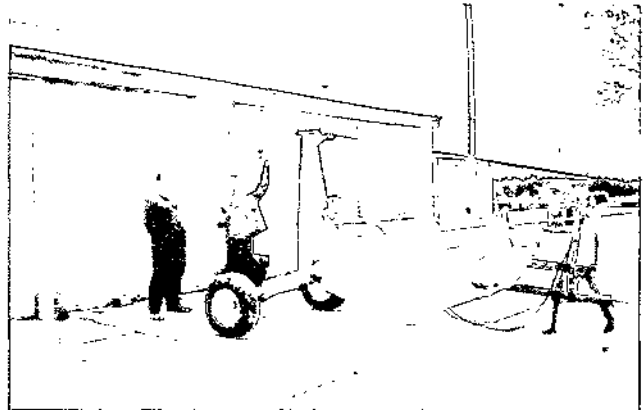
Flail Mowers:			
Alamo Group P.O. Box 549 Sequin, TX 78156-0549 (512) 379-1480	Cartner Corp. P.O. Box 262 Cambridge, OH 43725 (614) 439-2725	Gravely International, Inc. P.O. Box 5000 1 Gravely Lane Clemmons, NC 27012 (919) 766-4721	Kuhn Farm Machinery, Inc. P.O. Box 224 Vernon, NY 13476 (315) 829-2620
Alloway Mfg. & Distributing Co. P.O. Box 2825 Fargo, ND 58108 (701) 282-7014	J.I. Case A Tenneco Co. 700 State St. Racine, WI 53404 (414) 636-5399	Haban Mfg. Co. 2100 Northwestern Ave. Racine, WI 53404 (414) 637-8388	Kut-Kwick Corp. 1927 Newcastle St. Brunswick, GA 31521 (912) 265-1630
Arts-Way Mfg. Co. P.O. Box 288 Armstrong, IA 50514 (712) 864-3131	Dandl Mfg. Corp. P.O. Box 637 Chico, CA 95926 (916) 891-5163	Haven Steel Products, Inc. P.O. Box 430 Haven, KS 67543 (316) 465-2271	Lundell Mfg. Co., Inc. P.O. Box 171 Cherokee, IA 51012 (712) 225-5181
Balzer Mfg. Co. Highway 60 E Mountain Lake, MN 56159 (217) 427-3133	Deere & Co. John Deere Rd. Moline, IL 61265 (309) 765-5678	Hiniker Co. P.O. Box 3407 Mankato, MN 56002 (507) 624-6621	Mathews Co. 500 Industrial Ave. Crystal Lake, IL 60012 (815) 459-2210
BEFCO, Inc. P.O. Box 6036 Rocky Mount, NC 27801 (919) 977-9920	Edwards Equipment Co. 4312 Main St. Yakima, WA 98903 (509) 248-1770	Impex International, Inc. 115/A Belton Dr. Spartanburg, SC 29304 (800) 274-4410	Motrim, Inc. 240 Steubenville Ave. Cambridge, OH 43725 (614) 439-2725
Bomford Center-North P.O. Box 28 West Jefferson, OH 43162-00 (614) 879-7601	Flory Industries P.O. Box 908 4737 Tomes Salida, CA 95368 (209) 545-1167	Jacobsen Div. of Textron Inc. 1721 Packard Ave. Racine, WI 53403-2561 (414) 637-6711	Fear's Mfg. Co. 2140 Prairie Rd. Eugene, OR 97402 (503) 688-1002
Brillion Iron Works, Inc. 200 Park Ave. Brillion, WI 54110 (414) 756-2121	Ford New Holland, Inc. 500 Diller Ave. New Holland, PA 17557-0903 (717) 355-1121	Kelly Ryan Equipment Co. P.O. Box 488 Blair, NE 68008 (402) 428-2151	Rousseau, Inc. 2717 W 5th St. N Unit B Summerville, SC 29483 (803) 875-1850
Bush Hog Div. Allied Products Corp. P.O. Box 1039 Selma, AL 36702-1039 (205) 872-6261	Graham-Hoeme P.O. Box 3779 Amarillo, TX 79106 (214) 475-0405	Kubota Tractor Corp. 550 W Artesia Blvd. Compton, CA 90220 (213) 537-2531	Schulte Industries, Ltd. P.O. Box 70 Englefeld, Saskatchewan Canada S0K 1N0 (306) 287-3715

Miscellaneous

Disc mowers and silage cutters can also *be* modified to top-prune seedlings. Oklahoma State Nursery modified a John Deere Model 34 silage cutter with a direct-cut head for top pruning seedlings. Bessey Nursery has a similar unit that works very well. For more information, contact them at the following addresses:

Oklahoma State Tree Nursery
P.O. Box 44
Rt. 1
Washington, OK 73093
(405) 288-2385

Bessey Nursery
State Spur 86B
Halsey, NE 69142
(308) 533-2257



Flail Mowers:

Servis-Rhino, Inc.
P.O. Box 712
Sequin, TX 78156-0712
(512) 379-1480

Side Winder
P.O. Box 818
Minden, LA 71058-0818
(501) 935-1970

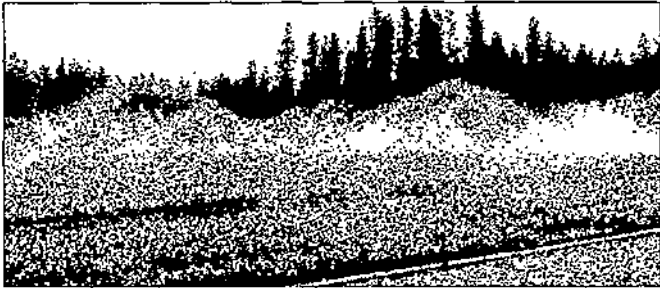
Tiger Corp.
3301 N Louise Ave.
Sioux Falls, SD 57107
(605) 336-7900

Turner International, Ltd.
Div. of Elswick PLC
1360 Business Center Dr.
Conyers, GA 30207
(404) 922-1154

United Farm Tools, Inc.
P.O. Box 4026
Glasgow, KY 42142
(502) 651-7121

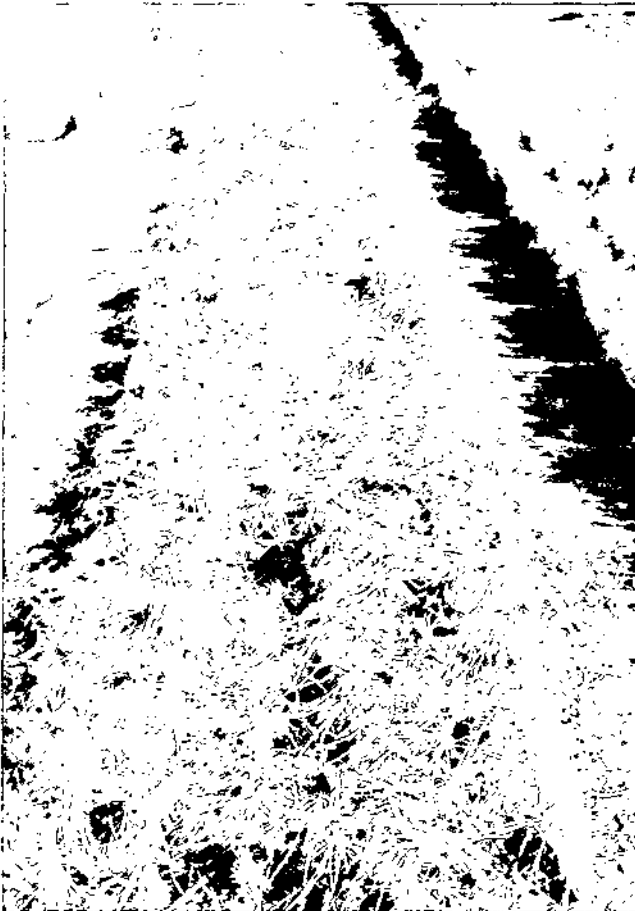
White Farm Equipment
123 W Sycamore St.
Coldwater, OH 45828
(419) 678-5311

5.7 Overwinter Mulches



Many nurseries apply mulch over their seedlings during the fall of the year to protect the crop from cold damage or desiccation. Many different types of overwinter mulch have been used, but they must be permeable to water and air. Organic mulches, such as sawdust, pine needles, or excelsior, have been used. Thick layers must be removed the following spring. Permeable white plastic tarps or microfoam sheets are also popular in some locations. In exposed, windy areas, overwinter mulches must be secured to the seedbed.

Mulches can be applied with modified manure spreaders (see Section 3.5 Applying Soil Amendments) or protective tarps can be installed and removed with special equipment (see Section 3.4 Fumigation Tarp Remover).



Overwinter Mulch:

Armin Plastics Corp.
841 S Norbury
Lombard, IL 60148
(312) 916-8277

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5365

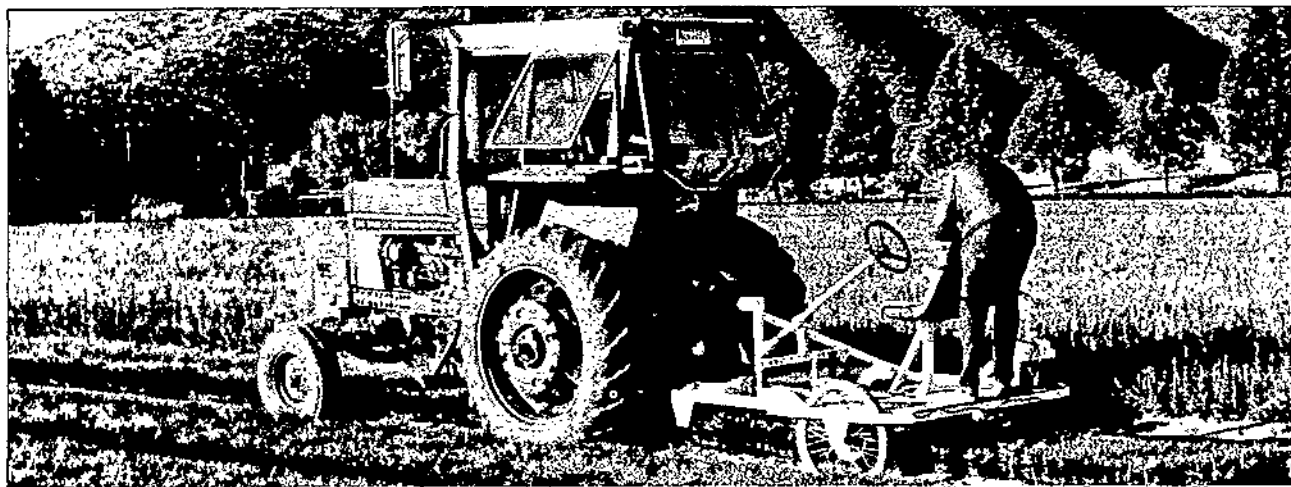
A.M. Leonard, Inc.
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

PPS Pack Co.
P.O. Box 56
204 N Seventh St.
Fowler, CA 93625
(209) 834-1641

Terra Tech, Inc.
2100 W Broadway
P.O. Box 5547
Eugene, OR 97405
(503) 345-0597

Uittokalusto Oy
Fredrikinkatu 61, PL 455
00101 Helsinki, Finland
(90) 694-2400

6.0 Inventory and Quality Monitoring



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Each year nurseries conduct one or more inventories of the seedling crop using standard sampling procedures. Seedling inventories are used to:

- Determine the sowing efficiency for each seed lot and species to calculate the sowing rate for future crops.
- Calculate the number of seedlings in each age class to help plan for staffing and supply needs.
- Estimate the number of seedlings that will meet grading standards. These statistics not only help the nursery manager project seedling sales and establish prices, but also can be used to develop better cull factors for each species and seedlot to better manage future crops.
- Survey the amount and extent of damage by pests or abiotic injury. These unanticipated events can seriously affect seedling survival and growth rates, and estimates of damage are needed to adjust the standard inventories.

The purpose of the inventory will determine its timing. Sowing checks are usually done as soon as the germinants have emerged and become established in the seedbed, although earlier checks may be needed as problems are observed. Some nurseries perform only one inventory per year to predict the number of shippable seedlings, usually after the seedlings have stopped height growth and set buds. Pest surveys are done whenever serious damage is observed.

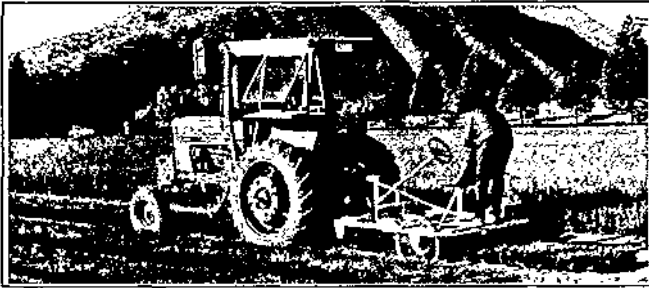
Common inventory terms include:

Gross— the overall number of seedlings per seedlot.

Net (shippable) — estimated number of seedlings which will meet morphological standards of height, caliper, root volume, etc.

Cull—the difference between the gross and net inventories, i.e., the number of seedlings that will be discarded (culled) for size or quality purposes, usually expressed in percent.

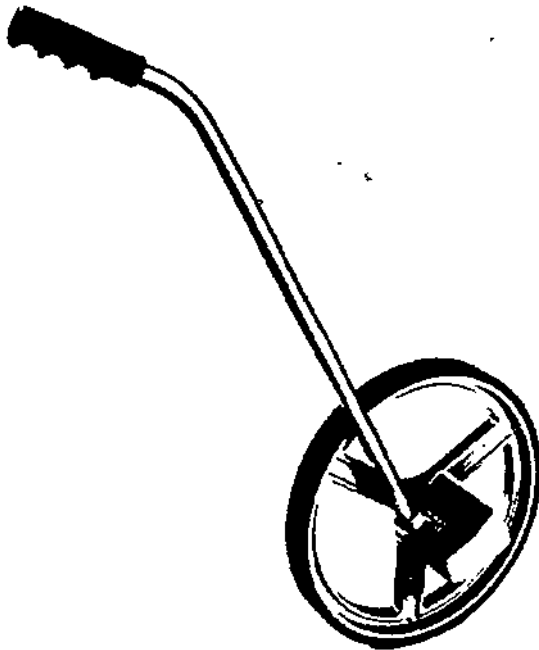
6.1 Measuring Seedbeds



Many nursery cultural operations require an accurate knowledge of the area that is sown with each particular seedlot. The correct application of fertilizers, herbicides, fungicides are all contingent upon knowing the amount of area to be covered. Seedbeds are measured in a number of ways. Some nurseries use ordinary tape measures or land-measuring wheels to determine the actual sown area of seedbed. Others use more sophisticated electronic measurement instruments. The choice of method will depend on the cost and the amount of precision and accuracy desired.

Land-Measuring Wheels

These wheels are used to determine distances, area, and acreages. They consist of a wheel mounted on a light frame. A meter records each revolution of the wheel.



Land-Measuring Wheels:

A.M. Leonard, Inc.
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Edwards Equipment Co., Inc.
4312 Main St.
Yakima, WA 98903
(509) 248-1770

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

General Supply Corp.
P.O. Box 9347
303 Commerce Pk. Dr.
Jackson, MS 39286-9347
(601) 981-3382

Nasco
901 Janesville Ave.
Ft. Atkinson, WI 58538
(414) 563-2446

Redington Counters, Inc.
P.O. Box 608
130 Addison Rd.
Windsor, CT 06095
(203) 688-6205

Trumeter Co., Inc.
38-40 W 32nd St.
New York, NY 10001
(212) 564-0666

Electronic Distance Meters

These devices, known as EDMs, measure distance only. They can be used alone or mounted on a transit or theodolite. An infrared beam and a prism are used to measure distance and some models have built-in calculators. The cost of the various models will vary with the accuracy range. Ultrasonic measuring instruments that can measure up to 250 feet are also available for short distance measurement and are inexpensive.

Electronic Distance Meters:

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Forestry Suppliers, Inc.
P.O. Box 8397
Jackson, MS 39284-8397
(800) 647-5368

6.2 Inventory Equipment



Typical seedbed inventory equipment consists of a rectangular metal sampling frame that is slightly longer than the distance across the seedbed and either 6 inches or 1 foot in width. These sampling frames are usually fabricated at the nursery. The sampling position within the seedbed is determined with a measuring tape and the inventory information is recorded on a clipboard or entered into an electronic data recorder. The use of an electronic data recorder greatly reduces or eliminates data entry time into a PC or mainframe computer. The drawback of some data recorders is the small viewing screen, which hinders the review of previously entered data.

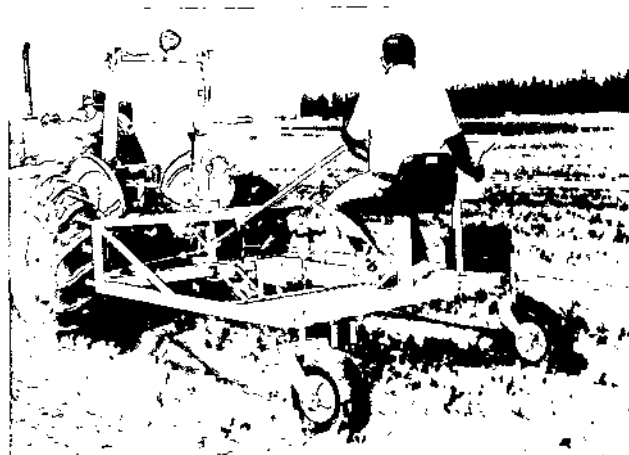
MTDC Seedling Counter

The MTDC counter consists of transmitter and receiver circuitry housed in sealed aluminum enclosures and mounted on skids, a magnetic pickup for determining distance traveled, a stem diameter reference, and a computer for data storage and retrieval that interfaces with a personal computer and provides a permanent data base. These components are transported on a steel frame that attaches to a tractor with a category II three-point hitch.

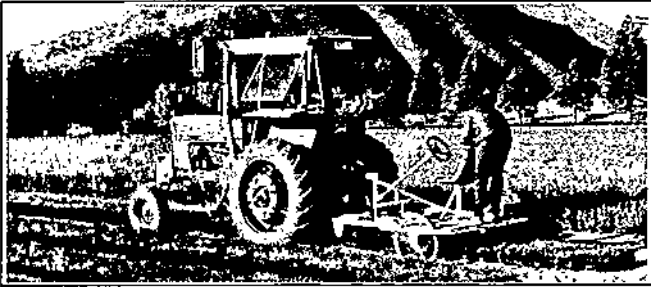
The counter's optoelectronic detector uses an invisible infrared light beam to detect and count seedlings. A transmitter emits a beam of light across and through the seedling row to a receiver. The beam shape—a vertical plane of light makes it possible to distinguish seedling stems from branches.

Drawings, an operating manual, and a video, *The Seedling Counter*, are available on request from:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



6.3 Data Processing

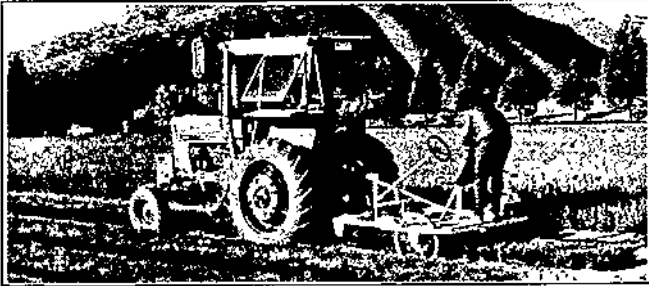


Use of computers to calculate nursery inventories has greatly facilitated this time-consuming project. Personal desk and laptop computers as well as mainframe systems are used. Most nurseries develop their own software for inventories. Field use of hand-held and laptop computers for information storage is common. Processing and data manipulation is usually accomplished on PC's and mainframe systems in the office. Local computer stores and software consultants can provide the necessary assistance.

Data Recorders and computers are available from common computer outlets and:

Omnidata International
P.O. Box 448
Logan, UT 84321
(801) 753-7760

6.4 Measuring Seedling Quality



The "quality" of tree seedlings depends on how the stock will be used. For most forestry and conservation purposes, seedling quality is defined as outplanting performance on a specific site — both initial survival and subsequent growth. Currently, there is no single test or procedure that totally predicts seedling outplanting performance, but seedling quality tests can be divided into two categories:

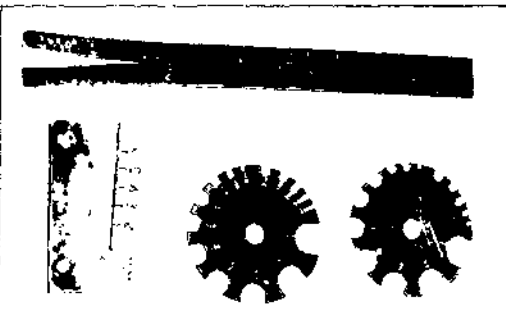
Morphology Tests—Tree seedlings have traditionally been evaluated by morphological characteristics such as shoot height, stem caliper, and dry weight. Chemical tests of mineral nutrient and carbohydrate status also fall into this category and are sometimes used to help measure seedling quality.

Physiology Tests—In recent years, a number of seedling quality tests that actually measure seedling performance under specific environmental conditions have to been developed. Root Growth Capacity (RGC) tests measure the ability of seedlings to regenerate new roots when grown under ideal growth conditions. Cold hardness tests involve placing seedlings in a cold chamber at a range of freezing temperatures and measuring the actual damage to foliage, buds, and stem tissue.

Although some larger nurseries are equipped to do these tests on-site, others use the services of private testing laboratories. By having an independent laboratory perform the test, both the nursery and the customer are assured of receiving an unbiased, objective evaluation of the condition of the seedlings.

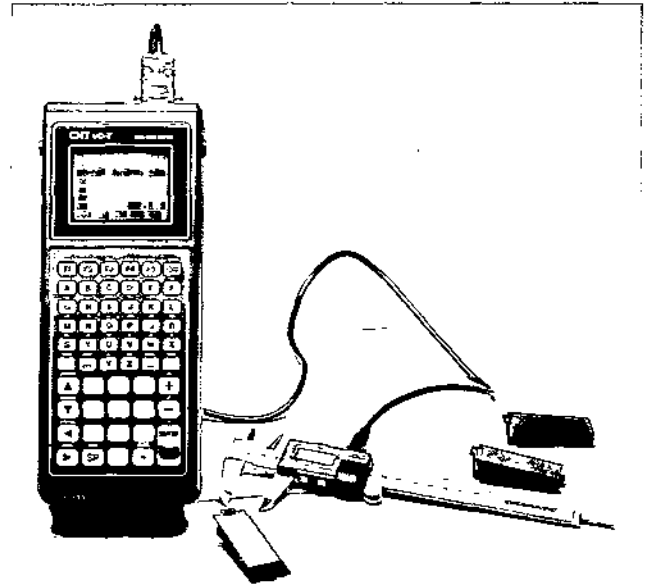
Stem Caliper Measurement Devices

Devices to quickly gauge the stem diameter of seedlings are used both in the field for inventory and also in the packing shed. They range from circular gauges to "V"-shaped home-made devices to electronically record micrometers. Stem caliper can be obtained by using various devices.



