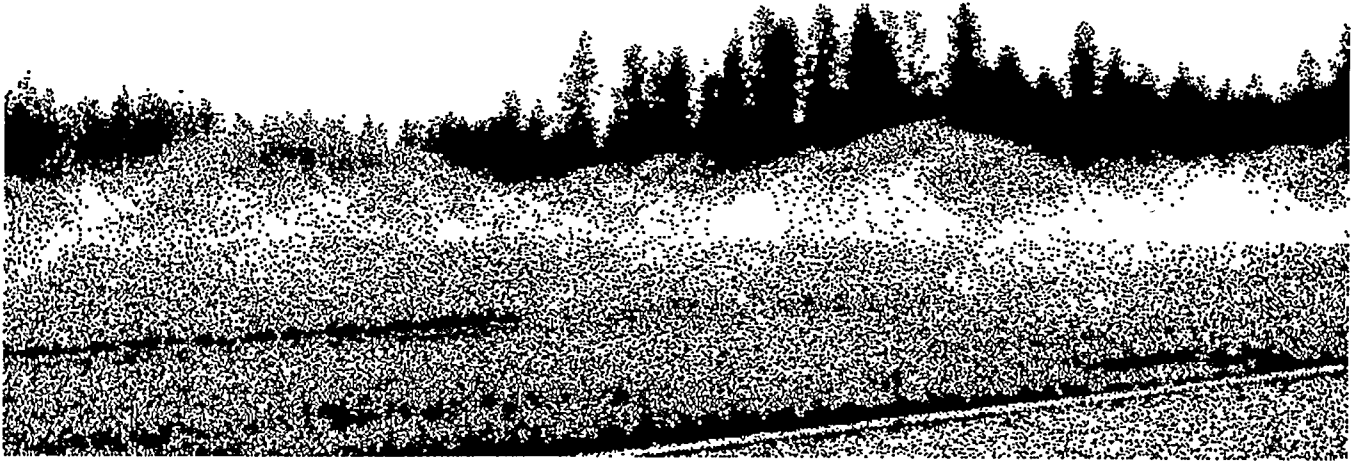


5.0 Cultural Practices



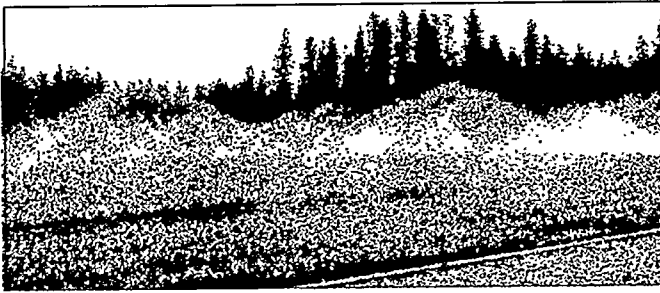
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This section deals with the various cultural activities that occur in nurseries from the time seed is sown to the time when the seedlings are ready for harvesting. The sown seedbeds should be lightly irrigated immediately after sowing to stimulate 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.

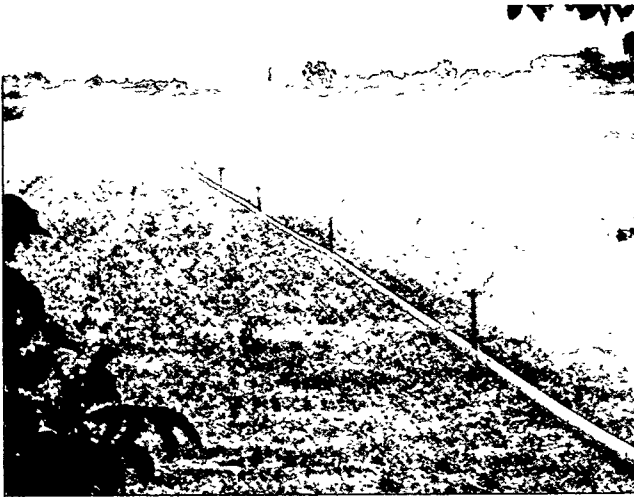
Irrigation Pumps

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. Conshohockem, 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
Dorward 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 Jannsen 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

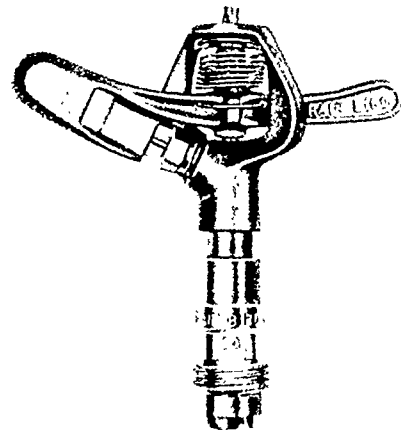
The sprinkler head controls the rate and pattern of water application and consists of the body and the nozzle. Nozzles come in a variety of sizes and are interchangeable. Although stationary heads are available, bareroot nurseries generally use rotary heads that move in a circular pattern and can throw 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

Irridelco 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