Chase Tree Gauge:

A.M. Leonard
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694



Electronic Caliper:

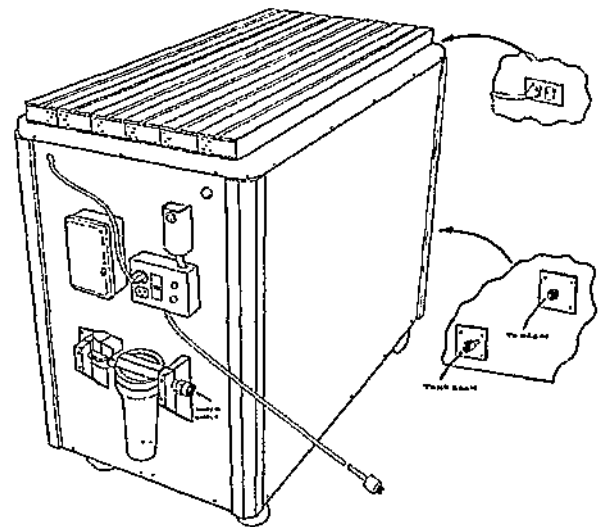
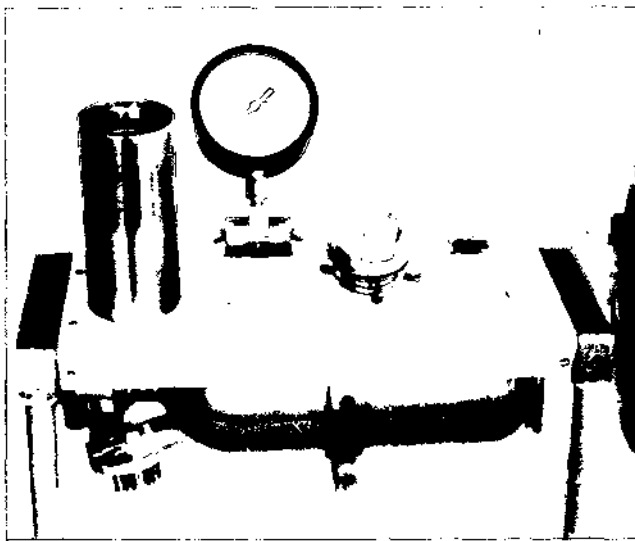
Corvallis Microtech, Inc.
413 SW Jefferson Ave.
Corvallis, OR 97333
(503) 752-5456

PMS (Plant Moisture Stress) Test Devices

Plant moisture stress (PMS) is a measure of the internal water content of plants. While nurseries now have the capabilities to measure the amount of water (osmotic) stress seedlings are exhibiting at any point in time, this measure is not truly an accurate assessment of seedling quality. It is an indicator of the amount of water stress the seedling is exhibiting at the moment the test is performed and is useful for scheduling irrigation as well as checking PMS levels during lifting, grading, packing, storing, transporting, and outplanting operations.

Drawings of a Root Growth testing chamber are available from MTDC upon request:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



Moisture Stress Equipment:

PMS Instrument, Co.
2750 NW Royal Oaks Dr.
Corvallis, OR 97330
(503) 752-7926

Testing Facilities:

International Paper Co.
Seedling Testing Service
34937 Tennessee Rd.
Lebanon, OR 97355

Weyerhaeuser Research Center
Seedling Testing Lab
505 N. Pearl St.
Centralia, WA 98531

Foliar Testing:

Century West
P.O. Box 1174
Bend, OR 97709
(503) 382-6432

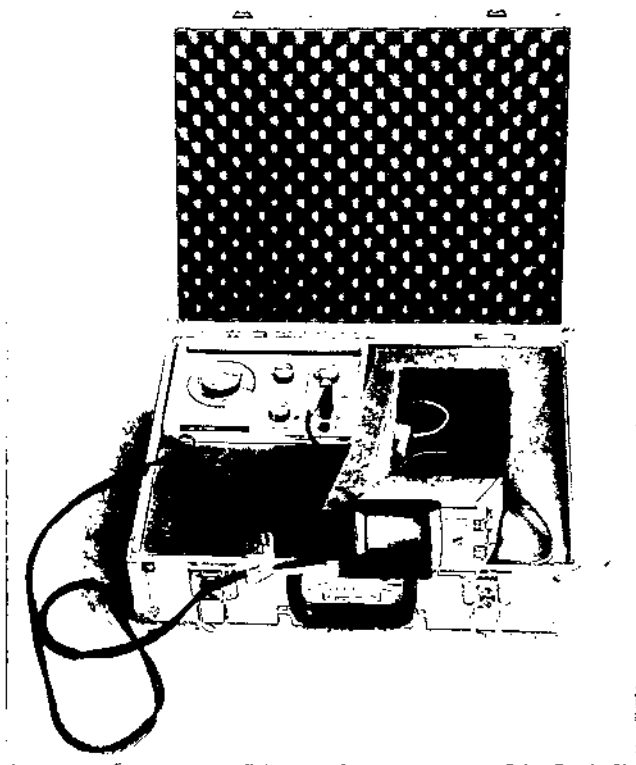
Soil/Plant Testing Lab
Strand Ag. Hall
Oregon State University
Corvallis, OR 97331
(503) 737-2187

Dormancy Testers

Shock is one of the primary problems in transplanting nursery stock. It is generally believed that the best time to transplant is during dormancy.

Tests show if the plants are dormant. Forest Service nurseries at Lucky Peak and Coeur d'Alene test their plants with an electronic apparatus that consists of an oscilloscope, a square-wave generator, and an electrode. The operator inserts the electrode into the seedling's stem. The amplitude of the wave produced on the oscilloscope indicates the seedling's state of dormancy.

For more information on performing this test, see *Portable Oscilloscope Technique for Detecting Dormancy in Nursery Stock*, 1975, Technical Report INT-26, available from the USDA Forest Service Intermountain Forest and Range Experiment Station, 324 25th Street, Ogden, UT 84401.



Oscilloscope:	Wave Generator:
Tektonix, Inc. Time Square Park 300 W Mercer Way Salt Lake City, UT 84115 (801) 486-1091	Wavetek P.O. Box 85265 9045 Balboa Ave. San Diego, CA 92128 (619) 279-2200



7.0 Seedling Harvesting

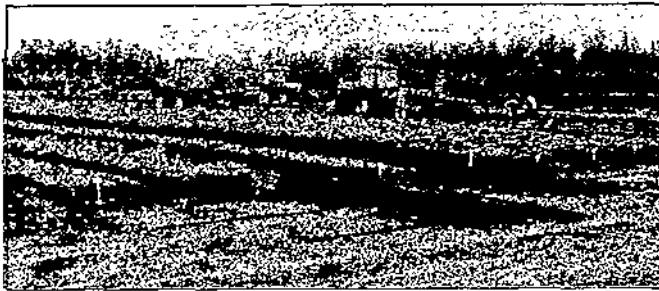


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Bareroot seedlings are harvested (lifted) during the dormancy period when physiological activity is at a minimum and resistance to stress is greatest. The lifting window is the period of time when seedlings are at maximum dormancy and typically occurs during mid-winter. The exact timing of the lifting window for a particular crop can be determined by seedling quality tests (See *Section 6.4*) but is often operationally determined by weather conditions.

Seedling harvesting consists of lifting the seedlings from the seedbed, shaking the soil from the roots, and then placing the seedlings in moisture-retarding boxes for transporting to the processing building. In some nurseries the harvested seedlings are temporarily stored under refrigeration to maintain dormancy and minimize stress until they can be processed. In the South, some nurseries lift and process seedlings directly in the field on specially designed harvesters (See *Chapter 8*).

7.1 Lifting Seedlings



The lifting process consists of varying amounts of hand and machine labor. All bareroot nurseries use some sort of lifter to undercut the seedbed and loosen the soil from the root system. Hand lifting consists of following the lifter, removing bunches of the seedlings from the seedbed, shaking the soil from the root system, and placing the seedlings in a container for shipment to the processing building.

A number of seedling harvesters are available that lift the undercut seedlings onto a vibrating chain belt that shakes the soil from the roots. With some lifters, the seedlings are removed from the belt by hand and placed into the containers. With the most sophisticated models, the seedlings are placed into the storage containers by other conveyors.

These specialized lifters use only a few operators to complete the lifting process.

Seedling harvesters must be matched to the type of tractor because some types require more horsepower, special hydraulics, and four-wheel drive capability. The best type of lifter for a particular nursery will depend on soil type, seedbed conditions, and type of crop. Proper operation of lifters in conjunction with visual inspection of seedlings during lifting must be performed to prevent excessive damage.

Lifters

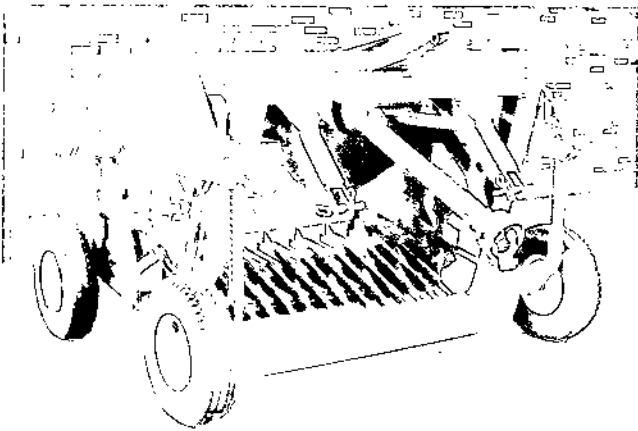
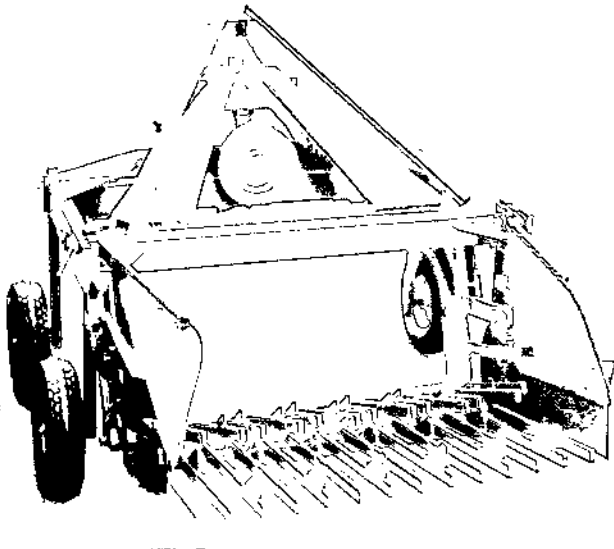
The simplest types of seedling lifters consist of rigid or vibrating undercutting blades that are tractor-mounted and are as wide as the seedbed. Some models have special spring-steel fingers on the back to create a vibrating motion that helps loosen the soil around the seedling roots. Others are mechanically-designed to vibrate. Seedlings are manually removed from the ground after they have been lifted. Some nurseries, such as the USDA Forest Service J. Herbert Stone Nursery, have modified Mann Lifters to accommodate tall seedlings. Lifters are commercially available, but some nurseries have built their own.



Frobro Lifters

Baertschi manufactures two models of Frobro lifters, one is heavier duty than the other. Both feature a fore and aft oscillating undercutter blade with lifting and shaking bars.

The standard machine is designed for a minimum 30 to 45 hp farm tractor and has a maximum working depth of 12 inches. The Super HD Lifter/Shaker is designed to be powered by tractors with a minimum of 65 hp and has a maximum working depth of 14 inches.

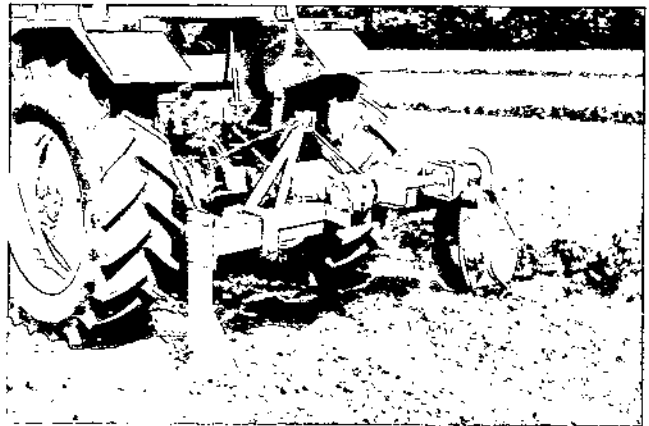


Frobro Lifters:

Baertschi of America, Inc.
P.O. Box 5139
Savierville, TN 37864
615-428-3961

Egedal Side Digger

For very tall seedlings Egedal makes a three-point attachment that allows lifting from the side. On the other side of the lifting fork is a stabilizing leg to compensate for the implement's side-shifting.



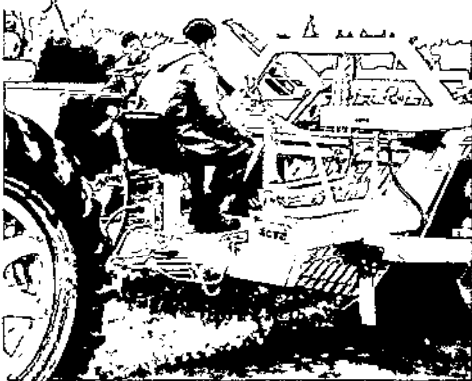
Egedal Side Digger:

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario,
Canada L6J 4Z5
(416) 878-4244

Love Tree Seedling Harvester

This harvester consists of an oscillating, undercutting blade, pickup belts, and conveyors and may be able to harvest 175,000 seedlings an hour under optimum conditions. Custom design is possible. The undercutting blade loosens and lifts seedlings and is adjustable for any depth. Eight pickup belts transfer the seedlings to oscillating beaters that remove soil from the roots. The seedlings are then manually transferred to a side conveyor where they are loaded onto trailers.

The harvester is mounted on a two-wheeled trailer chassis that is 72 to 76 inches wide. The hydraulic system aids in steering by directing movement of the trailer's wheels and tongue. The tractor driver controls all operations. Tractors must be 60 hp or larger with a power takeoff. They must be able to travel 0.17 to 0.34 mph at full engine speed. The number of people required for operation of the harvester depends on the harvesting techniques of the nursery.



Love Tree Seedling Harvester:

J.E. Love Co.
309 California St.
Garfield, WA 99130
(509) 635-1321

Whitfield Super Lift Seedling Harvester

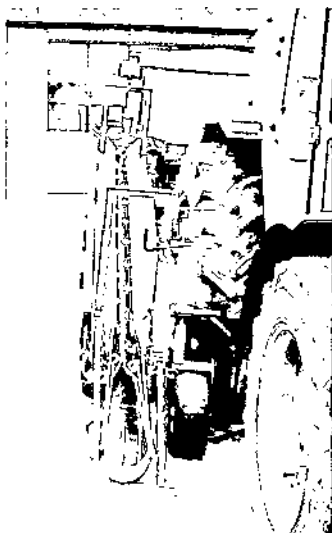
The Whitfield lifter is similar in basic design to the Love Harvester. An oscillating undercutting blade lifts seedlings. The seedlings are transferred by 16 lifting belts to adjustable pulleys that loosen the soil around the roots. After a shaver trims the roots, the seedlings are then transferred onto a mesh screen where soil falls away from the roots. A side-mounted conveyor moves the seedlings to a tub where operators put them onto a cart.

Whitfield Seedling Harvester:

R.A. Whitfield Mfg. Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

Egedal Liftmaster Seedling Harvester

The Egedal model adds bundle tying to the process of harvesting. The harvester uses a vibrating blade to lift seedlings. Because of separate hydraulic systems, it may lift one row of seedlings while leaving the other row undisturbed. The lifted seedlings pass over seven rotary rollers that remove dirt from the roots. The speed of the rollers is adjustable to prevent damage to the roots. Two rubber conveyors then carry the seedlings to the tying chamber. An electric sensor activates the tying mechanism when enough seedlings have filled the chamber. Tied bundles are carried to the lift side of the machine, where they are placed in a trailer.

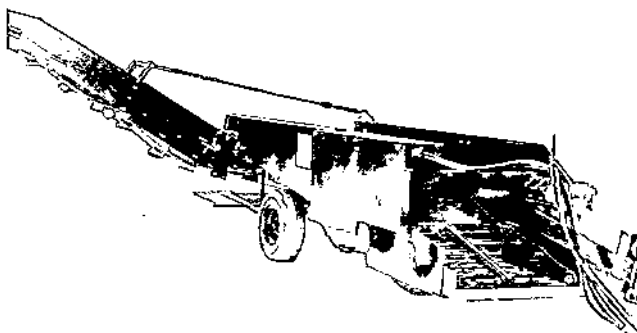


Egedal Liftmaster Seedling Harvester:

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Grayco Seedling Harvester

This harvester consists of an undercutting blade and chain conveyors mounted on a rubber tire chassis. The blade lifts seedlings onto the conveyor. The conveyor shakes soil loose as the seedlings are carried to the rear of the harvester. The seedlings are then manually placed into containers or loaded onto wagons by a side-loading attachment. The depth of the undercutting blade and the speed of the conveyors are controlled hydraulically.

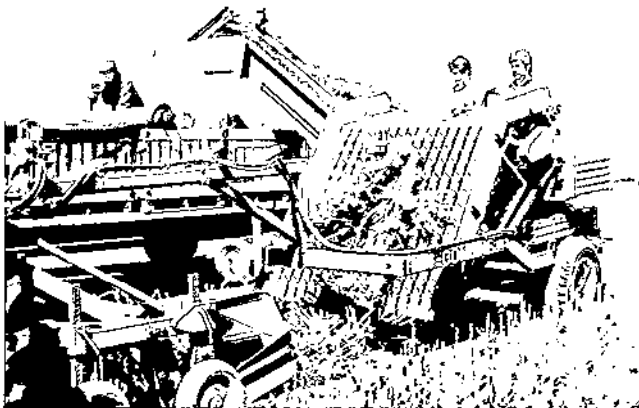


Grayco Seedling Harvester:

Grayco Potato Harvesters, Ltd.
Heidelberg, Ontario
Canada N0B 1Y0
(519) 699-5372

Frobro Seedling Harvesting Equipment

Frobro's harvesting technique combines use of the Frobro lifter-shaker and the Frobro combine/harvester. The lifter shaker drops the seedlings gently onto the sloping side of the combine. The seedlings are caught and carried upward by tines powered by a rotating belt. At the top of the combine the tines retract and the seedlings drop onto a discharge conveyor. The conveyor drops the seedlings into bins on a trailer, where they are covered and transported to the processing facility. Hydraulic controls on the working platform regulate the speed of the pickup tines and belts and the angle of conveyors and combine wall. The combine is easily linked hydraulically to the harvester.



Frobro Seedling Harvesting Equipment:

Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
615-428-3961

Seedling Lifters:

Baertschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

Lundby MFG
P.O. Box 136
Rt. 1
Tolna, ND 58380
(701) 262-4721

FESCO
Forestry Equipment Specialists
P.O. Box 1277
Highway 82 E
Starkville, MS 39759
(601) 323-5600

Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

Grayco Potato Harvesters, Ltd.
Heidelberg, Ontario
Canada N0B 1Y0
(519) 699-5372

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

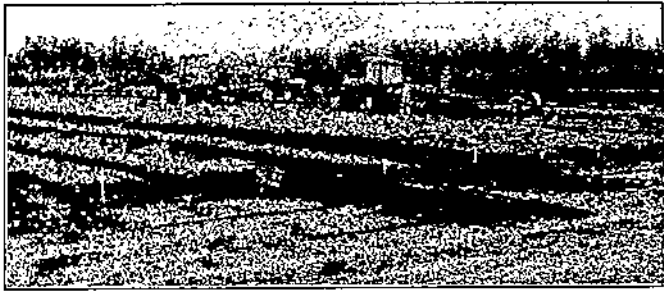
The Green Hoe Co., Inc.
West Main Rd.
Portland, N.Y. 14769
(716) 792-9433

R.A. Whitfield Mfg.Co.
Whitfield Forestry Equipment
P.O. Box 188
6431 Gordon Circle SW
Mableton, GA 30059
(404) 948-1212

HMS Soil Fumigation
7610 Highway 41 N
Palmetto, FL 33561
(813) 722-5587

J.E. Love Co.
309 California St.
Garfield, WA 99130
(509) 635-1321

7.2 Seedling Handling and Transportation



Depending on the type of lifter used, the seedlings are placed into tubs or bins for transportation to the processing building. Because it is important to keep the seedlings moist and cool, the tubs are usually lined with wet burlap that can be tucked over the tops of the seedlings. Some models have folding lids that serve the same purpose. Field containers are either hand-lifted onto trucks or trailers or some nurseries use special machinery that picks up the tubs from the ground.

Field Tubs

Nurseries use tubs extensively for loading seedlings in the field. Tub racks are sold for mechanical harvesters. Tub racks are generally constructed of plastic, although specially treated cardboard or wooden containers are also used. They are available in a variety of sizes, shapes, and styles. Some manufacturers will custom-design tubs. One desirable feature is the ability to nest the tubs for post-season storage, which greatly reduces the amount of required storage space. Size and type of tubs are based on individual nursery operations and preference. Many use tubs with the following dimensions: 101/2 inches deep—Top dimensions are 261/2 inches by 183/4 inches; Bottom dimensions are 23 inches by 161/4 inches.



Field Tubs:

Acro Plastics
Div. Lowry Mfg., Inc.
8630 Airport Highway
Holland, OH 43528
(419) 865-0258

Equipto
225 S Highland Ave.
Aurora, IL 60507
(708) 859-1000

InterMetro Industries Corp.
653 N Washington St.
Wilkes-Barre, PA 18705
(717) 825-2741

Lewis Systems
426 Montgomery St.
Watertown, WI 53094
(414) 261-3162

Nasco
901 Janesville Ave.
Ft. Atkinson, WI 58538
(414) 563-2446

NVF Co.
Primary Products Div.
P.O. Box 68-T
Haley Dr.
Yorklyn, DE 19736
(302) 239-5281

Plastech International, Inc.
John Fitch Industrial Park
P.O. Box C5050
Warminster, PA 18974
(215) 441-5200

Portage Industries Corp.
1325 Adams St.
Portage, WI 53901
(608) 742-7123

Regal Plastics Co.
4401 E 11th St.
Kansas City, MO 64127
(816) 483-3040

Rubbermaid Commercial
Products, Inc.
3124 Valley Ave.
Winchester, VA 22601
(703) 667-8700

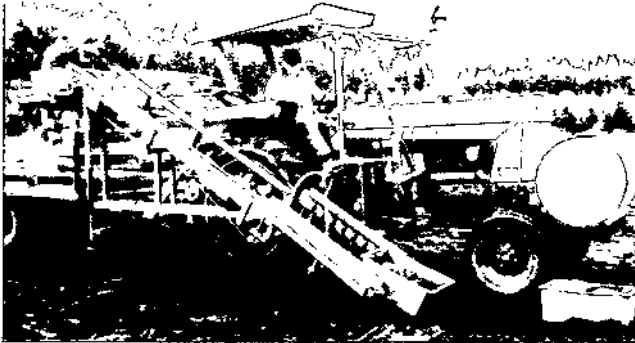
Toteline
Molded Fiberglass Tray Co.
1000 E Erie St.
Linesville, PA 16424-0376
(814) 683-4500

Tri-State, Inc.
P.O. Box 337
505 Fourth St.
Henderson, KY 42420-0337
(502) 826-8361

Seedling Box Lifter

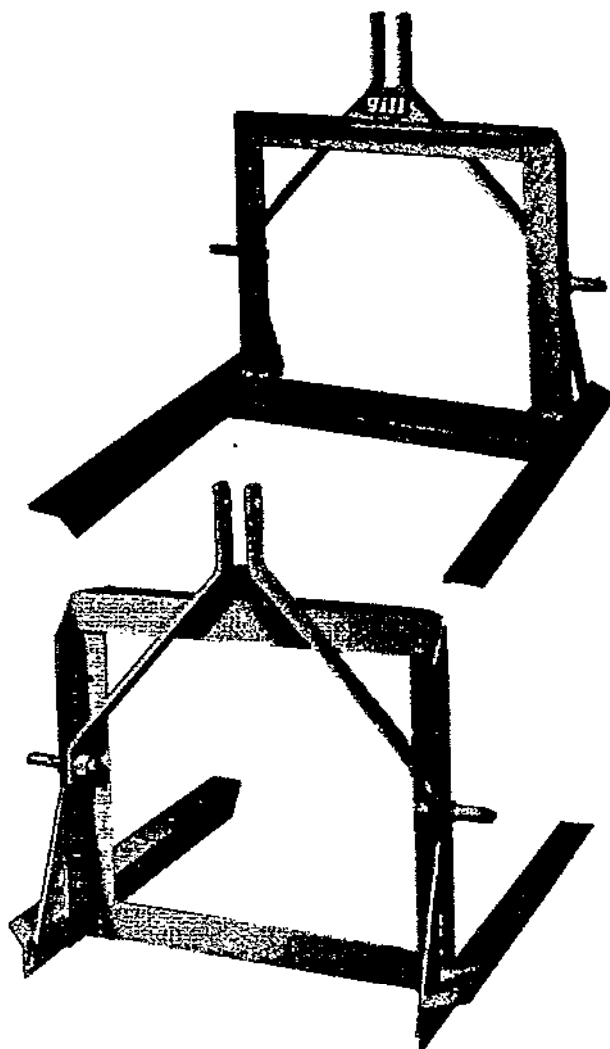
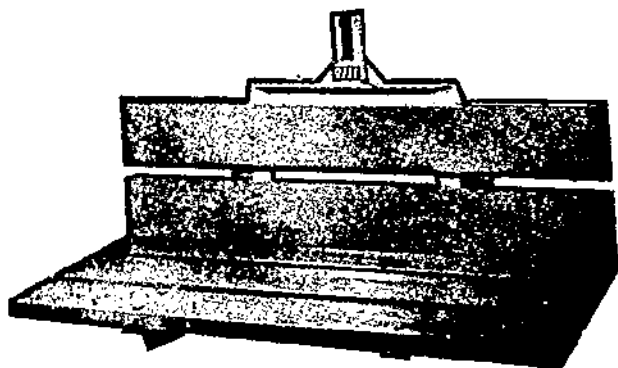
MTDC engineers developed a system to lift and deliver boxes from the ground to a transport trailer. It is mounted to the side of a farm tractor and is designed to minimize manual box handling by personnel. For more information or drawings, contact:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



Tractor Platforms

Three-point hitch platforms may be used for field transportation. They consist of a wood flatbed on a steel frame. Some manufacturers make frames specifically for attaching platforms, while others make carriers that suffice as frames.



Tractor Platforms:

Corsicana Grader and Machine Co.
P.O. Box 1699
Corsicana, TX 75110
(214) 872-1241

Edwards Equipment Co., Inc.
4312 Main St
Yakima, WA 98903
(509) 248-1770

Rears Mfg. Co.
2140 Prairie Rd.
Eugene, OR 97402
(503) 688-1002

Reddick Equipment Co., Inc.
P.O. Box 71
Williamston, NC 27892
(919) 792-1191

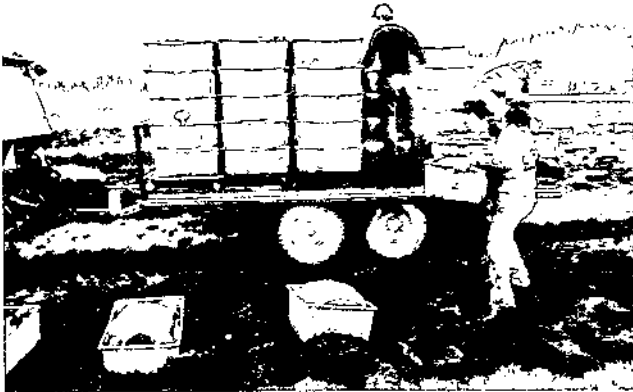
Rivinius, Inc.
925 W Center
Eureka, IL 61530
(309) 467-2303

Tractor Attachments:

Massey-Ferguson, Inc.
1901 Bell Ave.
Des Moines, IA 50315
(515) 247-2011

Field Trailers

Two- and four-wheel rubber-tire trailers are popular for field transportation. Most are drawn by a pickup or a tractor. Many types, sizes, and heights are available. However, many nurseries use custom-built trailers.



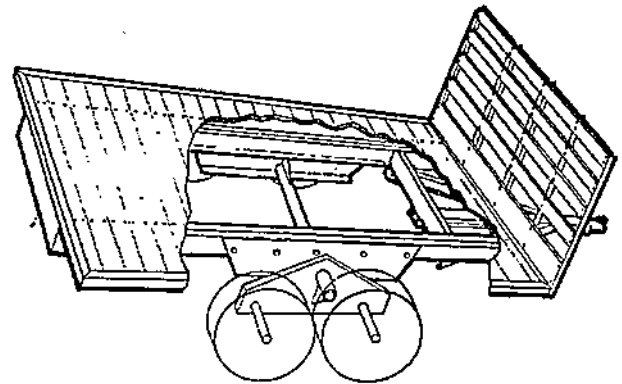
Lucky Peak Trailer

Lucky Peak Nursery has designed a trailer to transport seedling containers from the field. It consists of a flatbed mounted on a tandem wheel chassis. Plans are available from:

USDA Forest Service
Lucky Peak Forest Tree Nursery
(Y. Idaho City Stage
Boise, ID 83701

or

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT. 59801
(406) 329-3900.



Field Trailers:

Aeroil Products Co., Inc.
Wesley St.
South Hackensack, NJ 07606
(201) 343-5200

Dakota Mfg. Co., Inc.
P.O. Box 1188
Mitchell, South Dakota 57301
(605) 996-5571

Ford New Holland, Inc.
500 Diller Ave.
New Holland, PA 17557
(717) 355-1121

The Hamilton Caster & Mfg. Co.
1637 Dixie Highway
Hamilton, OH 45011
(513) 863-3300

A.M. Leonard, Inc.
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Summers Mfg. Co.
338 Railway Ave.
Maddock, ND 58348
(701) 438-2855

United Farm Tools
P.O. Box 4026
Glasgow, KY 42142
(502) 651-7712

8.0 Seedling Processing



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Once the bareroot seedlings have been harvested, they must be processed and packaged for outplanting. Seedlings that have been grown for transplants are also processed before they are transplanted back into the nursery.

Processing consists of grading and counting the harvested seedlings, trimming their roots to the requested root length, packaging them to retard moisture loss and to protect them from physical injury, and storing them until they can be shipped. Smaller nurseries often process their seedlings immediately after they are harvested from the fields, whereas larger nurseries often temporarily store the harvested stock until a sufficient inventory is available to permit continuous processing. In either case, the time between harvesting and processing should be kept to a minimum.

Some bareroot nurseries in the southern states use a bulk harvesting process in which seedlings are processed directly on the lifting equipment. This is referred to as "field pack" or "bed-run" processing. Seedlings are not individually counted, but instead are weighed as they are placed into the storage containers. The inventory per seed lot is determined by counting the seedlings in a number of representative samples and establishing a correlation between the harvested weight and the inventory count. Some nurseries do not even weigh the seedling bags, but use the field inventory. Bulk harvesting is only possible with species and seedlots that are uniform in seedbed density and grade or when seedlings are shipped to units with facilities to grade and trim roots on-site.

8.1 Grading and Counting Seedlings



Because most seedlots contain significant variation in seedbed density and seedling size, they must be individually graded and counted before they can be packaged. The information gained during the grading process not only establishes the final inventory of shippable seedlings, but is used to fine-tune cultural operations for future crops. In particular, the final pack statistics are compared to annual seedbed inventories to develop new seedling survival percentages that can be used to adjust the sowing calculations.

Harvested seedlings are processed by seedlot and are graded into two or three categories, depending on whether or not some will be used for transplants:

- **Shippable** - This class contains seedlings that meet the morphological and physiological specifications that were established for that particular seedlot. These seedlings are counted and placed on a moving belt or table where they are accumulated into bunches and the roots are trimmed.

- **Culls** - This classification includes all seedlings that did not meet either the size or quality standards for that seed lot. The graders usually drop the cull seedlings onto the floor where they are swept up and discarded.

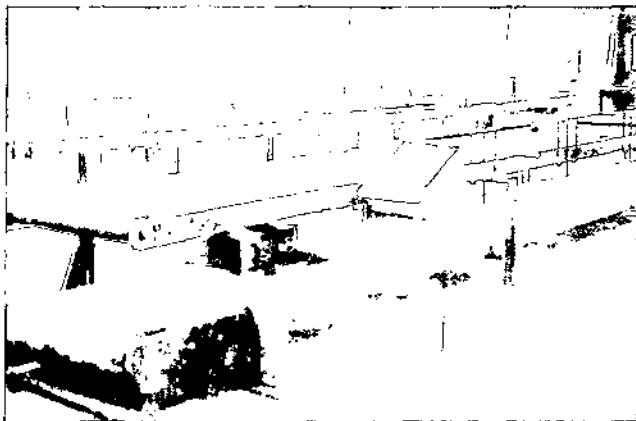
- **Transplants** - Some nurseries grow seedlings specifically for transplanting and grade this stock into transplants and culls. Other nurseries select their transplants by identifying an intermediate category of seedlings that has no obvious defects, but is slightly too small for the shippable grade. These seedlings are processed separately and stored until they can be transplanted.

Most nurseries only grade for shippable and cull seedlings because the task is so time-consuming and labor-intensive. Multiple grading is normally only done on special request orders where seed is scarce or unusually valuable.

Grading and Sorting Tables

Most bareroot nurseries use specially equipped packing rooms to process their lifted seedlings. A variety of grading table designs increases the efficiency of the processing. Most are long narrow tables with conveyor belts to move the graded seedlings to the packing station. Workers are located at stations at regular intervals along both sides of the tables, where they grade the seedlings and place them onto moving belts. Numerous variations have been developed to meet their particular needs, such as a two- or three-tiered belt system (see MTDC publication, *Improving the Packing Shed Operation*, Feb. 1980), or circular table designs.

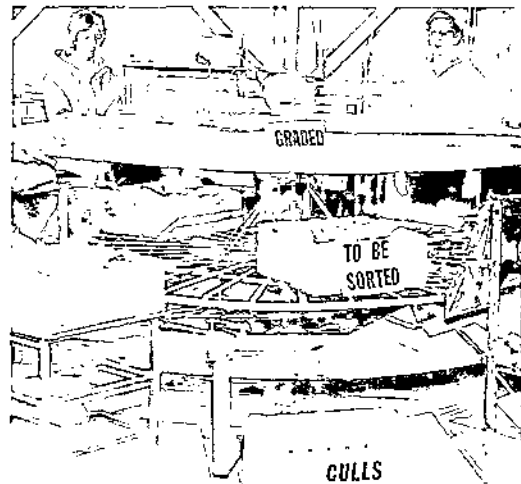
Grading tables must be custom-assembled to fit individual nursery needs.



Montana Sorting Table

The Montana State Forest Tree Nursery uses a circular, tri-level table for sorting seedlings. It can be inexpensively custom-built. The table is 42 inches high and about 8 feet in diameter. The 25-square feet on the top level provides working space for six people. The top is bounded by 1-inch-square tubing. The table's 3/8-inch wire mesh allows mud and water to drop through to the floor. The table top is rotated by an electric motor. The workers place the seedlings to be graded on the rotating second level, which is 27 inches high. Culls are placed on the third level, 18 inches from the floor. Plans are available from:

Forestry Division Headquarters
 Department of State Lands
 2705 Spurgin Rd.
 Missoula, MT 59801
 (406) 542-4300



Belt Conveyors:

Bilt-Rite Conveyors, Inc.
 141 Lanza Ave.
 Garfield, NJ 07026
 (201) 546-1000

W.A. Powers Co., Inc.
 1215-A S Main St.
 Fort Worth, TX 76104
 (800) 792-1243

The Chantland Co.
 P.O. Drawer A
 Humboldt, IA 50548
 (515) 332-4040

Simtrack Systems, Inc.
 50-T S Joey Drive
 Elk Grove Village, IL 60007
 (708) 956-0044

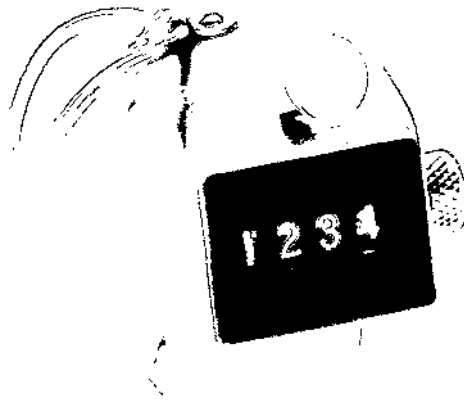
Mathews
 Lebanon Rd.
 Danville, KY 40422
 (606) 234-9400

Versa Ferguson Conveyor Corp.
 P.O. Box 152-T
 Mount Sterling, OH 43143
 (614) 869-2738

Performance Feeders, Inc.
 P.O. Box 276G
 Westfield, IN 46074
 (317) 896-5543

Counters

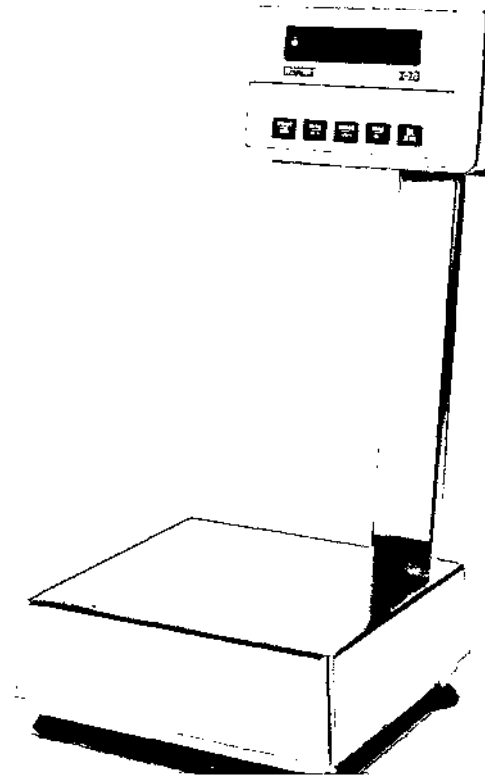
Mechanical counters are commonly used to count tree seedlings after the individual bunches are accumulated for packaging. Simple inexpensive counters can be obtained from all general forestry suppliers.



<p>Counters:</p> <p>Baker Electronics Ent., Inc. 8522 Davies Rd. Edmonton, Alberta Canada T6E 4Y5 (403) 465-0107</p> <p>Ben Meadows Co. P.O. Box 8049 Atlanta (Chamblee), GA 30366 (800) 241-6401</p> <p>The Denominator Co., Inc. Drawer P Woodbury, CT 06798 (203) 263-3210</p> <p>Douglas Homs Corp. P.O. Box 8-T Belmont, CA 94002 (415) 592-1616</p>	<p>ENM Co. 5617 NW Highway Chicago, IL 60646 (312) 775-8400</p> <p>Forestry Suppliers, Inc. P.O. Box 8397 205 W Rankin St. Jackson, MS 39284-8397 (800) 647-5368</p> <p>General Supply Corp. P.O. Box 9347 303 Commerce Park Dr. Jackson, MS 39286-9347 (601) 981-3882</p> <p>IVO Industries, Inc. 201 Industrial Way W Eatontown NJ 07724 (201) 542-5151</p>	<p>Lannen Tehtaat Plant Sys. Div. SF-27820 Iso-Vimma (Sakyla) Finland (938) 70 300</p> <p>A.M. Leonard, Inc. P.O. Box 816 Piqua, OH 45356-0816 (513) 773-2694</p> <p>Nasco 901 Janesville Ave. Fort Atkinson, WI 58538 (414) 563-2446</p> <p>Redington Counters, Inc. P.O. Box 608 130 Addison Rd. Windsor, CT 06095 (203) 688-6205</p>	<p>Simpson Electric Co. 853 Dundee Ave. Elgin, IL 60120 (312) 697-2260</p> <p>Walter Stern, Inc. P.O. Box 571 68 Sintsink Dr. E Port Washington, NY 22050 (516) 883-9100</p> <p>Trumeter Co., Inc. 38-40 W 32nd St. New York, NY 10001 (212) 564-0666</p> <p>Veeder-Root Digital Systems Div. P.O. Box 2003 125 Powder Forest Dr. Simsbury, CT 06070 (203) 651-2700</p>
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Scales

Nurseries that do not individually count seedlings during the processing operation can obtain an inventory by bulk weight. The weight of a certain number of trees is determined by establishing a statistical relationship between number of seedlings and weight. This method is only applicable to seedlots that are uniform in quality and size. Scales are available in many sizes and types, including electronic scales, and should be calibrated periodically for accuracy.



Scales:

A&D Engineering, Inc.
1555 McCandless Dr.
Milpitas, CA 95035
(408) 263-5333

Arkfeld Mfg. & Distributing Co., Inc.
P.O. Box 54
Norfolk, NE 68702-0054
(402) 371-9430

Cardinal Scale Mfg. Co.
P.O. Box 151
Webb City, MO 64870
(417) 673-4631

Chaus Corp.
P.O. Box 900
29 Hanover Rd.
Florham Park, NJ 07932-0900
(201) 377-9000

Detecto Scale Co.
1044 Northern Blvd.
Roslyn, NY 11576
(516) 625-3600

Eaton Corp. Controls Div.
191 E North Ave.
Carol Stream, IL 60188
(312) 260-3400

Fairbanks Scales
4850 Broadway
Denver, CO 80216
(303) 296-1216

General Supply Corp.
P.O. Box 9347
303 Commerce Park Dr.
Jackson, MS 39286-9347
(601) 981-3382

Douglas Homs Corp.
P.O. Box 8-T
Belmont, CA 94002
(415) 592-1616

Howe Richardson
680 Van Houten Ave.
Clifton, NJ 07015
(201) 471-3400

J-Star Industries
801 Janesville Ave.
Fort Atkinson, WI 53538
(414) 563-5521

Nasco
901 Janesville Ave.
Fort Atkinson, WI 58538
(414) 563-2446

Penn Scale Mfg. Co., Inc.
150 W Berks St.
Philadelphia, PA 19122
(215) 739-9644

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

Sterling Scale Co., Inc.
20-950 Boening Dr.
Southfield, MI 48075-5783
(313) 358-0590

Toledo Scale Reliance Electric
P.O. Box 17438
Cleveland, OH 44117
(800) 245-4501

Troemner, Inc.
6825 Greenway Ave.
Philadelphia, PA 19141
(215) 724-0800

Unverferth Mfg. Co., Inc.
P.O. Box 357
Star Route 224
Kalida, OH 45853
(419) 532-3121

White Bag Co., Inc.
P.O. Box 607
Warehouse Row & Campbell Dr.
Jacksonville, AK 72076
(501) 982-9551

Winslow Scale Co.
P.O. Box 1523
Terre Haute, IN 47808
(812) 466-5265

8.2 Root Trimming

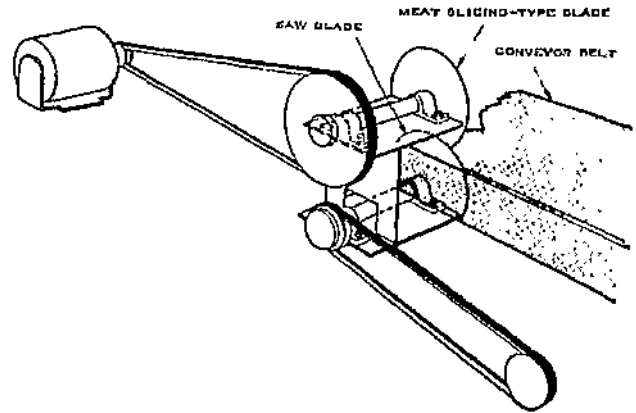


When seedlings are lifted from the seedbed they usually have some long trailing roots that must be trimmed away so that they can be outplanted properly. This operation is often called root pruning, but trimming is a more descriptive term and avoids any possible confusion with the root pruning that is done in the seedbed.

The length of the root system should be negotiated with the customer because it depends on the type of planting implement to be used as well as soil conditions on the out-planting site. After the graded and counted seedlings have been accumulated into bunches, the roots are trimmed immediately before they are packaged.

Pruning Saws

Saws are used by some nurseries to prune seedling roots before packaging. Root trimming can be accomplished manually with a knife or paper cutter, or mechanically with table-mounted rotary saws. They are usually custom-built and are often incorporated into a conveyor system.

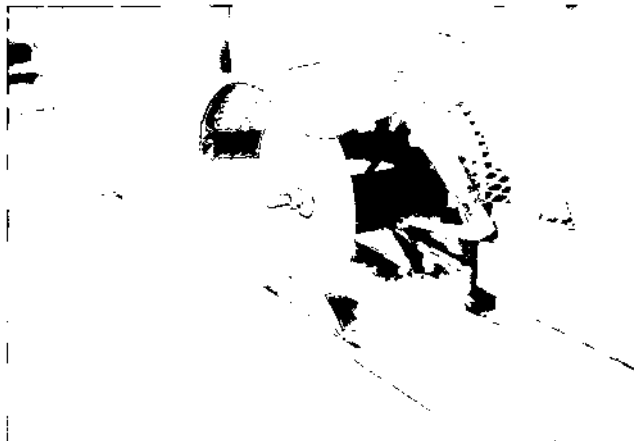


Drawings of this system are available from:

USDA Forest Service
Lucky Peak Forest Tree Nursery
% Idaho City Stage, Boise, ID 83701

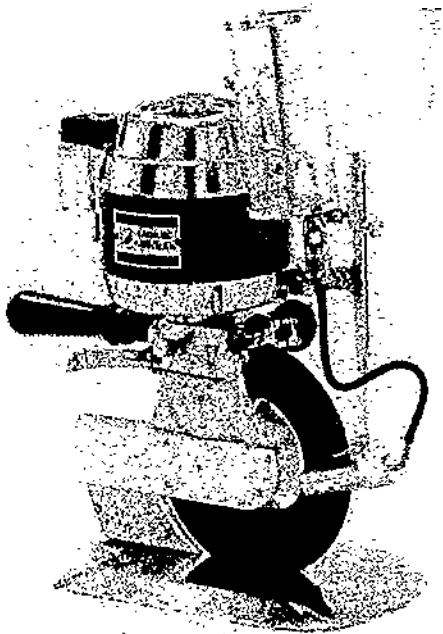
or

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900.



Cloth Cutting Pruning Saw

Two Forest Service Nurseries: Wind River at Carson, Washington, and J.W. Tourney at Watersmeet, Michigan, have used Eastman Machine Company cloth-cutting machines to cut tree roots on the grading table. The machine is equipped with an optional base plate and moistening device.



Cloth Cutting Pruning Saw:

Eastman Machine Co.
779 Washington St.
Buffalo, NY 14203
(716) 856-2200

Paper Cutters

Seedling roots can be trimmed with heavy-duty paper cutters and models with replaceable blades are preferred. Paper cutters are particularly handy for root trimming because they have a ready-made grid on the cutting board that can be used to measure the length of the root system.



Paper Cutters:

Igento
1100 S LaVergne Ave.
Oaklawn, IL 60453
(800) 327-1336

Pacific Paper Cutter Co.
3690 Santa Fe Ave.
Los Angeles, CA 90058
(213) 588-9138

Miscellaneous Root Trimmers

Two relatively new root trimmers are undergoing evaluation. Both use pneumatic power with blades to trim the roots.

Wind River Paper Cutter Pneumatic Table

Wind River Nursery personnel have developed a pneumatic powered paper cutter system to trim seedling roots in bundles of 25. This system was operationally tested in the fall of 1992. For more information, contact:

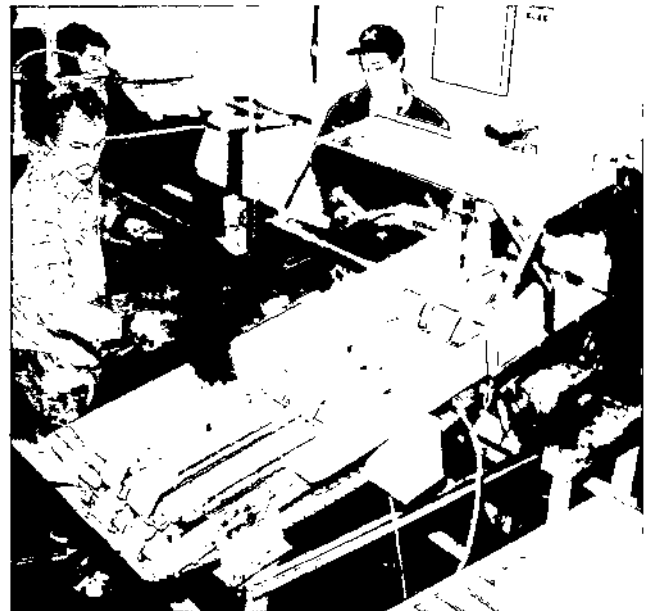
USDA Forest Service
Wind River Tree Nursery
M.P. 1.46 R Hemlock Rd.
Carson, WA 98610
(509) 427-5679

MTDC Root Trimmer

MTDC has developed and is currently testing a pneumatic powered root trimmer mounted on a conveyor table.

For more information or drawings of this system contact:

USDA Forest Service
Missoula Technology and
Development Center
Building 1, Fort Missoula
Missoula, MT 59801
(406) 329-3900



8.3 Seedling Packaging



After the seedlings have been graded, counted, and root-trimmed, they are packaged for immediate shipment to the outplanting site or for refrigerated storage. Some nurseries dip the seedling roots in water or special water-retentive materials to protect the roots during handling and keep them moist. The seedlings are counted as they are placed in the container, and a moist packing medium is often placed around the roots. Once the containers have been filled, the seedling count and the seed source identification code are marked on the outside. The container is then sealed and transported to the storage room.

Banding Cones

Some nurseries bundle seedlings in groups of twenty, fifty, or one hundred for ease of planting on-site. A banding cone allows a group of seedlings to be rubber-banded following root trimming with little slow-down in overall production. Rubber bands are stretched over the banding cone rim. Banding cones have been made from numerous materials such as PVC-pipe and re-enforcement rods. A counted bundle of seedlings is placed inside the cone (roots first) and a rubber band is easily placed around the bundle. Some nurseries use twist-ties or plastic strips.



Rubber Band Applicator:

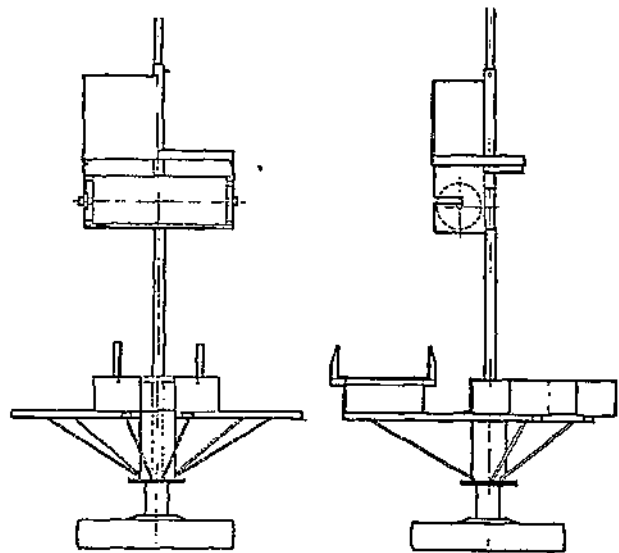
LPM Systems
16432 SW 72nd Ave.
Portland, OR 97224
(503) 684-5679

Rubber Band Technology, Ltd
P.O. Box 10327
Yakima, WA 98909
(509) 248-8606

Lucky Peak Packing Table

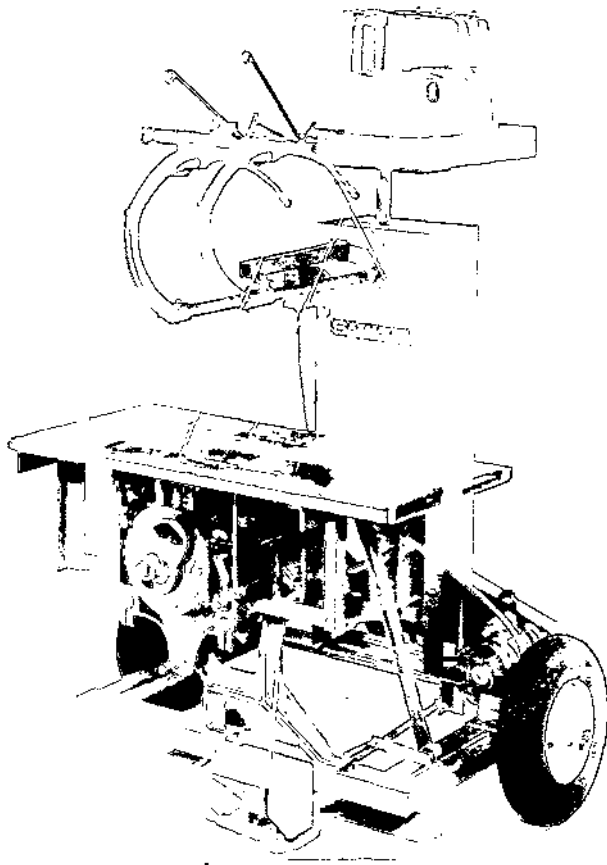
Lucky Peak's table for seedling packing has proved useful for many years. The tabletop is designed to hold packing boxes and bags. It is mounted on a vertical axis and may be rotated manually. Above the table, a rack holds a roll of treated paper for bundling the seedlings. Plans may be obtained from:

USDA Forest Service
Lucky Peak Forest Tree Nursery
P.O. Box 1085
HC 33
Boise, ID 83706
(208) 343-1977



Bundle Tying Machines

Many nurseries, especially those growing hard woods, bundle seedlings with string using bundle tying machines. The tying mechanism on most of them is basically the same as that used on hay balers. They are powered electrically.



Bundle Tying Machines:

Baetschi of America, Inc.
P.O. Box 5139
Sevierville, TN 37864
(615) 428-3961

B.H. Bunn Co.
2730 Drane Field Rd.
Lakeland, FL 33811
(813) 647-1555

Clements Industries, Inc.
50 Ruta Ct.
South Hackensack, NJ 07606
(201) 440-5500

Cyklop Strapping Corp.
Boot Rd.
Downingtown, PA 19335
(215) 873-0029

Felins Tying Machine Co., Inc.
8304 W Parkland Ct.
Milwaukee, WI 53223
(414) 355-7747

Saxmayer Tying Equipment
Saxmayer Corp.
P.O. Box 10
Blissfield, MI 49228
(517) 486-2164

Timm Enterprises, Ltd.
P.O. Box 157
5204 Trafalgar Rd.
Oakville, Ontario
Canada L6J 4Z5
(416) 878-4244

Tree Tie, Inc.
11539 Raspberry Hill Rd.
Eden Prairie, MN 55344
(612) 944-3399

Storage and Shipping Containers

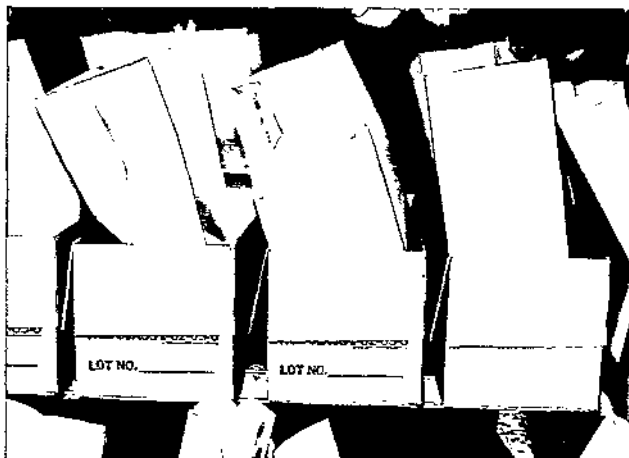
Bareroot seedlings have been packaged for shipping and storage in many different containers including open bundles, bags, and boxes. The choice of container depends on the species and size of seedling, the type of storage facilities, and the way in which the seedlings will be transported to the outside planting site.

Jelly-rolling of graded and root-trimmed seedlings has been integrated into some nursery packing procedures. Seedlings are laid out flat on a moistened, pre-cut material (burlap, Kim-wipe, etc.). The lower half of the material is folded over the seedlings so roots are not exposed to air. Then, starting at one end, the fabric is rolled towards the opposite end into a cylinder-shape. Jelly-rolling is thought to slow down dessication of roots during planting, so it is often used where planting sites are hot, dry, and windy.

Some nurseries wrap their conifer seedlings into bundles when they are to be stored under moist conditions. This has proved particularly effective in snow cache storage where bags or boxes would deteriorate. The seedlings are bundled with the roots on the inside, and the bundle is wrapped with either wet burlap or multi-layered wrapping paper that is plastic-lined or impregnated with tar. Many hardwood seedlings are also bundled because they are too large for boxes or have stiff branches or lateral roots that could puncture bags. Bundles of tree seedlings can be secured by electric tying machines that use synthetic binder twine. On-site bundling machines can operate from a power takeoff-driven tractor or a gas engine in the field.

Many nurseries pack conifer seedlings in bags that are constructed of heavy-duty craft paper with a moisture-proof liner. Some use plastic bags that can be heat sealed. Storage bags are sewn closed or the tops are stapled, folded over, and sealed with tape.

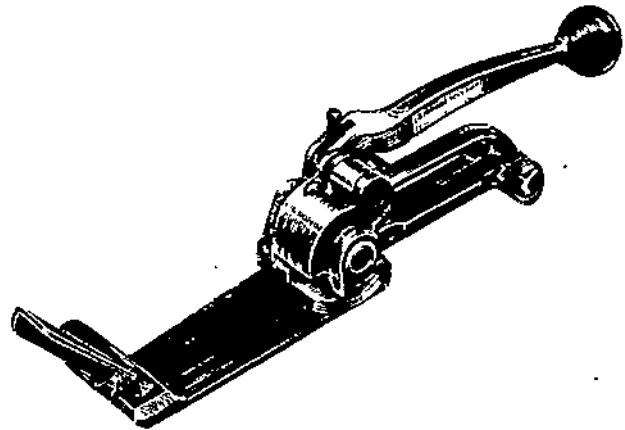
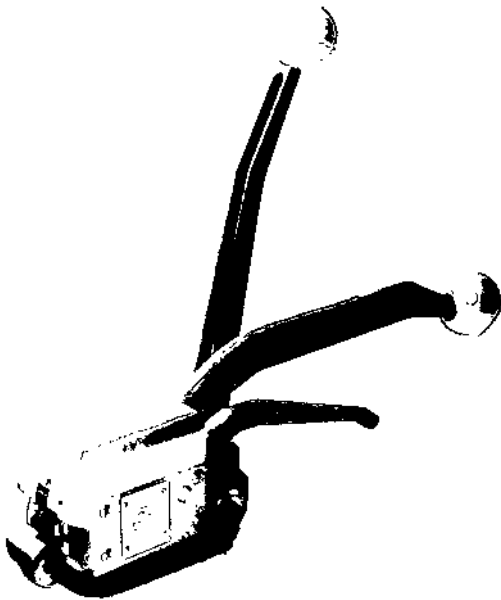
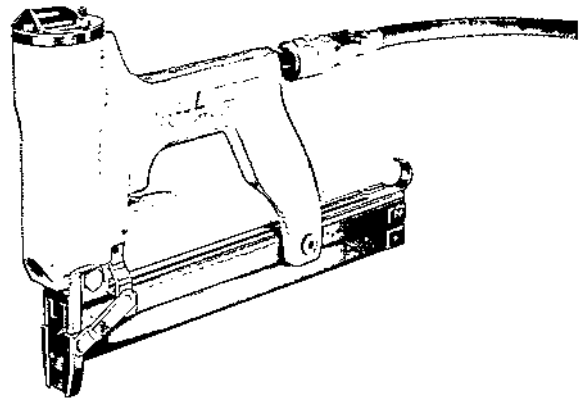
Other nurseries store seedlings in boxes that are lined with plastic bags. Boxes can be constructed of either corrugated cardboard, that is impregnated with wax or a plastic film. Some have hand holes. Reusable boxes can be disassembled after the seedlings are removed and then returned to the nursery. Many nurseries order their containers with custom labeling and seedling care and planting instructions. In using boxes lined with plastic bags extra care must be taken in cooler storage, as mold problems can develop rapidly if seedlings are improperly stored.



Storage Boxes:	August Packaging, Inc. 2901 Olive St. St. Louis, MO 63103	Portco Corp. 4200 Columbia Way Vancouver, WA 98661 (206) 606-1641	Percy Kent Bag Co., Inc. 5910 Winner Rd. Kansas City, MO 66125 (816) 483-9800
Georgia Pacific 900 SW Fifth Ave. Portland, OR 97204	Bemis Bag 1401 W 4th Plain Blvd. Vancouver, WA 98661	Sterling Bag & Supply Co., Inc. Foot of Fisher Rd. Lackawanna, NY 14218 (716) 826-1991	Portco Corp. Paper Prod. Div. 4200 Columbia Way Vancouver, WA 98661 (206) 606-1641
Menasha Corp. Container Div. P.O. Box 2175 Tacoma, WA 98401	Carpenter Paper Co. P.O. Box 3333 South San Francisco, CA	Twist-Tie Bundler:	St. Regis Laminated & Coated Products Div. Tracy, CA 95376 (209) 835-0353
Western Kraft Paper Grp. P.O. Box Div. 5800 SW Western Ave. Beaverton, OR 97005 (503) 641-4455	Friedman 802 Commercial Los Angeles, CA 90012	Tach-It Clemonts Industries, Inc. 50 Ruter Ct. South Hackensack, NJ 07606 (201) 440-5500	U.S. Packaging P.O. Box 2566 High Point, NC 27260 (800) 258-4102
Weyerhaeuser Co. Tacoma, WA 98401 (206) 924-3508	Interpolymer Industries 3161 E Washington Los Angeles, CA 90023	Paper for Wrapping Bundles:	Westvaco US Envelope Div. Flexible Packaging P.O. Box 1675 311 Industry Ave. Springfield, MA 01101 (413) 736-7211
Paper Bags:	More Plastic Bags 801 Suite G, Mahler St. Burlingame, CA 94010 (415) 692-8018	Bemix Specialty Films P.O. Box 2968 2450-T Badger Ave. Oshkosh, WI 45901 (414) 426-1222	
Alabama Bag & Burlap P.O. Box 320797 Birmingham, AL 35292-0797 (205) 595-6116	Percy Kent Bag Co., Inc. 5910 Winner Rd. Kansas City, MO 66125 (816) 483-9800	Central States Diversified 9322 Manchester Rd. St. Louis MO 63119 (314) 961-4300	

Equipment and Materials to Secure Bundles, Boxes, or Bags

Staplers are used to close tree containers such as bags, boxes, and crates. Manual, electric, and pneumatic staplers are available in a wide selection of sizes and styles. Bags of tree seedlings may also be closed with taping or stitching machines. Metal and plastic strapping is widely used to secure boxes or bats of tree seedlings, and electric, pneumatic, and manually operated equipment is commercially available.



Stapling Supplies and Equipment:

Acme Staple Co., Inc.
N Main St.
West Franklin, NH 03235
(603) 934-2320

Arrow Fastener Co., Inc.
271 Mayhill St.
Saddle Brook, NJ 07662
(201) 843-6900

Ben Meadows Co.
P.O. Box 80549
Atlanta (Chamblee), GA 30366
(800) 241-6401

Container Stapling Div.
Wiredyne Inc.
100 S 27th St.
Herrin, IL 63948
(618) 942-2125

Duo-Fast South Central
1010 N Willow Ave.
Broken Arrow, OK 74012
(918) 254-6070

Forestry Suppliers, Inc.
P.O. Box 8397
205 W Rankin St.
Jackson, MS 39284-8397
(800) 647-5368

General Supply Corp.
P.O. Box 9347
303 Commerce Park Dr.
Jackson, MS 39286-9347
(601) 981-3882

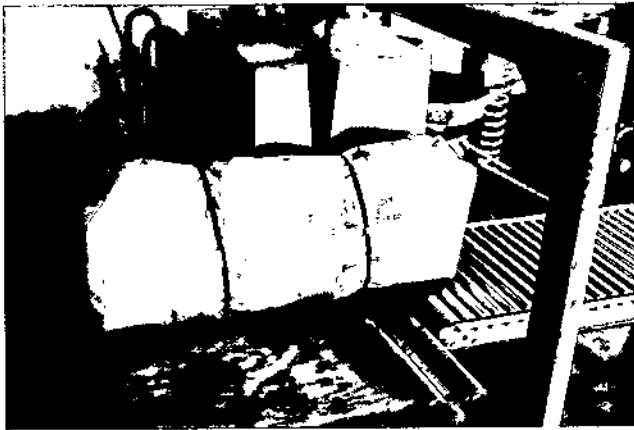
International Staple and
Machine Co.
P.O. Box 629
Butler, PA 16003
(412) 287-7711

Lannen Tehtaast
Plant Systems Div.
SF-27820 Iso-Vimma
(Sakyla) Finland
(938) 70 300

A.M. Leonard, Inc.
P.O. Box 816
Piqua, OH 45356-0816
(513) 773-2694

Senco Products, Inc.
8486 Broadwell Rd.
Cincinnati, OH 45244
(800) 543-4596

Stanley/Bostich
Rt. 2
East Greenwich, RI 02818
(401) 884-2500



**Metal and Plastic Strapping
Supplies and Equipment:**

Acme Steel Co.
13500 S Perry Ave.
Riverdale, IL 60627-1182
(312) 849-2500

Brainard Strapping Div.
2250-2 Larchmont Rd. NE
Warren, OH 44483
(800) 321-7773

B.H. Bunn Co.
2730 Drane Field Rd.
Lakeland, FL 33811
(813) 647-1555

Delta Strapping Industries, Inc.
58-52nd Ave.
Woodside, NY 11377
(718) 478-5800

A.J. Gerrard and Co.
400 E Touhy Ave.
Des Plaines, IL 60018
(312) 827-5121

Saxmayer Tying Equipment
Saxmayer Corp.
P.O. Box 10
Blissfield, MI 49228
(517) 486-2164

Signode
3610 W Lake Ave.
Glenview, IL 60025-281
(800) 323-2464

Stitching and Taping Machines:

Acme Staple Co., Inc.
N Main St.
W Franklin, NH 03235
(603) 934-2320

**New Jersey Wire
Stitching Machine Co.**
10th and Newton Ave. TR
Camden, NJ 08103
(609) 365-0196

White Bag Co., Inc.
P.O. Box 607
Warehouse Row & Campbell Dr.
Jacksonville, AK 72076
(501) 982-9551

Labeling Equipment

Seedling storage containers must be labeled with information on the number of seedlings, species, seed sources, and stock type. Some nurseries use indelible markers to write on the bags or boxes; others use stencils. Some nurseries are using computer-printed labels for clear reading and mass printing. The future of labeling includes the use of bar codes.

Labeling Equipment:	Control Print Div. Dennison Mfg. Co. 300 Howard St. Framingham, MA 01701	Industrial Marking Equipment Co., Inc. 4385 Westroads Dr. West Palm Beach, FL 33407	Pryor Marking Products, Inc. 21 E Hubbard St. Chicago, IL 60611
Avery Label 777 E Foothill Blvd. Azusa, CA 91702	Dataroyal, Inc. 235 Main Dunstable Rd. Nashua, NH 03060	Mark Pack Inc. 550 W Western Ave. Muskegon, MI 49440	Stadia Corp. P.O. Box 19176 65 Sheridan Blvd. Denver, CO 80219
Bell-Mark Corp. 37 West St. Bloomfield, NJ 07003	Glue-Fast Equipment Co., Inc. 11 White St. New York, NY 10013	Markem Corp. 1000 Congress St. Keene, NH 03431	3M 3M Center St. Paul, MN 55101
Bemis Co., Inc. Packaging Service Div. 315 27th Ave. NE Minneapolis, MN 55418	Ideal Stencil Machine & Tape Co. P.O. Box 305 Belleville, IL 62222 (618) 233-0162	Marsh Stencil Machine Co. 707 East B St. Belleville, IL 62222	Weber Marking Systems, Inc. 711 W Algonquin R. Arlington Heights, IL 60005
Better Packages, Inc. 8 Brook St. Shelton, CT 06484		Monarch Marking Systems, Inc. P.O. Box 608 Dayton, OH 45401	

8.4 Seedling Storage



Seedlings are stored in either refrigerated coolers or freezers to maintain seedling quality until they can be planted. Cold temperature storage minimizes seedling biological activity, especially respiration and transpiration. It also reduces the possibility of damaging storage molds. If the storage period is shorter than 3 months, refrigerated storage (30 to 34 degrees F) is recommended. Freezer storage (28 to 32 degrees F) should be used if seedlings must be stored for longer periods. Although these ambient temperatures are important, the 'in-bag' temperature is critical and must be carefully monitored. Relative humidity should also be kept at or near 100 percent in the storage building to minimize seedling desiccation, although the need for high relative humidity is less when moisture retentive packaging is used.

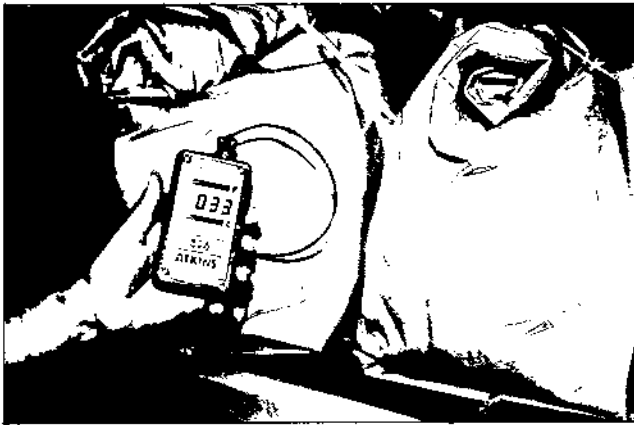
Storage Racks and Handling Equipment

Bags or boxes of seedlings are usually placed on pallets or tier racks in the packing shed and transported to the storage facility with pallet jacks or forklifts. See *Section 1.2 Cone Handling and Storage* and *Section 2.8 Seed Handling and Storage* for more information and a list of suppliers.



Temperature and Humidity Monitoring Equipment

The ambient conditions in the storage building can be monitored with standard environmental monitoring equipment, and many models offer automated recording systems. Modern storage facilities use computer controls to maintain ambient temperature and humidity levels, but it is still necessary to monitor in-bag temperatures with long-stemmed thermometers or temperature probes. Because psychrometers are difficult to operate under below-freezing conditions, electronic humidity sensors are usually used.



Humidity Control Devices:

Airflow Co.
295 Bailes Ln.
Frederick, MD 21701
(301) 695-6500

Airtech-Applied Industries Refrigerated Technologies, Inc.
P.O. Drawer 189
Duplessis, LA 70728
(504) 647-0403

Armstrong Machine Works
8091 Maple St.
Three Rivers, MI 49093
(616) 273-1415

Binks Mfg. Co.
9201 W Belmont Ave.
Franklin Park, IL 60131
(312) 671-3000

Copeland Corp.
Campbell Rd.
Sidney, OH 45365
(513) 498-3011

D&B Humidifier Mfg., Inc.
Dept. T, Route 11
Dixie Club Rd.
Winston Salem, NC 27107
(919) 764-2076

Flakt, Inc.
Bahnsen Div.
P.O. Box 10458
500 Shepherd St.
Winston-Salem, NC 27108
(919) 760-3111

The Geldback Refrigerator Co.
P.O. Box 276-T
1 Demarest Rd.
Sparta, NJ 07871
(201) 383-6368

Hermidifier Co., Inc.
1770 Hempstead Rd.
Lancaster, PA 17603
(717) 294-4021

Industrial Ventilation, Inc.
4659 Enterprise St.
Boise, ID 83705
(208) 344-3531

Research Products Corp.
P.O. Box 1476
1015 E Washington Ave.
Madison, WI 53701
(800) 356-9652

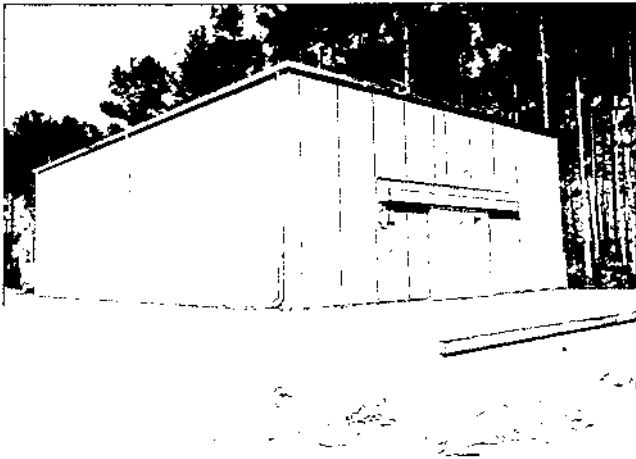
Silica Gel Desiccant Products Co.
734 E Hyde Park Blvd.
Inglewood, Ca 90302
(213) 673-5196

Spraying Systems Co.
North Ave.
Wheaton, IL 60188
(312) 665-5000

Stulz-America, Inc.
270 Technology Park
5350 Spectrum Dr., Suite Y
Frederick, MD 21701
(301) 663-8885

Refrigerated Storage

Refrigerated storage of seedlings is a common and necessary practice. Sliding-floor and upright walk-in refrigerators of various sizes are available with maximum operating temperatures ranging from -40 degrees to 50 degrees F. Many nurseries use custom-designed units from local refrigeration sources.



Refrigeration:

Baily Engineering Structures, Inc.
P.O. Box 98
20 N Front St.
Baily, PA 19503-0098
(215) 845-2311

Power Refrigerator Co.
Main Office
3466 Arden Rd.
Hayward, CA 94545
(415) 887-4105

The Geldback Refrigerator Co.
P.O. Box 276-T
1 Demarest Rd.
Sparta, NJ 07871
(201) 383-6368

Warren Refrigerator Co.
10101-10 E
Beaumont, TX 77703
(409) 838-3791

Suppliers

MR Brooks & Perkins
Handling Technology Division
P.O. Box 1227
Aberdeen, NC 28315
(919) 944-2167

Ace Supply, Inc.
P.O. Box 1098
315 N Kit Ave.
Caldwell, ID 83606-1098
(208) 459-0731

ACI Sales & Service
P.O. Drawer Z
Filer, ID 83328
(208) 326-4305

Acme Staple Company, Inc.
N Main St.
West Franklin, NH 03235
(603) 934-2320

Acme Steel Co.
13500 S Perry Ave.
Riverdale, IL 60627-1182
(312) 849-2500

Acro Plastics
Division of Lowry Mfg., Inc.
8630 Airport Highway
Holland, OH 43528
(419) 865-0258

Adasco, Inc.
P.O. Box 58
Mound, MN 55364
(612) 472-6422

A&D Engineering, Inc.
1555 McCandless Dr.
Milpitas, CA 95035
(408) 263-5333

AEC Machinery, Ltd.
143 Brockley Dr.
Hamilton, Ontario,
Canada L7E 3C4

Aeroil Products Co., Inc.
Wesley St.
South Hackensack, NJ 07606
(201) 343-5200

Ag-Chem Equipment Co., Inc.
Suite 100
5720 Smetana Dr.
Minnetonka, MN 55343
(612) 933-9006

A.G. Fumigation
P.O. Box 9068
Brooks, OR 97305
(503) 393-1077

Ag-Machinery & Safety, Inc.
(AMOS)
P.O. Box 5613
Lafayette, IN 47903
(317) 447-5073

Aguitte Crew
P.O. Box 415
Independence, OR 97351-0415

Agri-Business International, Inc.
P.O. Box 909
Villa Rica, GA 30180
(404) 459-4401

Agrico Machinery, Ltd.
P.O. Box 211
Lichtenburg 2740
Republic of South Africa
01441-26068

Agridisc & Implements Corp.
5502 NW 72nd Ave
Miami, FL 33166
(305) 884-6100

Agri-Fab, Inc.
P.O. Box 903
Sullivan, IL 61951
(217) 728-8388

Agrotech, Inc.
P.O. Box 49-T
Highway 35 N
Pendleton, NC 27862
(919) 585-1222

Agro-Util Division
Kalamazoo International, Inc.
P.O. Box 271
South Haven, MI 49090-0271
(616) 637-2178

Airflow Co.
295 Bailes Lane
Frederick, MD 21701
(301) 695-6500

Airtech-Applied Industrial Refrigeration Technology, Inc.
P.O. Drawer 189
Duplessis, LA 70728
(504) 647-0403

Alabama Bag and Burlap Co.
P.O. Box 320797
4330 Powell Ave. S
Birmingham, AL 35232-0797
(205) 595-6116

Albany Tractor Co.
1709A S Stappay Blvd.
Albany, GA 31701
(912) 432-7468

Alamo Group
P.O. Box 549
Sequin, TX 78156-0549
(512) 379-1480

Alloway Mfg. & Distributing Co.
P.O. Box 2825
Fargo, ND 58108
(701) 282-7014

Almaco
P.O. Box 296
99 M Ave
Nevada, IA 50201
(515) 382-3506

Aluminum Ladder Co.
P.O. Box 5329, Dept. LS
Florence, SC 29502
(803) 662-2595

Amadas Industries
1100 Holland Rd.
Suffolk, VA 23434
(804) 539-0231

Amco Mfg., Inc.
P.O. Box 1107
Yazoo City, MS 39194
(601) 746-4464

American Excelsior Co.
609 S Front St.
Yakima, WA 98901
(800) 228-0729
(509) 575-5794

American Excelsior Co.
6475 N Franklin
Denver, CO 80229
(303) 287-3261

American International Mfg.
P.O. Box 729
1230 Forma Ave.
Woodland, CA 95695
(916) 666-2446

American Standard Co.
P.O. Box 325
Plantsville, CT 06479
(203) 628-9643

Ames Lawn & Garden Tools
P.O. Box 1774
Parkersburg, WV 26102
(304) 424-3288

A&M Industries
3610 N Cliff
Sioux Falls, SD 57104
(800) 888-2615

Andec Corp.
2310 E Logan St.
Decatur, IL 62526
(217) 428-4365

E.L. Anderson Mfg., Inc.
P.O. Box 5602
Eugene, OR 97405
(503) 344-4932

Anderson Reclamation
1125W Baseline 295
Mesa, AZ 85210

Argis, Ltd.
P.O. Box 154
Listowel, Ontario
Canada N4W 3H2
(519) 291-4205

Arrens Co.
655W Ryan St.
Brillion, WI 54110
(414) 756-2141

Arimitsu Industry Co., Ltd.
3-21 Fukaeita 2 Chome
Higashinari-ku, Osaka
537-Japan

Arkfeld Mfg & Distributing Co., Inc.
P.O. Box 54
Norfolk, NE 68702-0054
(402) 371-9430

Armin Plastics Corp.
841 S Norbury
Lombard, IL 60148
(312) 916-8277

Armor Metal Products
P.O. Brix 4609
2500 Phoenix Ave.
Helena, MT 59604
(406) 442-5560

Armstrong Machine Works
8091 Maple St.
Three Rivers, MI 49093
(616) 273-1415

Arrow Fastener Co., Inc.
271 Mayhill St.
Saddle Brook, NJ 07662
(201) 843-6900

Arts-Way Mfg. Co.
P.O. Box 288
Armstrong, IA 50514
(712) 864-3131

Ashland Industries, Inc.
P.O. Box 717
Ashland, WI 54806
(715) 682-4622

Athens Plow Co.
Athens, TN 37303
(615) 744-7569

ATI, Inc.
Advanced Technical Implements
5338 Merriam Dr.
Merriam, KS 66203
(913) 384-5051

Auburn Construction Industries, Inc.
P.O. Box 350
Auburn, NE 68305
(402) 274-4911

August Packing, Inc. 2901 Olive St. St. Louis, MO 63103	Barber Engineering Co. N 1404 Regal Spokane, WA 99202	Bemis Company, Inc. Packaging Service Div. 315 27th Ave. NE Minneapolis, MN 55418	Bishop Ladder Co., Inc. 1400 Park St. Hartford, CT 06106 (203) 951-3246
Automatic Equipment Mfg. Co. One Mill Road Pender, NE 68047 (402) 885-3051	H. Barber & Sons, Inc. 15 Ray Tkwich Road Naugatuck, CT 06770 (203) 729-9000	Bemis Paper Bag Div. P.O. Box 171821 Memphis, TN 38187-1821 (208) 523-0546	Blair Soil Fumigation 1401 Camellia Dr. Quitman, GA 31643 (912) 263-7083
Avery Label 777 E Foothill Blvd. Azusa, CA 91702	Bement Co. 28 N 092 Commercial Ave. Barrington, IL 60010 (708) 381-7050	Bemix Speciality Films P.O. Box 2968 2450-T Badger Ave. Oshkosh, WI 45901 (414) 426-1222	Blanchard Co. P.O. Box 1607 Minot, ND 58702 (701) 852-1924
Azel Corp. 2121 S Susan St. E Santa Ana, CA 92704 (714) 557-6426	Barnes Tree Improvement Co. P.O. Box 630 1210 Vincent Place Cottage Grove OR 97424 (503) 942-4066	Ben Meadows Co. P.O. Box 80549 Atlanta (Chamblee), GA 30366 (800) 241-6401	Blessent Manufacturing Co. 5 Triumph Dr. Urbana, IL 61801 (217) 367-3636
Badger Northland, Inc. P.O. Box 1215 Kaukauna, WI 54130 (414) 766-4603	Bartlett Manufacturing Co. 3003 E Grand Blvd. Detroit, MI 48202 (313) 873-7300	Bernard Franklin Co. 4055 Torresdale Ave. Philadelphia, PA 19124 (215) 744-9300	Blount Industrial Products 805 S Decker Dr. Bluffton, IN 46714 (219) 824-3400
Baertschi of America, Inc. P.O. Box 5139 Sevierville, TN 37864 (615) 428-3961	BCS America, Inc. P.O. Box 1739 Matthews, NC 28105 (704) 846-1040	Ber-Vac Inc. 2835 Chemin De l'Aeroport Thetford Mines, Quebec Canada G6G 5R7 (418) 338-4290	BMB Co., Inc. N Vermont & 9th Holton, KS 66436
BAIC Bluffton Agri/Industries Corp. P.O. Box 256 805 S Decker Dr. Bluffton, IN 46714	Beaver Valley Supply Atwood, KS 67730 (913) 626-3251	Better Packages, Inc. 8 Brook St. Shelton, CT 06484	BMC Manufacturing, Inc. 100-T S Mill Street Plymouth, MI 48170 (313) 453-5400
Bally Engineered Structures, Inc. P.O. Box 98 20 N Front St. Bally, PA 19503-0098 (215) 845-2311	Beecomist Systems, Inc. 31 Meetinghouse Rd. Telford, PA 18969 (215) 721-0751	Big A Equipment Co., Inc. Industrial Rd. Jackson, MN 56143 (913) 825-1631	Bolens Corp. 215S Park St. Port Washington, WI 53074 (414) 284-5521
Balzer Manufacturing Co. Highway 60 E Mountain Lake, MN 56159 (507) 217-3133	BEFCO, Inc. P.O. Box 6036 Rocky Mount, NC 27801 (919) 977-9920	Big Bud Manufacturing Co. P.O. Box 1790 Havre, MT 59501 (406) 265-1247	Bombardier, Inc. Industrial Equipment Div. Walcourt, Quebec Canada JOE 2L0 (514) 523-2211
Baker Electronics Enterprises, Inc. 8522 Davies Rd. Edmonton, Alberta Canada T6E 4Y5 (403) 465-0107	Belarus Machinery, Inc. P.O. Box 23608 Milwaukee, WI 53223 (414) 355-2000	Bigham Brothers, Inc. P.O. Box 3338 Lubbock, TX 79452 (806) 765-8201	Bomford Center North P.O. Box 28 W Jefferson, OK 4316200 (614) 879-7601
Baker Material Handling Corp. 2450 W 5th North St. P.O. Box 2400 Summerville, SC 29484 (803) 875-8000	Beline Manufacturing Co., Ltd. P.O. Box 1840 Kindersley, Saskatchewan Canada SOL 150 (306) 463-6491	Big John Manufacturing Co., Inc. P.O. Box 456 Osmond, NE 68765 (402) 748-3868	Bomford & Evershed, Ltd. P.O. Box 18 Salford Priors Evesham, Worechostor England WR11 5SW 0789-773383
Baker, The Tillage Co. 625 Linden Alva, OK 73717 (405) 327-0234	C.S. Bell Co. P.O. Box 291 170W Davis St. Triffin, OH 44883 (419) 448-0791	Bilt-Rite Conveyors, Inc. 141 Lanza Ave. Garfield, NJ 07026 (201) 546-1000	Borden Chemical Co. Adhesives & Graphics Div. 630 Glendale-Milford Road Cincinnati, OH 45215 (513) 782-6200
Barber Agricultural Sales E 2904 Mission Spokane, WA 99202 (509) 535-3051	Bell-Mark Corp. 37 West St. Bloomfield, NJ 07003	Rinks Manufacturing Co. 9201 W Belmont Ave. Franklin Park, IL 60131 (312) 671-3000	Bouldin and Lawson P.O. Box 208 Rt. 10 McMinnville, TN 37110 (615) 668.4090
	Bemis Bag 1401 W 4th Plain Blvd. Vancouver, WA 98661'		

Bowie Industries, Inc. P.O. Box 931-T Bowie, TX 76230 (817) 872-1106	Buddingh Weeder Co. 7015 Hammond Ave. Dutton, MI 49316 (616) 698-8613	Canadian Forestry Equipment, Ltd. 90 E Boul. Brunswick Blvd. D.D.O., Quebec Canada H9B 2T5 (403) 484-2447	CBT/USA, Inc. 4575 Hilton Parkway Colorado Springs, CO 80907 (719) 590-1118
Bowman Manufacturing Co., Inc. P.O. Box 705 Rt. 3 Newport, AR 72112 (501) 523-2785	Buffalo Farm Equipment Fleischer Manufacturing Inc. P.O. Box 848 Columbus, NE 68601 (402) 564-3244	Canton Canvas Products 336 6th St. NE Canton, OH 44702 (216) 453-2525	Centaur International, Ltd. 2501 E Waterloo Rd Edmond, OK 73034 (405) 341-7653
C.W. Brabender Instruments, Inc. P.O. Box 2127 50 E Wesley St. South Hackensack, NJ 07606 (201) 343-8425	Buffalo Turbine Agricultural Equipment Co., Inc. P.O. Box 156 Gowanda, NY 14070 (716) 532-2272	W.C. Cantrell P.O. Box 11216 3245 May (76110) Ft. Worth, TX 76109 (817) 923-7382	Central States Diversified 9322 Manchester Road St. Louis, MO 63119 (314) 961-4300
Brainard Strapping Div. 2250-2 Larchmont Rd. NE Warren, OH 44483 (800) 321-7773	Buhler-Miag, Inc. 1100 Xenium Lane Minneapolis, MN 55441 (612) 545-1401	Cardinal Scale Manufacturing, Co. P.O. Box 151 Webb City, MO 64870 (417) 673-4631	Central Tractor Farm & Family Center P.O. Box 3330 Des Moines, IA 50316 (515) 266-3101
Brillion Iron Works, Inc. 200 Park Ave. Brillion, WI 54110 (414) 756-2121	Bulk Handling Systems, Inc. 1040 Arrowsmith Eugene, OR 97402 (503) 485-0999	Carpenter Paper Co. P.O. Box 3333 South San Francisco, CA	Century Engineering Division of Westeel, Inc. 803 N 25th St. Fargo, ND 58103-3112 (319) 364-4101
Brinly-Hardy Co., Inc. P.O. Box 1116 Louisville, KY 40201 (502) 585-3351	B.H. Bunn Co. 2730 Drane Field Rd. Lakeland, FL 33811 (813) 647-1555	Carter-Day Co. 500 73rd Ave. NE Minneapolis, MN 55432 (612) 571-1000	Century West P.O. Box 1174 Bend, OR 97709 (503) 382-6432
Brown Bear Corp. Blue Grass Industrial Park Corning, IA 50841 (515) 322-4220	Ray Burkhardt P.O. Box 1112 Redmond OR 97756	Cartons & Boxes Corrugated Paper Products, Inc. 13 Ranick Dr. W Amityville, NY 11701 (516) 842-5100	The Chantland Co. P.O. Drawer A Humboldt, IA 50548 (515) 332-4040
Brown Manufacturing Corp. P.O. Box 339 Rt 3 Highway 27 E Ozark, AL 36360 (205) 795.6603	Burrows Enterprises Inc. 6340 W Tenth St. Greeley, CO 80634 (303) 353-3769	Lewis M. Carter (LMC) Manufacturing Co., Inc. P.O. Box 428 Donalsonville, GA 31745 (912) 524-2197	Chapin Equipment Co. 202 Fulton St. Fresno, CA 93721 (209) 233-7141
The Broyhill Co. N Market Square Dakota City, NE 68731 (402) 987-3412	Busatis Corp. 1813 Linn St. North Kansas City, MO 64116-3626	Canner Corp. P.O. Box 262 Cambridge, OH 43725 (614) 439-2725	R.E. Chapin Manufacturing Works, Inc. 700 Ellicott St. P.O. Box 549 Batavia, NY 14020 (716) 343-3140
Brushking 4173 Domestic Ave. Naples, FL 33942 (813) 643-6368	Bush Hog Division Allied Products Corp. P.O. Box 1039 Selma, AL 36702-1039 (205) 872-6261	J.I. Case A Tenneco Company 700 State St. Racine, WI 53404 (414) 636-5399	Chaus Corp. 29 Hanover Road P.O. Box 900 Florham Park, NJ 07932-0900 (201) 377-9000
Bryan Co Salinas Farm Implements P.O. Box 1196 Salinas, CA 93902 (408) 754.6674	B&W Foundry & Manufacturing Co. 520 Upton St. San Angelo, TX 76901 (915) 653-4516	Castle & Cooke Techniculture, Inc. P.O. Box 1759 Salinas, CA 93902 (408) 754-5278	Cheap Tractors P.O. Box 658 Bethlehem, CT 06751 (203) 266-7387
Buckeye Tractor Co. P.O. Box 123 Columbus Grove, OH 45830 (419) 659-2162	Callahan Implement Mfg., Inc. 107 11th Ave. N Nampa, ID 83651 (208) 466-0871	Caterpillar Inc. 100 NE Adams St. Peoria, IL 61629-2325 (309) 675-1000	Chem-Farm, Inc. P.O. Box 6510 Evansville, IN 47719 (812) 423-8017
	Canpak, Inc. 3351 Stokley St. Philadelphia, PA 19130 (215) 223-5715	Cat Pumps Corp. 1681 94th Lane NE Minneapolis, MN 55434 (612) 780-5440	Clark Material Systems Technology Co. 333W Vine St. Lexington, KY 40507-1640

Clements Industries, Inc. 50 Ruta Court South Hackensack, NJ 07606 (201) 440-5500	Conway Technologies Corp. P.O. Box 350 McAllen, TX 78502 (512) 687-7500	Cub Cadet Corp. P.O. Box 360930 Cleveland, OH 44136 (216) 273-4550	Deere & Co. John Deere Rd. Moline, IL 61265 (309) 765-5678
Clyde Machinery, Inc. P.O. Box 194 Glenwood, MN 56334	Cooper, Pegler & Co., Ltd. 2 Victoria Gardens Burgess Hill West Sussex RH159LA England	Cushman, Inc. P.O. Box 82409 Lincoln, NE 68501-9971 (402) 475-9581	Degelman Industries, Inc. P.O. Box 490 Minot, ND 58701 (701) 852-1876
Coastal Chemical Corp. P.O. Box 856 Greenville, NC 27834 (919) 756-1156	Copeland Corp. Campbell Road Sidney, OH 45365 (513) 498-3011	Cyklops Strapping Corp. Boot Rd. Downington, PA 19335 (215) 873-0029	Delavan, Inc. Gas Turbine Products Div. P.O. Box 100 West Des Moines, IA 50265-0100 (515) 274-1561
Comaway, Inc. P.O. Box 303 Lawrence, PA 15055 (412) 746-2550	Corn States Hybrid Service, Inc. P.O. Box 2706 2505 McKinley Ave. Des Moines, IA 50325 (575) 285-3091	Damas A/S Industrivej 2 Vester Aaby DK-5600 Faaborg Danmark	Delmhorst Instrument Co. P.O. Box 68 51 Indian Lane E Towaco, NJ 07082 (201) 334.2557
Consolidated Container Corp. 735 N Third St., Dept. 110 Minneapolis, MN 55401 (612) 338-0753	Corn States Metal Fabricators, Inc. P.O. Box 65635 1323 Maple St. West Des Moines, IA 50265 (515) 225-7961	Dandl Mfg., Corp. P.O. Box 637 Chico, CA 95926 (916) 891-5163	Delta Strapping Industries, Inc. 58 52nd Ave. Woodside, NY 11377 (718) 478-5800
Consolidated Pipe & Tube Co. P.O. Box 5695 Lubbock, TX 79417 (806) 763-9591	Corona Clipper Co. P.O. Box 1388 1540E Sixth SL Corona, CA 91718-1388 (714) 737-6515	Dakota Mfg. Co., Inc. P.O. Box 1188 Mitchell, SD 57301 (605) 996-5571	Dempster Industries, Inc. P.O. Box 848 711 S 6th St. Beatrice, NE 68310 (402) 223.4026
Container Stapling Div. Wiredyne, Inc. 100 S 27th St. Herrin, IL 63948 (618) 942-2125	Corsicana Grader & Machine Co. P.O. Box 1699 Corsicana, TX 75110 (214) 872-1241	C.R. Daniels, Inc. 3451 Ellicott Ctr. Dr. Ellicott City, MD 21043-4191 (301) 461-2100	The Denominator Co., Inc. Drawer P Woodbury, CT 06798 (203) 263-3210
Continental Belton Co. P.O. Box 660 920 E 6th Belton, TX 76513 (817) 939-3731	Corvallis Microtechnology, Inc. 413 SW Jefferson Ave. Corvallis, OR 97333 (503) 752-5456	Dataroyal, Inc. 235 Main Dunstable Road Nashua, NH 03060	Detecto Scale Co. 1044 Northern Blvd. Roslyn, NY 11576 (516) 625-3600
Control Print Div. Dennison Manufacturing Co. 300 Howard St. Framingham, MA 01701	Crandel-Hicks Co. P.O. Box 5012 30 Oak St. Westboro, MA 01581 (508) 898-2808	H.D. Davis Sons Manufacturing Co., Inc. P.O. Box 395 Bonner Springs, KS 66012 (913) 422-3000	Dethmers Mfg. Co. P.O. Box 189 Boyden, IA 51234 (712) 725-2311
Control-Tek Applications, Inc. 172-34 Henley Road Jamaica, NY 11432 (718) 526-6800	Crippen Manufacturing Co. 700 W End St. Alma, MI 48801 (517) 463-2119	DavSon Mfg., Inc. 33 S Belmont Ave. Springfield, OH 45505 (513) 834-3590	Deutz-Allis Corp. 3883 Steve Reynolds Blvd. Norcross, GA 30093 (404) 564-7100
Conveyors, Inc. 2735 S Highway 55 Eagan, MN 55121 (612) 456-9225	CrustBuster/Speed King, Inc. P.O. Box 1438 Fort Dodge Rd. Dodge City, KS 67801 (316) 227-7106	Day-Pac, Inc. 2208 Sandridge Road Dayton, OH 45439 (513) 294-7311	Dickey Machine Works P.O. Box 5610 Pine Bluff, AR 71611 (501) 536-1300
Conveyor Matic, Inc. 31475 Utica Rd. Fraser, MI 48026 (313) 296-0200	CSC Scientific Co., Inc. 8325 Lee Highway Fairfax, VA 22031 (800) 621-4778	D&B Humidifier Manufacturing, Inc. Dept T, Rt. 11 Dixie Club Road Winston-Salem, NC 27107 (919) 764-2076	Display Pack, Inc. 1342 Monroe Ave. NW Grand Rapids, MI 49505 (616) 451.3061
Conveyor Systems, Inc. 6453 Main St. Morton Grove, IL 60053 (312) 966-7700		Decoto Manufacturing, Inc. P.O. Box 44 Yakima, WA 98907 (509) 457-5167	Dixie Air Engineering Co., Inc. 111 Kane St. Baltimore, MD 21224 (301) 633-2644

Dixie Products 2080 Atlanta Rd. Smyrna, GA 30080 (404) 432-0626	Dyco Industries 2 Powder Mill Road Maynard, MA 01754 (617) 897-6381	Estes Equipment, Inc. Rt 4, Bybee Rd. Winchester, KY 40391 (606) 744-5900	Faxitron Series Hewlett Packard McMinneville Div. 1700 SW Baker St. McMinneville, OR 97128 (503) 472-5101
DMI, Inc. P.O. Box 65 Goodfield, IL 61742 (309) 965-2233	Eagle Tractor Co., Inc. P.O. Box 806 367 N Freedom St. Ravenna, OH 44266 (216)297-1484	Evans Process Equipment 9875W Grand Ledge Highway Sunfield, MI 48890 (507) 566-8041	Felins Tying Machine Co., Inc. 8304W Parkland Ct. Milwaukee, WI 53223 (414) 355-7747
D.M.I.T. Moulton P.O. Box 280 Somerset, WI 54025 (715) 247-3321	Eastern Steel Barrel Corp. 4110 New Brunswick Ave. Piscataway, NJ 08854 (201) 752-1211	Eversman, Inc. P.O. Box 390336 Denver, CO 80239 (303) 371-0333	Ferrari Tractors, Inc. P.O. Box 278 Poynette, WI 53955 (608) 635-7350
Dodyns-Hart Pest Control P.O. Box 1005 Pendleton, OR 97801-0020	Eastman Machine Co. 779 Washington St. Buffalo, NY 14203 (716) 856-2200	Evert Fumigation Co., Inc. 4040 Colvert St. Lincoln, NE 68506 (402)488-2478	The Ferguson Mfg. Co., Inc. P.O. Box 1098 Suffolk, VA 23434 (804) 539-3409
Dorward Pump Co. P.O. Box 4 Concord, CA 94522 (415) 432-3113	Eaton Corp. Controls Div. 191 E North Ave. Carol Stream, IL 60188 (312) 260-3400	Ezee-On Manufacturing, Ltd. Highway 16 W Vegreville, Alberta, Canada 50B 4L0 (403)632-2126	FESCO Forestry Equipment Specialists P.O. Box 1277 Highway 82 E Starkville, MS 39759 (601) 323-5600
Douglas-Homs Corp. P.O. Box 8-T Belmont, CA 94002 (415) 592-1616	ED-KA Manufacturing Co. P.O. Box 37 Garfield, WA 99130 (509) 635-1521	Fairbanks Scales 4850 Broadway Denver, CO 80216 (303) 296-1216	Fimco, Inc. First & Court Streets Sioux City, IA 51101 (712) 258-0171
Dowling Bag Co. P.O. Box 1768 Valdosta, GA 31601 (912) 244-0133	Edwards Equipment Co. 4312 Main St. Yakima, WA 98903 (509) 248-1770	Fairmont-Hydraulics 415 N Main Fairmont, MN 56031 (507) 238-4357	Finn Corp. 9281 LeSaint Dr. Fairfield, OH 45014 (513) 874-2818
Drum Service Co. of Florida 803 Jones Ave. Zellwood, FL 32798 (407) 889-5500	Elliot Equipment Corp. 2600 Florence Blvd. Omaha, NE 68110 (402) 341-1004	Falkenberg, Inc. 8833 SE Jannsen Clackamas, OR 97015 (503) 656-9511	Flakt, Inc. Bahnsen Div. P.O. Box 10458 500 Shepherd St. Winston-Salem, NC 27108 (919) 760-3111
Du-Al Mufactuiing Co. 1000W Cherokee Sioux Falls, SD 57117-5041 (605) 336-3860	Engineering Products Co. P.O. Box 1510 Waukesha, WI 53187 (414) 785-0786	Farm Bureau Co. P.O. Box 54 Amitgo, WI 54409 (715) 627-4844	Flame Engineering, Inc. P.O. Box 577 W Highway 4 LaCrosse, KS 67548 (800) 255-24690
Duo-Fast South Central 1010 N Willow Ave. Broken Arrow, OK 74012 (918) 254-6070	Enid Fabricators, Inc. P.O. Box 3411 Enid, OK 73702 (405) 233-3111	Farmhand, Inc. P.O. Box 1500 Excelsior, MN 55331 (612) 474-1941	Fleischer Mfg., Inc. P.O. Box 848 Columbus, NE 68602-0848 (402) 564-3244
The Duplex Mill & Manufacturing Co. P.O. Box 1266 415 Sigler St. Springfield, OH 45501 (513) 325.5555	ENM Co. 5617 NW Highway Chicago, IL 60646 (312) 775-8400	Farm King Allied, Inc. P.O. Box 1003 Winnipeg, Manitoba, Canada R3C 2W5 (204) 661-8711	Flexcon Products Corp. 673-1 Morris Ave. Springfield, NJ 07081 (201) 467-3323
Durland-Wayland, Inc. P.O. Box 1404 Lagrange, GA 30241 (404) 882-8161	Equipment Specialists, Inc. P.O. Box 392 Rt, 48 W Taylorville, IL 62568 (217)287-7227	Farnam Equipment P.O. Box 34820 Phoenix, AZ 85067 (602) 285-1660	Flexi-Coil, Ltd. P.O. Box 1928 Saskatoon, Saskatchewan Canada S7K 3S5 (306) 934-3500
Dustvent, Inc. 100 W Fay St. Addison, IL 60101 (312) 543-9007	Equipto 225 S Highland Ave. Aurora, IL 60507 (312) 859-1000	Fast Track Harrow 72188 Cosmic Dr. Temecula, CA 92390 (714) 676-6749	
Melvin R. Dybvig 4025 Rio Vista Milwaukee, OR 97222 (503) 659-0718			

Flory Industries P.O. Box 908 4737 Tomes Rd. Salida, CA 95368 (209) 545-1167	Gallenberg Equipment Inc. W 9112 Cherry Rd. Amtigo, WI 54409 (715) 623-3754	Georgia Pacific 900 SW Fifth Ave. Portland, OR 97204	Great Lakes Chemical Corp, P.O. Box 2200 Highway 52 NW West Lafayette, IN 47906 (317) 497-6100
Ford New Holland, Inc. 500 Diller Ave. New Holland, PA 17557-0903 (717) 355-1121	Gandy Co. P.O. Box 528 Owatonna, MN 55060 (507) 451-5430	Geosource, Inc. 9800 Townpark Dr. Houston, TX 77036 (713) 981-9185	Great Northern Corp. Plastics Group P.O. Box 939 Appleton, WI 54912 (414) 739-3671
Forage King Industries, Inc. P.O. Box 215 Ridgeland, WI 54763 (715) 949-1020	Garber Seeders Division of Riburn Inc. P.O. Box 770 St. Paris, OH 43072 (513) 663-4865	A.J. Gerrard & Co. 400 E Touhy Ave. Des Plaines, IL 60018 (312) 827-5121	Great Plains Mfg., Inc. P.O. Box 218 Assaria, KS 67416 (913) 667-4755
Forest Soil Restoration 36195 SE Boitono Rd. Sandy, OR 97055 (503) 668.4405	Gardner Manufacturing Co. P.O. Box 11371T Haricon, WI 53032 (414) 485-4303	Gill Industries P.O. Box 7324 Charlotte, NC 28241-7324 (800) 476-1511	The Green Hoe Co., Inc. W Main Rd. Portland, NY 14769 (716) 792-9433
Forestry Suppliers, Inc. P.O. Box 8397 205W Rankin St. Jackson, MS 39284-8397 (800) 647-5368	Gator Pump, Inc. P.O. Box 57 Brownwood, TX 76804 (800) 735-9811	Gilmour American Standard Co. P.O. Box 325 Plantsville, CT 06479 (203) 628-9643	Grouser Products P.O. Box 545 West Fargo, ND 58078 (701) 282-7710
Forrest City Machine Works, Inc. P.O. Box 984 Forrest City, AR 72335-0984 (501) 633-1514	Gaylord Container Corp. 210 Water St. Baltimore, OH 43105 (614) 862-4161	Gimco 1276 Abbott St. Salinas, CA 93901 (408) 424-0508	G.T., Inc. P. O. Box 525 Clay Center, KS 67432 (913) 632-2151
Forsbergs, Inc. P.O. Box 510 Thief River Falls, MN 56701 (218) 681-1927	Geest Overseas Mechanisation Ltd. White House Chambers Spalding, Lines England PE11 2AL (0775) 761111	Glenmac Inc. P.O. Box 2135 Jamestown, ND 58402 (800) 437-9779	Gustafson, Inc. 1400 Preston Rd. Suite 400 Plano, TX 75075-5112 (214) 985-8877
Frazier Industrial Co. P.O. Box F Fairview Ave. Long Valley, NJ 07853 (201) 876-3001	Gehl Co. 143 Water St. West Bend, WI 53095 (414) 334-9461	Glue-Fast Equipment Co., Inc. 11 White St. New York, NY 10013	Haban Manufacturing Co. 2100 Northwestern Ave. Racine, WI 53404 (414) 637-8388
Freund Can Co. 199 W 8th St. Chicago, IL 60620 (312) 224-4230	The Geldback Refrigerator Co. P.O. Box 276-T 1 Demarest Rd. Sparta, NJ 07871 (201) 383-6368	Golden Bear Div. Witco Corp. P.O. Box 456 Chandler, AZ 85244-0161 (601) 963-2267	Hallco, Inc. 358 NW F St. Richmond, IN 47374 (317) 966-8161
Friday Tractor Co., Inc. 69226 CR 687 Hartford, MI 49057 (616) 621-3318	General Container Corp. P.O. Box 686-T Hillside, NJ 07205 (201) 687-8233	The Gorman-Rupp Co. P.O. Box 1217 Mansfield, OH 44901 (419) 755-1011	Nagle Manufacturing Co. P.O. Box 273 Clarion, IA 50525 (515) 532-2861
Friedman 802 Commercial Los Angeles, CA 90012	General Irrigation Co. P.O. Box 776 Carthage, MO 64836 (417) 358-8171	Graham-Hoeme P.O. Box 3779 Amarillo, TX 79106 (214) 475-0405	Hahn Inc. 1625 N Garvin St. Evansville, IN 47711 (812) 428-2020
Friedman Bag Co., Inc. P.O. Box 3067 Terminal Annex 801 E Commercial St. Los Angeles, CA 90051 (213) 595-6116	General Kinematics Corp. 777 Lake Zurich Rd. Barrington, IL 60010 (312) 381-2240	Graveley International, Inc. P.O. Box 5000 Clemmons, NC 27012-5000 (919) 766-4721	Hale Pumps 700 Spring Mill Ave. Conshohockem, PA 19428 (215) 825-6300
Fuerst Brothers, Inc. P.O. Box 427 Gibson City, IL 60936 (217) 784-4266	General Supply Corp. P.O. Box 9347 303 Commerce Park Dr. Jackson, MS 39286-9347 (601) 981-3382	Grayco Potato Harvesters, Ltd. Heidelberg, Ontario Canada NOB1Y0 (519) 699-5372	Halsted Corp. P.O. Box 4068 Bergen Station 78-94 Halladay St. Jersey City, NJ 07304 (201) 433-3323

The Hamby Co. 5200 N Columbia Plainview, TX 79072 (806) 293-1010	Haven Steel Products, Inc. P.O. Box 430 Haven, KS 67543 (316) 465-2271	Hiniker Co. P.O. Box 3407 Mankato, MN 56002 (507) 624-6621	Howse Implement Co., Inc. P.O. Box 86 Laurel, MS 39441 (601) 428-0841
The Hamilton Caster & Manufacturing Co. 1637 Dixie Highway Hamilton, OH 45011 (513) 863-3300	Haybuster Mfg. P.O. Box 1940 Jamestown, ND 58401 (701) 252-4601	HMS Soil Fumigation 7610 Highway 41 N Palmetto, FL 33561 (813) 722-5587	H & S Manufacturing Co., Inc. P.O. Box 768 Marshfield, WI 54449 (715) 87-3414
Hance Corp. 235 E Broadway Westerville, OH 43081 (614) 882-7400	HCC, Inc. 1501 First Ave. Mendota, IL 61342 (815) 539-9371	Hobbs and Hopkins, Ltd. 1712 SE Ankeny Portland, OR 97214 (503) 239-7518	H.D. Hudson Manufacturing Co. 500 N Michigan Ave. Chicago, IL 60611 (312) 644-2830
Hanson General Products Div. of Accra Plastics Tooling, Inc. 238 Charles St. South Beloit, IL 61080 (815) 389.5100	Hege Equipment, Inc. P.O. Box 34A Rt.1 Colwich, KS 67030 (316) 796-0992	Hoffman Manufacturing Co. 325 11th Ave. SE Albany, OR 97321 (503) 926-2920	Huebner Implement Works, Inc. P.O. Box 95 Forest Junction, WI 54123 (414) 989-1215
Hanson General Products Division of Accra Plastic Tooling, Inc. 238 Charles Street South Beloit, IL 61080 (815) 389-5100	Henderson Mfg. P.O. Box 40 1085 S 3rd St. Manchester, IA 52057 (319) 927-2828	Hohl Machine and Conveyor Co. 1580 Niagara St. Buffalo, NY 14213 (716) 882-7210	A.H. Hummert Seed Co. 2746 Chouteau Ave. St. Louis, MO 63103 (800) 325-3055
Hans-Ulrich Hege Saatzuchtmaschinen Domane Hohebuch D7112 Waldenburg/Wurtt Germany (0 79 42) 581	Hendrickson Enterprises 4050 NE Minnesota Ave. Corvallis, OR 97330 (503) 754-7610	Holland Hitch Western, Ltd. 17909 Roam Place Surray, British Columbia Canada V36 5K1	Humphry's Textile Products Co. 1243 Carpenter St. Philadelphia, PA 19147 (215) 724-8181
Hardee Mfg., Inc. P.O. Box 232 Loris, SC 29569 (803) 756-4051	Hendrix and Dail, Inc. P.O. Box 648 Greenville, NC 27835 (919) 758-4263	Holland Transplanter Co. P.O. Box 1527 510 E 16th St. Holland, MI 49422-1527 (616) 392-3579	Huntley Manufacturing Co. 6069 Peerless St. Brocton, NY 14716 (716) 792-9134
Nardi, Inc. 477 Exeter Rd. London, Ontario Canada N6E 2Z3 (519) 685-6730	Herd Seeder Co., Inc. P.O. Box 448 Logansport, IN 46947 (219) 753-6311	Homelite Division of Textron, Inc. P.O. Box 7047 14401 Carowinde Blvd. Charlotte, NC 28217 (704) 588-3200	Hurricane Ditcher Co. 2815 Old Decker Rd. Vincennes, IN 47591 (812) 886-9663
Harlan Contracting Co. 1101 Chatburn Ave. Harlan, IA 51537 (712) 755-5016	Herrmidifier Co., Inc. 1770 Hempstead Rd. Lancaster, PA 17603 (717) 294-4021	Hopkins Agricultural Chemical Co. P.O. Box 7532 537 Atlas Ave. Madison, WI 53707 (800) 356-7202	Hutch Master Products P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621
Harmon International Industries, Inc. P.O. Box 1444 2401 Millar Ave. Saskatoon, Saskatchewan Canada S7K 3P7 (306) 931-1161	Hesston Corp. 245 E North Ave. Carol Stream, IL 60188 (312) 260-4490	House Manufacturing Co., Inc. P.O. Box 214 Cherry Valley, AR 72324 (501) 588-3307	Hydro Engineering, Inc. P.O. Box 98 115 E Main St. Young America, MN 55397
Harper Trucks, Inc. P.O. Box 12330 Wichita, KS 67277 (800) 835-4099	Hester Plow Co., Inc. P.O. Box 340 Lake City, FL 32056.0340 (904) 755-0960	Howard Price Turf Equipment 18155 Edison Ave. Chesterfield, MO 63005 (314) 532-7000	Hydroflo Corp. Easton Rd. Rt. 611 N Plumsteadville, PA 18949 (215) 766.6867
Harrison Industries, Inc. P.O. Box 378 Minbt, ND 58261 (701) 248.3286	Hickok, Inc. P.O. Box 2091 Wenatchee, WA 98807 (509) 662-6065	Howe Richardson 680 Van Houten Ave. Clifton, NJ 07015 (201) 471-3400	Hytrol Conveyor Co., Inc. 2020 Hytrol Dr. Jonesboro, AR 72401 (501) 935-3700
	Highway Equipment Co. 616 D Ave. NW Cedar Rapids, IA 52805 (319) 363-8281	S.Howes Company, Inc. 1974 Miller St. Silver Creek, NY 14136 (716) 934-2611	Ideal Grain and Seed Cleaner Co. 85 Second Ave. SE New Brighton, MN 55112 (612) 636-7323

Ideal Stencil Machine & Tape Co. P.O. Box 305 Belleville, IL 62222 (618) 233-0162	Interstate Equipment & Mfg. Corp. P.O. Box 70296 Bakersfield, CA 93387 (805) 322-6659	Kale Industries, Inc. 3553 NW 50 St. Miami, FL 33152 (305) 633-2556	Kernco Instrument Co., Inc. 420 Kenazo Ave. El Paso, TX 79927 (915) 852-3375
Igento 1100 S LaVergne Ave. Oaklawn, IL 60453 (800) 327-1336	Intertractor American Corp. P.O. Box 627 Elkhorn, WI 53121	Kamas Kvarnmaskiner AB Fack S-200 42 Malmo 7, Sweden	Kewanee Farm Equipment Co. 1516 Burlington Ave. Kewanee, IL 61443 (309) 852-2191
Impex International, Inc. 115A Belton Dr. Spartanburg, SC 29304 (800) 274-4410	Irridelco Corp. 440 Sylvan Ave. Englewood Cliffs, NJ 07632 (201) 569-3030	Kamas-Westrup P.O. Box 27 DK-4200 Slagelse Denmark (0) 3 522564	Kifco/Ag-Rain, Inc. P.O. Box 367 Havana, IL 62644 (309) 543-4425
Industrial Marking Equipment Company, Inc. 4385 Westroads Dr. West Palm Beach, FL 33407	Irrigation Accessories Co. P.O. Box 20176 Portland, OR 97220 (503) 255-0610	Kasco Manufacturing Co., Inc. P.O. Box 393 Rt. 3 Shelbyville, IN 46176 (317) 398-7973	E.D. Kilby Manufacturing Co. 286W Evans-Reimer Rd. Gridley, CA 95948 (916) 846-5625
Industrial Ventilation, Inc. 4659 Enterprise St. Boise, ID 83705 (208) 344-3531	Irronmeter Co. P.O. Box 2424 Riverside, CA 92516-2424 (714) 689-1701	The KBH Corp. P.O. Box 670 Clarksdale, MS 38614 (601) 624-5471	King Brother Industries 27781 Hopkins Ave. Valencia, CA 91384 (805) 257-3262
Injecto-O-Meter Mfg. Co., Inc. 820 Thornton Clovis, NM 88101 (505) 763-4461	FIT Marlow Pumps P.O. Box 200 Midland Park, NJ 07432 (201) 444-6900	Kello-Bilt Industries Ltd. P.O. Box 1119 Stettler, Alberta Canada TOC 2L0 (403) 742-3663	King Cutter, Inc. P.O. Box 480 Winfield, AL 35594 (205) 487-3202
InterMetro Industries Corp. 653 N Washington St. Wilkes-Barre, PA 18705 (717) 825-2741	IVO Industries, Inc. 201 Industrial Way W Eatontown, NJ 07724 (201) 542-5151	Kelley Manufacturing Co. P.O. Drawer 1467 Tifton, GA 31793-1467 (912) 382-9393	King Plow Corp. P.O. Box 93009 Atlanta, GA 30377 (404) 876-4476
International Forest Seed Co. P.O. Box 490 Blair Farm Rd. Odenville, AL 35120 (205) 629-5726	Jacobsen Div. of Textron, Inc. 1721 Pachard Ave. Racine, WI 53402-2561 (414) 637-6711	C.C. Kelley & Son 61501 Bremen NW Misawaka, IN 46544 (219) 255-4746	Kinze Manufacturing Inc. P.O. Box 806 Williamsburg, IA 52361 (319) 668-1300
International Paper Co. Seedling Testing Service 34937 Tennessee Rd. Lebanon, OR 97355	JCB, Inc. P.O. Box 209 10939 Philadelphia Rd. White Marsh, MD 21162-0209 (301) 335-2800	Kelly Ryan Equipment Co. P.O. Box 488 Blair, NE 68008 (402) 426-2151	Kirby Manufacturing Inc. P.O. Box 989 Merced, CA 95341 (209) 723.0778
International Paper Co. Container Div. 6400 Poplar Ave. Memphis, TN 38119 (800) 223-1268	Jet Company, Inc. Highway 169 N Humboldt, IA 50548 (515) 332-3117	Kemco Instruments Co., Inc. 420 Kenazo Ave. El Paso, TX 79927 (915) 852-3375	Kirchner Machine Ltd. 2419 Second Ave. N Lethbridge, Alberta Canada T1H 0C1 (403) 328-5569
International Reforestation Suppliers P.O. Box 5547 2100W Broadway Eugene, OR 97405 (503) 345-0597	John Blue Co. P.O. Box 1607 Huntsville, AL 35807 (205) 721-9090	Kennco Manufacturing, Inc. P.O. Box 1158 Ruskin, FL 33570 (813) 645-2591	KMN Modern Farm Equipment Inc. P.O. Box 1896 West Memphis, AR 72301 (501) 732-4270
International Staple & Machine Co. P.O. Box 629 Butler, PA 16003 (412) 287-7711	Johnson's Industrial Supply Co. 1941 Karlin Dr. St. Louis, MO 63131 (314) 966-2420	Kent Manufacturing Co., Inc. P.O. Box 126 Tipton, KS 67485 (913) 373-4145	Knight Manufacturing Corp. P.O. Box 167 Brodhead, WI 53520 (608) 897-2131
Interpolymer Industries 3161 E Washington Los Angeles, CA 90023	J-Star Industries 801 Janesville Ave. Fort Atkinson, WI 53538 (414) 563-5521	Kep Industries, Ltd. P.O. Box 395 Kerrobert, Saskatchewan Canada 50L 1R0 (306) 834-5353	Knowles Manufacturing Co. P.O. Box 97 Glenbeulah, WI 53023 (414) 526.3241

Koppers, Inc. Sprout-Waldron Div. Muncy, PA 17756 (717) 546-8211	Robert H. Laning and Sons, Ltd. 289 Lemon St. Waterford, Ontario Canada NOE WO (518) 443-8601	Lighfoot, Inc. 3810 McIntyre Ave. Eau Claire, WI 54703 (715) 834-2361	Lundebj Mfg. P.O. Box 136 Rt. 1 Tolna, ND 58380 (701) 262-4721
Kosch Co. P.O. Box 707 Columbus, NE 68602 (402) 564-7161	Lannen Tehtaat Oy Plant Systems Div. SF-27820 Iso-Vimma (Sakyla) Finland (938) 70-300	Lightfoot Manufacturing, Inc. 1526 Marlin Rd. Bloomer, WI 54724 (715) 568-2333	Lundell Mfg., Inc. P.O. Box 171 Cherokee, IA 51012 (712) 225-5181
Jack Kovar Sales Co. 1329 3rd Ave. S Anoka, MN 55303 (612) 421-4047	Larchmont Engineering & Irrigation, Inc. 11 Larchmont Lane Lexington, MA 02173	Lindsay Manufacturing Co. P.O. Box 156 Lindsay, NE 68644 (402) 428-2131	MAC Equipment, Inc. P.O. Box 205 S Highway 75 Sabetha, KS 66534 (913) 284-2191
Krause Plow Corp. P.O. Box 2707 Hutchinson, KS 67504-2707 (316) 663.6161	W.F. Larson, Inc. P.O. Box 1967 Plainview, TX 79073-1967 (806) 293-1353	Liquid Waste Technology P.O. Box 250 Somerset, WI 54025 (715) 247-5464	MAGIK Corp. P.O. Box 467 Harlan, IA 51537 (712) 755-5016
Krueger Enterprises P.O. Box 234 Longmont, CO 80501 (303) 776-6140	Lehman H. Feeder & Plow, Inc. P.O. Box 53 Rt. 3 Corpus Christi, TX 78415 (512) 855-0049	Litton Industrial Automation Unit Handling Systems Litton Lane Hebron, KY 41048 (606) 334-2500	Manitoba Industry, Trade, & Technology 500-155 Carlton St. Winnipeg, Manitoba Canada R3C 3H8 (204) 945-2466
Kubota Tractor Corp. 550W Artesia Blvd. Compton, CA 90220 (213) 537-2531	Leinbach Machines Co. P.O. Box 11786 Winston-Salem, NC 27116 (919) 924-4115	Loeering Manufacturing, Inc. P.O. Box 870 IT asseltton, ND 58012 (701) 347-5441	March Manufacturing, Inc. 1819 Pickwick Ave. Glenview, IL 60025 (312) 729-5300
Kuhn Farm Machinery, Inc. P.O. Box 224 Vernon, NY 13476 (315) 829-2620	The Lely Corp. P.O. Box 1060 Wilson, NC 27894-1060 (919) 291-7050	Long Manufacturing N.C., Inc. P.O. Box 1139 Tarboro, NC 27886 (919) 823-4151	Marco Industrial Products 2300W Commodore Way Seattle, WA 98199 (206) 285-3200
Kut-Kwik Corp. 1927 Newcastle St. Brunswick, GA 31521 (912) 265-1630	Lely Kioti, Inc. P.O. Box 1060 Wilson, NC 27894-1060 (919) 291-7050	Lor-Al, Inc. P.O. Box 265 Benson, MN 56215 (612) 843-4161	Markem Corp. 1000 Congress St. Keene, NH 03431
Lakeside Truck Body & Equipment Co. P.O. Box 1104 S Golden State Blvd. Turlock, CA 95381	A.M. Leonard, Inc. P.O. Box 816 6665 Spiker Rd. Piqua, OH 45356-0816 (513) 773-2694	Lorenz Manufacturing Co. P.O. Box 127 Benson, MN 56215 (612) 843-3210	Mark Pack, Inc. 550 W Western Ave Muskegon, MI 49440
Landini 7049 NW 4th St Plantation, FL 33317 (305) 321.9711	Leon-Ram Enterprises, Inc. 135 York Road E Yorkton, Saskatchewan Canada S3N 3Z4 (306) 783-6592	Louisville Ladder Co. 1163 Algonquin Parkway Louisville, KY 40208 (502) 636-2811	Maritime Farm Implements, Inc. P.O. Box 209 Middletown, Nova Scotia Canada BOS 1P0 (902) 825-4040
Landoll Corp. 1700 May St. Marysville, KS 66508 (913) 562-5381	Lewis M. Carter (LMC) Mfg. P.O. Box 428 Donalsonville, GA 31745 (912) 524-2197	J.E. Love Co. 309 California St. Garfield, WA 99130 (509) 635-1321	Marliss Supply Co., Inc. P.O. Box 9370 Jonesboro, AR 72403 (501) 932-7550
Marvin Landplane P.O. Box 1880 Woodland, CA 95695 (916) 662-2871	Lewis Systems 426 Montgomery St. Watertown, WI 53094	Loveland Industries P.O. Box 1289 Greeley, CO 80632 (303) 346-8920	Marsh Stencil Machine Co. 707 E B St. Belleville, IL 62222
Land Pride P.O. Box 218 Asada, KS 67416 (913) 667-4755	Lift-It/PCM Corp. P.O. Box 106 Industrial Park Unionville, MO 63565 (816) 947-2446	LPM Systems 16432 SW 72nd Ave. Portland, OR 97224 (503) 684-5679	Marunaka, Ltd. 11, Mukaidanishi-ku Kyoto, Japan, 601 (075) 321-1901

Massey-Ferguson, Inc. 1901 Bell Ave. Des Moines, IA 50315 (515) 247-2011	Micron Agri Sprayers Canada, Inc. Rt 3 Walkerton, Ontario Canada NOG 2V0 (519) 882-3602	J. Mollema & Sons 5400 36th St. SE Grand Rapids, MI 49508 (616) 940-1441	My-D Han-D Manufacturing, Inc. Rt 1 W McArtor Dodge City, KS 67801 (316) 225-0263
Mater International, Inc. 101 SW Western Blvd. Corvallis, OR 97333 (503) 753-7335	Mid-America Agricultural, Ltd. 12800 Pflumm Olathe, KS 66062 (913) 829-6007	Monarch Industries, Ltd. P.O. Box 429 8890 Erin St. Winnipeg, Manitoba, Canada R3C 3E4 (204) 786-7961	Narcan Farm Equipment, Ltd. P.O. Box 1237 Cambridge, Ontario Canada N1R 6C9 (519) 623-8261
Mathews Co. 500 Industrial Ave. Crystal Lake, IL 60012 (815) 459-2210	Mid-States Equipment Co., Inc. P.O. Box 146 Lake View, IA 51540 (712) 657-8585	Monarch Marking Systems, Inc. P.O. Box 608 Dayton, OH 45401	Nasco 901 Janesville Ave. Ft. Atkinson, WI 58538 (414) 563-2446
Mathews Lebanon Rd Danville, KY 40422 (606) 234-9400	T.R. Miller Mill Co. P.O. Box 708 Brewton, AL 36427 (205) 867-4331	Montana State Forest Tree Nursery 2705 Spurgin Rd Missoula, MT 59801 (406) 542-4300	Natico, Inc. 6700 South LaClaire Ave. Chicago, IL 60638 (312) 767-2900
May-Wes Manufacturing, Inc. P.O. Box 33 Gibbon, MN 55335 (507) 834-6572	Miller-St. Nazianz, Inc. 511 E Main St. St. Nazianz, WI 54232 (414) 773-2121	L.A. Moran Reforestation Center California Department of Forestry P.O. Box 1590 5800 Chiles Rd Davis, CA 95616 (916) 322-2299	National Tree Seed Laboratory 5156 Riggins Mill Rd. Rt. 1, P.O. Box 182-B Dry Branch, GA 31020 (912) 744-3312
McConnell Manufacturing Co., Inc. McConnell Ave. Prattsburg, NY 14873 (607) 222-3701	Mil-Rich P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621	More Plastic Bags 801 Suite G Mahler St. Burlingame, CA 94010 (415) 692-8018	Nebraska Irrigation, Inc. 911 23rd St. E Columbus, NE 68601 (402) 564-1514
McFarlane Manufacturing Co., Inc. P.O. Box 577 1259 S Water St. Sauk City, WI 53583 (608) 643-3321	Minnesota Wanner Co. 5145 Eden Ave. S Minneapolis, MN 55436 (612) 929-1070	Morris Industries, Ltd. 85 York Rd Yorton, Saskatchewan Canada S3N 2X2 (306) 783-8585	Nelson Irrigation Corp. P.O. Box 169 Airport Rd Walla Walla, WA 99362 (509) 525-7600
McLoughlin Ward & Co. 409 S 23rd St. Jackson, MI 49203 (517) 787-5030	Miskin Scraper Works, Inc. P.O. Box 218 Ucon, ID 83454 (208) 522-2139	Motrim, Inc. 240 Steubenville Ave. Cambridge, OH 43725 (614) 4398-2725	New Castings, Inc. Spokane Industrial Park Bldg. 4 Spokane, WA 99216 (509) 924.6464
A.W. McPhearson and Associates, Inc. P.O. Box 5011 1406 Howell Dr. Monroe, LA 71203 (318) 343-5957	Mitchell, Lewis, & Stayer Co. 9925 SW Commerce Circle Wilsonville, OR 97070 (503) 682-0991	MTD Products, Inc. P.O. Box 36900 Cleveland, OH 44136 (216) 225-2600	New Idea Farm Equipment Div. 123W Sycamore St. Coldwater, OH 45828 (419) 678-5311
Mechanical Transplanter Co. P.O. Box 1708 1150 S Central Ave. at US 31 Holland, MI 49422-1708 (616) 396-8738	M&M Plow & Equipment Mfg. Co., Inc. P.O. Box 831 San Angelo, TX 76902 (915) 653-7231	Murphy-Rodgers, Inc. 2301 Belgrave Ave. Huntington Park, CA 90255 (213) 587-4118 (213) 587-4118	New Jersey Wire Stching Machine Co. 10th and Newton Avenues TR Camden, NJ 08103 (609) 365-0196
Menasha Corp. Container Div. P.O. Box 2175 Tacoma, WA 98401	Modern Equipment Co., Inc. 2011 Cuming St. Omaha, NE 68102 (402) 341-4939	The Murray Ohio Manufacturing Co. P.O. Box 268 Brentwood, TN 37027 (615) 373-6500	Nibex, Inc. P.O. Box 8585 Emeryville, CA 94662 (415) 28-0871
Meyer Manufacturing Corp. P.O. Box 405 Dorchester, WI 54425 (715) 654-5132	Modern, Inc. P.O. Box 790 Beaumont, TX 77704 (409) 833-2665	M&W Gear Co. Rt 47 S Gibson City, IL 60936 (217) 784-4261	Nicholls Farm Equipment Rt. 3 Waintleet, Ontario Canada LOS 1V0 (416) 732-2000
MF Industrial 1700 Belle Meade Ct. Lawrenceville, GA 30243 (404) 822-3072	Mohawk Equipment Co. P.O. Box 3605 Temple, TX 76505 (817) 778-1631		

Nichols Tillage Tools, Inc. 312 Hereford Ave. Sterling, CO 80751 (303) 522-8676	Oliver Manufacturing Co., Inc. P.O. Box 512 Rocky Ford, CO 81067 (303) 254-6371	Patent Scaffolding Co. One Bridge Plaza Dept. TR Fort Lee, NJ 07024 (201) 461-8700	Pickle Creek Manufacturing P.O. Box 9 Lamed Industrial Park Lamed, KS 67550 (316) 285-6965
Noble P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621	Omnidata International P.O. Box 448 Logan, UT 84321 (801) 753-7760	Pathfinder Snowplows Rt. 3 Exeter, RI 02822 (401) 397-5053	Plainsmen Manufacturing, Inc. P.O. Box 186 Plains, KS 67869 (310) 563-7233
Norcan Farm Equipment, Ltd. P.O. Box 1237 Cambridge, Ontario Canada N1 R 6C9 (519) 623-8261	Orchard Machinery Corp. 2700 Colusa Highway Yuba City, CA 95991 (916) 673-2822	Pearson Industries, Inc. P.O. Box Z Rt. 34 E Galva, IL 61434 (309) 932-8171	Plashford Packaging Group 1140 Hayden St. Fort Wayne, IN 46803 (219) 423-9431
North American Micron P.O. Box 1227 Reedley, CA 93654 (209) 638.4252	Orthman Manufacturing, Inc. P.O. Drawer B Lexington, NE 68850 (308) 324-4654	Peerless Manufacturing Co., Inc. U.S. Highway 82 E Shellman, GA 31787 (912) 679-5353	Plastech International, Inc. P.O. Box C-5050 John Fitch Industrial Park Warminster, PA 18974 (215) 441-5200
Northern Michigan Equipment Co. P.O. Box 1270 Traverse City, MI 49685 (616) 943-3700	Orto Lan Via Lungochiampo, 90 Montebellow (Vicenza) Italy 36054 (0444) 649565	Penco Products, Inc. 200 Brower Ave. Paks, PA 19456 (215) 666-0500	Plummer Supply P.O. Box 177 Bradley, MI 49311 (616) 792-2215
Northwest Chemical Corp. 4560 Ridge Dr. NE Salem, OR 97303 (503) 390-3030	Overun Farm Machinery, Inc. 866 Langs Dr. Cambridge, Ontario Canada N3H 2N7 (519) 653-8880	Penn Line Service, Inc. 300 Scottsdale Ave. Scottsdale, PA 15683 (412) 887-9110	Plyfiber Container Corp. Johnson Dr. Raritan, NJ 08869 (201) 526-8333
Northwest Tillers, Inc. P.O. Box 10932 Yakima, WA 98909 (509) 575-1950	Pacer Pumps One Lark Ave. Leola, PA 17540 (717) 656-2161	Penn Scale Manufacturing Co., Inc. 150W Berks St. Philadelphia, PA 19122 (215) 739-9644	PMS Instrument Co. 2750 NW Royal Oaks Dr. Corvallis, OR 97330 (503) 752-7926
NVF Co. P.O. Box 68-T Haley Dr. Yorklyn, DE 19736 (302) 239-5281	Pacific Paper Cutter Co. 3690 Santa Fe Ave. Los Angeles, CA 90058 (213) 588-9138	Pepin Farm Implements P.O. Box 158 610 Pine St. Pepin, WI 54759 (715) 442-2111	Portable Elevator Div. 920 E Grove St. Bloomington, IL 61701 (309) 329-1235
NW Pesticides Enterprises, Inc. 14520 Beck Rd. Dallas, OR 97338	Pacific Rim Packaging Corp. P.O. Box 4026 801-T Chesley Ave. Richmond, CA 94804-0026 (800) 372-7311	Percy Kent Bag Company, Inc. 5910 Winner Rd. Kansas City, MO 66125 (816) 883-9800	Portage Industries Corp. 1325 Adams St. Portage WI 53901 (608) 742-7123
Off-Road Floater Equipment Co. 627 Adana Rd. Chillcothe, OH 45601 (614) 775-2666	Pacific Stihl, Inc. 11096 Midway Chico, CA 95928-9562	Performance Feeders, Inc. P.O. Box 276G Westfield, IN 46074 (317) 896-5543	Portco Corp. Paper Products Div. 4200 Columbia Way Vancouver, WA 98661 (206) 606-1641
Ohaus Corp. P.O. Box 900 29 Hanover Rd. Florham Park, NJ 07932-0900 (201) 377-9000	Pacific Wire Works 14615 Anson Ave. Santa Fe Springs, CA 90670 (213) 921-7925	The Perry Co. P.O. Box 7187 Waco, TX 76714 (817) 756-2131	Porter-Ferguson, Inc. 321 Newbury St. Danvers, MA 01923 (508) 774-1629
Olathe Manufacturing, Inc. 100 Industrial Parkway Industrial Airport, KS 66031 (913) 782-4396	Pallier Corp. 1701 Kentucky St. Michigan City, IN 46360 (219) 872-7238	PFRA Shelterbelt Centre Agriculture Canada Indian Head, Saskatchewan, Canada SOG 2K0	Powell Manufacturing Co., Inc. P.O. Drawer 707 Bennettsville, SC 29512 (803) 479-6231
The Old Mill Co. Savage Industrial Center Savage, MD 20763 (301) 725.8181	Panel Controls Corp. 1000 Mt. Elliott Ave. Detroit, MI 48207 (313) 568-2400	P & H Manufacturing Co. P.O. Box 549 Shelbyville, IL 62565 (217) 774-2123	Power King Tractors P.O. Box 1510 Waukesha, WI 53187 (414) 785-0786

Power Refrigeration Co. Main Office 3466 Arden Rd. Hayward, CA 94545 (415) 887-4105	H.C. Ranger, Inc. P.O. Box 177 N4 22610 Bluemound Rd. Waukesha, WI 53187-0177 (414) 547-1000	Remlinger Manufacturing Co., Inc. P.O. Box 299 Kalida, OH 45853 (419) 532-3647	Roseman Tractor Equipment, Co. 2620 Crawford Ave. Evanston, IL 60201 (312) 864-1842
WA Powers Co., Inc. 1215A S Main St. Ft. Worth, TX 76104 (800) 792-1243	Rapistan Corp. 507 Plymouth Ave. NE Grand Rapids, MI 49505 (616) 451-6200	Research Products Corp. 1015 E Washington Ave. P.O. Box 1476 Madison, WI 53701 (800) 356-9652	Rosseau, Inc. 2717W 5th St. N Unit B Summerville, SC 29483 (803) 875-1850
PPS Pack Co. 204 N 7th St. Fowler, CA 93625 (209) 834-1641	Raven Industries, Inc. Plastics Div. P.O. Box 1007 205 E 6th St. Sioux Falls, SD 57117 (605) 336-2750	Reynolds Televator Corp. 1005W Laketon Ave. Muskegon, MI 49441 (616) 722-3698	Rotech, Inc. P.O. Box 31 Olathe, KS 66061 (913) 782-3456
Prater Industries, Inc. 1515 S 55th Court Chicago, IL 60650 (312) 656-8500	Rayne Land Planes, Inc. P.O. Box 549 Rayne, LA 70578 (318) 334-2101	Rickel, Inc. P.O. Box 626 Salina, KS 67401 (913) 823-6222	Rowse Hydraulic Rakes Co., Inc. P.O. Box 42 HC 80 Burnell, NE 678823 (308) 348-2276
Priefert Mfg. Co., Inc. P.O. Drawer 2540 Mt. Pleasant, TX 75455 (800) 527-8616	Rears Manufacturing Co. 2140 Prarie Rd. Eugene, OR 97402 (503) 688-1002	Ridg-U-Rak, Inc. 120-T S Lake St. North East, PA 16428 (814) 725-8751	R & R Agri-Products, Inc. Rt. 1, P.O. Box 121 Wilbur, WA 99185 (509) 647-5707
Prime Manufacturing Co., Inc. P.O. Box 433 Poplarville, MS 39470 (601) 795-4553	Rebel Industries, Inc. 5700W Broading Crystal, MN 55428 (800) 338-8348	Rite-Way Fumigation Co., Inc. 1705 N 13th St. Norfolk, NE 68701 (402) 371-2421	Rubber Band Technology, Ltd. P.O. Box 10327 Yakima, WA 98909 (509) 248-8606
Prosem Rt 4 Howick, Quebec CanadaJOS 160	Reclamare Co. 20727 7th Ave. S Seattle, WA 9818 (206) 824-2385	Rite Way Manufacturing Co., Ltd. P.O. Box 3344 1891 Albert St. N Regina Saskatchewan Canada S4P 3H1 (306) 543-6777	Rubbermaid Commercial Products, Inc. 3124 Valley Ave. Winchester, VA 22601 (703) 667-8700
Protective Lining Corp. 603 39th St. Brooklyn, NY 11232 (800) 221-9712	Reddick Equipment Company, Inc. P.O. Box 71 Williamston, NC 27892 (919) 792-1191	Rivinius, Inc. 925W Center Eureka, IL 61530 (309) 467-2303	SAME Tractors P.O. Box 127 St. Nazianz, WI 54232 (414) 773-2121
Pryor Marking Products, Inc. 21 E Hubbard St. Chicago, IL 60611	Redington Counters, Inc. P.O. Box 608 130 Addison Rd. Windsor, CT 06095 (203) 688.6205	Robinson & Grissom Tractor Co., Inc. P.O. Box 36 Rt. 2 Guntown, MS 38849 (601) 869-1028	Sanderson Safety Supply Co. 800 SE Hawthorne Blvd. Portland, OR 97214 (503) 238-5700
Pucel Enterprises, Inc. 1440-T E 36th St. Dept. TR Cleveland, OH 44114 (216) 881-4604	Regal Plastic Co. 440 E 11th St. Kansas City, MO 64127 (816) 483-3040	Rome Industries P.O. Box 48 Cedartown, GA 30125 (404) 748-4450	Satake (USA), Inc. 11999 Katy Freeway Suite 505 Houston, TX 77079 (713) 493-6828
Pumps & Softners, Ltd P.O. Box 5332 London, Ontario Canada N6A 4N8	Reinco, Inc. P.O. Box 584 Plainfield, NJ 07061 (207) 755-0921	Rokon International, Inc. P.O. Box 189 Jaffrey, NH 03452 (800) 632-2481	Sauze Technical Products Corp. 212 Oak St. Extension Plattsburgh, NY 12901 (518) 561-6440
Rainbow Irrigation Systems P.O. Box 70 Fitzgerald, GA 31750 (912) 423-4341	Reiten, Inc. P.O. Box 589 Cooperstown, ND 58425 (701) 797-2751	Root Lowell Corp. 1000 Foreman Rd. Lowell, MI 49331 (616) 879-9212	Saxmayer Tying Equipment Saxmayer Corp. P.O. Box 10 Blissfield, MI 49228 (517) 486-2164
Ramacher Manufacturing, Co. P.O. Box 506 Linden, CA 95236 (209) 887-3815	RemCar, Inc. P.O. Box 717 Howe, TX 75059 (214) 532-6214	Roseman Manufacturing Co. Marketing & Sales P.O. Box 158 Rt. 29 Collegeville, PA 19426 (215) 489-1400	Scientific Separators, Inc. 621 17th St. Suite 1515 Denver, CO 80293 (303) 623.6178

Schumacher Irrigation, Inc. P.O. Box 218 Main St. Platte Center, NE 68650 (402) 246-3685	Signode 3610W Lake Ave. Glenview, IL 60025-281 (800) 323-2464	Soilmover Manufacturing Corp. P.O. Box P Pender, NE 68047 (402) 385-3051	Stanhay Webb, Ltd. Exning, Suffolk Newmarket, England CB8 7HD 44 63877 206
T.G. Schmeiser Co., Inc. P.O. Box 1047 Fresno, CA 93714 (209) 268-8128	Silica Gel Desiccant Products Co. 734 E Hyde Park Blvd. Inglewood, CA 90302 (213) 673-5196	Soil/Plant Testing Laboratory Strand Ag. Hall Oregon State University Corvallis, OR 97331 (503) 737-2187	Stanley/Bostich Rt. 2 East Greenwich, RI 02818 (401) 884-2500
Schulte Industries, Ltd. P.O. Box 70 Englefeld, Saskatchewan Canada SOK 1 NO (306) 287-3715	Silver Mountain Equipment, Inc. 4672 Drift Creek Rd. SE Sublimity, OR 97385 (503) 769-7127	Soil Stabilization Products Co. P.O. Box 2779 Merced, CA 95344 (209) 383-3296	Stanley Hydraulic Tools 3810 SE Naef Rd. Milwaukee, OR 97222 (503) 659-5660
Seedburo Equipment Co. 1022 W Jackson Blvd. Chicago, IL 60607-2990 (312) 738-3700	Henry Simon, Inc. 2955 Fairfax Trafficway Kansas City, KS 66115 (913) 621-6466	Solex P.O. Box 490 220 S Jefferson Dixon, CA 95620	Steelcraft, Inc. P.O. Box 1284 505 30th Ave. NW Miami, OK 74355 (918) 542-4466
Senco Products, Inc. 8486 Broadwell Rd. Cincinnati, OH 45244 (800) 543-4596	Simonsen Manufacturing Co. P.O. Box 247 Quimby, IA 51049 (712) 445-2211	Solo, Inc. P.O. Box 5030 5100 Chestnut Ave. Newport News, VA 23605 (804) 245-4228	Steiger Tractor, Inc. P.O. Box 6006 Fargo, ND 58108 (701) 293-4714
Servis-Rhino Co. P.O. Box 712 Sequin, TX 78156-0712 (512) 379-1480	Simplicity Manufacturing, Inc. 500-T N Spring St. Port Washington, WI 53074 (414) 284-5535	Solomat Instrumentation Div. Glenbrook Industrial Park 652 Glenbrook Rd. Stamford, CT 06906 (203) 348-9700	Sterling Bag & Supply Co., Inc. Foot of Fisher Rd. Lackawanna, NY 14218 (716) 826-1991
Settlers Corp. P.O. Box 93 Bruce Crossing, MI 49912 (906) 827-3515	Simpson Electric Co. 853 Dundee Ave. Elgin, IL 60120 (312) 697-2260	Sonoco Fibre Drum, Inc. One Parkway Center 1850 Parkway Place Marietta, GA 30067 (404) 423-2500	Sterling Scale Company, Inc. 20-950 Boening Dr. Southfield, MI 48075-5783 (313) 358-0590
Seymour Manufacturing Co. 500 N Broadway Seymour, IN 47272 (812) 522-2900	Simtrack Systems, Inc. 50-T S Joey Dr. Elk Grove Village, IL 60007 (708) 956-0044	Southpine, Inc. P. O. Box 530127 Birmingham, AL 35253 (205) 879-1099	Stewart-Glapat Corp. P.O. Box 2486 1637 Moxahala Ave. Zonesville, OH 43702 (614) 452-3601
Seymour Smith & Son, Inc. 900 Main St. Oakville, CT 06779 (203) 274-2558	Smith Precision P.O. Box 276 Newbury Park, CA 91320 (805) 498-6616	Speed King Manufacturing P.O. Box 1438 Dodge City, KS 67801 (316) 227-7106	Stihl, Inc. 536 Viking Dr. Virginia Beach, VA 23452 (804) 486-8444
Shaver Manufacturing Co. P.O. Box 358 Graettinger, IA 51342 (712) 859-3293	Smoke River Chemicals Caldwell, ID (208) 454-0475	Spraying Systems Co. North Ave. Wheaton, IL 60188 (312) 665-5000	Stocker & Son, Inc. P.O. Box 749 Bayport, NY 11705 (516) 472-1881
Shindaiwa Inc. P.O. Box 1090 11975 SW Herman Rd. Tualatin, OR 97062 (503) 692-3070	Snapper Power Equipment P.O. Box 777, Dept. B McDonough, GA 30253 (402) 957-9141	Sprayrite Manufacturing Co. P.O. Box 3289 West Helena, AR 72390 (501) 572-6737	Stolzhus Spreaders Morgan Way P.O. Box 527 Morgantown, PA 19543 (215) 286-5146
Skolnick Industries, Inc. 4900 S Kilbourn Ave. Chicago, IL 60632 (312) 735-0700	Snorkel Economy P.O. Box 65 Stockyards Station St. Joseph, MO 64504 (913) 989-4481	Stadia Corp. 65 Sheridan Blvd. P.O. Box 19176 Denver, CO 80219	J. Herbert Stone Nursery 2606 Old Stage Rd. Central Point, OR 97502 (503) 776-4281
Side Winder P.O. Box 818 Minden, LA 71058.0818 (501) 935-1970	Snow Corp. 4350 McKinley St. Omaha, NE 68112 (402) 453-2200	Standen Engineering, Ltd. Station Rd. Ely Combs England CB7 4BP (035) 361111	St. Regis Laminated & Coated Products Div. Tracy, CA 95376 (209) 835-0353

C.F. Struck Corp. P.O. Box 307 Ceaderburg, WI 53012 (414) 377-3300	TEMCO H-M Parts Co. P.O. Box 40210 Memphis, TN 38174.0210 (901) 274-1158	Trac 4, Inc. P.O. Box 58 Wilmington, IL 60421 (815) 476-6778	Troemner, Inc. 6825 Greenway Ave. Philadelphia, PA 19141 (215) 724.0800
Stulz-America, Inc. 270 Technology Park 5350 Spectrum Dr. Suite Y Frederick, MD 21701 (301) 663-8885	Terra Tech, Inc. P.O. Box 5547 2100W Broadway Eugene, OR 97405 (503) 345-0597	Tractor Implement Supply Co. 232 Lothenback Ave. St. Paul, MN 55118 (612) 455-6682	Troy Sunshade Co. 607 Riffle Ave. Greenville, OH 45331 (415) 861-4455
Stulz Scientific Engineering 3313 S 6th Highway Frontage Rd. W Springfield, IL 62703 (217) 529-3723	Testing Machines, Inc. 400 Bayview Ave. Amityville, NY 11701 (516) 842-5220	Trademark Sales & Marketing, Inc. 1920 American Ct. Neenah, WI 54956 (414) 727-1818	Trumeter Company, Inc. 38-40W 32nd St. New York, NY 10001 (212) 564.0666
Sukup Manufacturing Co. P.O. Box 677 Sheffield, IA 50475 (515) 892-4222	3M 3M Center St. Paul, MN 55101	Traver Sales Corp. 84636 Highway 25 Folsom, LA 70437 (504) 796-3286	True Temper Hardware Div. Ernhart Consumer Group P.O. Box 3500 465 Railroad Ave. Shiremanstown, PA 17011
Summers Manufacturing Co. 338 Railway Ave. Maddock, ND 58348 (701) 438-2855	Thompson Manufacturing Co. P.O. Box 1500 Dept. TR Chino, CA 91710 (714) 591-4851	Tree Improvement Enterprises P.O. Box 630 1119-1/2 S 4th St. Cottage Grove, OR 97424 (503) 942-4066	Tryco Manufacturing Co., Inc. P.O. Box 1277 Decatur, IL 62525 (217) 428-0901
Summit Products Co. P.O. Box 909 146S Beeson Ave. Uniontown, PA 15401 (412) 437-7251	Thurston Manufacturing Co. Blu-Jet Products P.O. Box 218 Thurston, NE 68062 (402) 385-3041	Tree Tie, Inc. 11539 Raspberry Hill Rd. Eden Prairie, MN 55344 (612) 944-3399	G.L. Turner Co. P.O. Box 5652 North Little Rock, AR 72119 (501) 375-0297
Sunflower Manufacturing Co., Inc. P.O. Box 566 Beloit, KS 67420 (913) 738-2261	Tier-Rack Corp. 818 Olive St. Dept. 8B St. Louis, MO 63101 (314) 241-5451	Tri-Ag Corp. 555 N Tenth Logan, UT 84321 (801) 753-1950	Turner International, Ltd. Div. of Elswick PLC 1360 Business Center Dr. Conyers, GA 30207 (404) 922-1154
Joseph Swantak, Inc. P.O. Box 93 H.C.. 64 Delhi Stage Oneonta, NY 13820 (607) 432-0891	Tiger Corp. 3301 N Louise Ave. Sioux, SD 57107 (605) 336-7900	Tri-Cal P.O. Box 1327 8770 Highway 25 Hollister, CA 95024 (916) 966-2930	The Tye Co. P.O. Box 218 Lockney, TX 79241 (806) 652-3367
Tach-It Clemonts Industries, Inc. 50 Ruter Court South Hackensack, NJ 07606 (201) 440-5500	Tilth, Inc. 26979 Dawson Rd. Monroe, OR 97456 (503) 847-6200	Trident Agricultural Products, Inc. 8002 NE Highway 99 Suite 259 Vancouver, WA 98665	Tyler E Highway 12 Benson, MN 56215 (612) 843-4000
Taylor/Pittsburgh Implements P.O. Box 769 Athens, TN 37303 (615) 745-3110	Timm Enterprises, Ltd. P.O. Box 157 5204 Trafalgar Rd. Oakville, Ontario Canada L6J 4Z5 (416) 878-4244	Triple/S Dynamics 1031 S Haskell Ave. Dallas, TX 75223 (214) 828-8600	Uittokalusto Oy Fredrikinkatu 61, PL 455 00101 Helsinki, Finland (90) 694.2400
Tebben Manufacturing P.O. Box 140 Rt. 2 Clara City, MN 56222 (612) 847-2200	Toledo Scale, Reliance Electric P.O. Box 17438 Cleveland, OH 44117 (800) 245-4501	Tri-River Chemical Co., Inc. P.O. Box 2778 Pasco, WA 99302	Union Iron Works, Inc. P.O. Box 1069 1102 N 18th St. Decatur, IL 62525 (217) 429-5148
Tektonix, Inc. Time Square Park 300W Mercer Way Salt Lake City, Utah 84115 (801) 486-1091	The Toro Co. 8111 Lyndale Ave. S Minneapolis, MN 55420 (612) 887-8813	Tri-State, Inc. P.O. Box 337 505 Fourth St. Henderson, KY 42420-0337 (502) 826-8361	Union Steel Products, Inc. P.O. Box 60 509 N Albion St. Albion, MI 49224 (517) 629-2181
	Toteline Molded Fiberglass Tray Co. 1000 E Erie St. Linesville, PA 16424 (814) 683-4500	Tri-State Metal Fabricators, Inc. Building 8 Spokane Industrial Park Spokane, WA 99216 (509) 9926-7165	Union Tools P.O. Box 1940 Columbus, OH 43216 (614) 222-4400

United Farm Tools, Inc. . P.O. Box 4026 Glasgow, KY 42142 (502) 651-7121	Vada Covington Corp., dba Covington Planter P.O. Box 2 Albany, GA 31702 (912) 888-2032	W & A Manufacturing Co. P.O. Box 5238 Pine Bluff, AR 71611 (501) 534-7420	Western Kraft Paper 5800 SW Western Ave. Beaverton, OR 97005 (503) 641-4455
United Kalamazoo 116 N 15th St. Chesterton, IN 46304 (219) 926-1186	Valmont Industries, Inc. Valley, NE 68064 (402) 359-2201	Wacker Corp. P.O. Box 9007 N 92W 15000 Anthony Ave. Memomonee Falls, WI 53052-9007 (414) 255-0500	Western Land Roller Co. P.O. Box 668 Hastings, NE 68901 (402) 463-1306
United States Plastic Corp. 1376 Neubrecht Lima, OH 45801 (419) 228-2242	Valmar Airflow, Inc. P.O. Box 100 Elie, Manitoba Canada ROH OHO (204) 353-2782	Wade Manufacturing Co. P.O. Box 23666 Portland, OR 97223 (503) 641-1865	Western Manufacturing Co., Inc. P.O. Box 55 Bottineau, ND 58318 (701) 228-3757
Unverferth Manufacturing Co., Inc. P.O. Box 357 Star Route 224 Kalida, OH 45853 (419) 532-3121	Vandermolen Corp. 119 Dorsa Ave. Livingston, NJ 07039 (201) 992-8506	Walter Stern, Inc. P.O. Box 571 68 Sintsink Dr. E Port Washington, NY 22050 (516) 883-9100	Westheffer Co., Inc. P.O. Box 363 Lawrence, KS 66044 (913) 843-1633
USDA Forest Service Bend Pine Nursery 63095 Deschutes Market Rd. Bend, OR 97701 (503) 882-6922	Van Leer Containers, Inc. 4300-T W 130th St. Chicago, IL 60658 (312) 568-3535	Warren Refrigerator Co. 1010 1-10 E Beaumont, TX 77703 (409) 838-3791	Westvaco US Envelope Div. P.O. Box 1675 311 Industry Ave. Springfield, MA 01101 (413) 736-67211
USDA Forest Service Coeur d'Alene Nursery 3600 Nursery Rd. Coeur d'Alene, ID 38314 (208) 765-6365	The Vassar Co. P.O. Box 609 207 N Main Perkins, OK 74059 (405) 647-2454	Wavetek P.O. Box 85265 9045 Balboa Ave. San Diego, CA 92128 (619) 279-2200	Weyerhaeuser Co. Tacoma, WA 98401 (206) 924-3508
USDA Forest Service Humbolt Nursery P.O. Box 2158 McKinleyville, CA 95521 (707) 839-3256	Veeder-Root Digital Systems Div. P.O. Box 2003 125 Powder Forest Dr. Sinsbury, CT 06070 (203) 651-2700	Weather-Matic Div. of Telsco Industries P.O. Box 180205 3301 W Kingsley Rd. Garland, TX 75041-2207 (214) 278-6131	Weyerhaeuser Research Center Seedling Testing Laboratory 505 N Pearl St. Centralia, WA 98531
USDA Forest Service Lucky Peak Forest Tree Nursery HC 33, P.O. Box 1085 Boise, ID 83706 (208) 343-1977	Vermeer Manufacturing Co. P.O. Box 200 Pella, IA 50219 (515) 628-3141	Weber Marking Systems, Inc. 711 W Algonquin Rd. Arlington Heights, IL 60005	White Bag Co., Inc. P.O. Box 607 Warehouse Row & Campbell Dr. Jacksonville, AK 72076 (501) 982-9551
USDA Forest Service Missoula Technology & Development Center Building 1, Fort Missoula Missoula, MT 59801 (406) 329-39090	Versa Ferguson Conveyor Corp. P.O. Box 152-T Mt. Sterling, OH 43143 (614) 869-2738	Weir Pumps Ltd. Cathcart Glasgow, Scotland G44 4EX 041-637-7141	White Farm Equipment 123W Sycamore St. Coldwater, OH 45828 (419) 678-5311
U.S. Packaging P.O. Box 2566 High Point, NC 27260 (800) 258-4102	Vicom Farm Machinery, Inc. 2885 Charlestown, Rd. Lancaster, PA 17603 (717) 872-8661	Weiss-McNair, Inc. 531 Country Dr. Chico, Ca 95926 (916) 891-6214	RA. Whitfield Manufacturing Co. Whitfield Forestry Equipment P.O. Box 188 6431 Gordon Circle SW Mableton, GA 30059 (404) 948-1212
Utensco United Molded Products Div. United Utensils Co., Inc. P.O. Box 710 Port Washington, NY 11050 (516) 838-7300	Viel Manufacturing Co. P.O. Box 632 Billings, MT 59103 (406) 252-6808	Wengers Farm Machinery, Inc. 251 S. Race St. Myerstown, PA 17067 (717) 866-2130	Willmar Manufacturing Co. P.O. Box 957 Willmar, MN 56201 (612) 235-0767
Utility Tool & Body Co., Inc. P.O. Box 360 Clintonville, WI 54929 (715) 823-3167	Volm Bag Co. P.O. Box B 1804 N Edison Amtigo, WI 54409 (715) 627-4826	R.D. Werner Company, Inc. P.O. Box 580 Greenville, PA 16125 (412) 588-8600	Wil-Rich Farm Equipment Div. Lear Siegler, Inc. P.O. Box 1030 Wahpeton, ND 58074 (701) 642-2621
	W. A. Powers Co., Inc. 1215-A S Main St Fort Worth, TX 76104 (800) 792-1243	Westendorf Manufacturing Co., Inc. P.O. Box 29 Onawa, IA 51040 (712) 423-2762	

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Wylie Manufacturing Co.
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Yanmar Tractor (USA), Inc.
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Year-A-Round Cab Corp.
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Yellow Devil Tarp Layer
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Jackson, MS 39212

Yetter Manufacturing Co., Inc.
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Colchester, IL 62326
(309) 776-4111

Yielder Drill, Inc.
S 4305 University Rd.
Spokane, WA 99206
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York Modern Corp.
P.O. Box 488
Umadilla, NY 13849
(607) 369-7111

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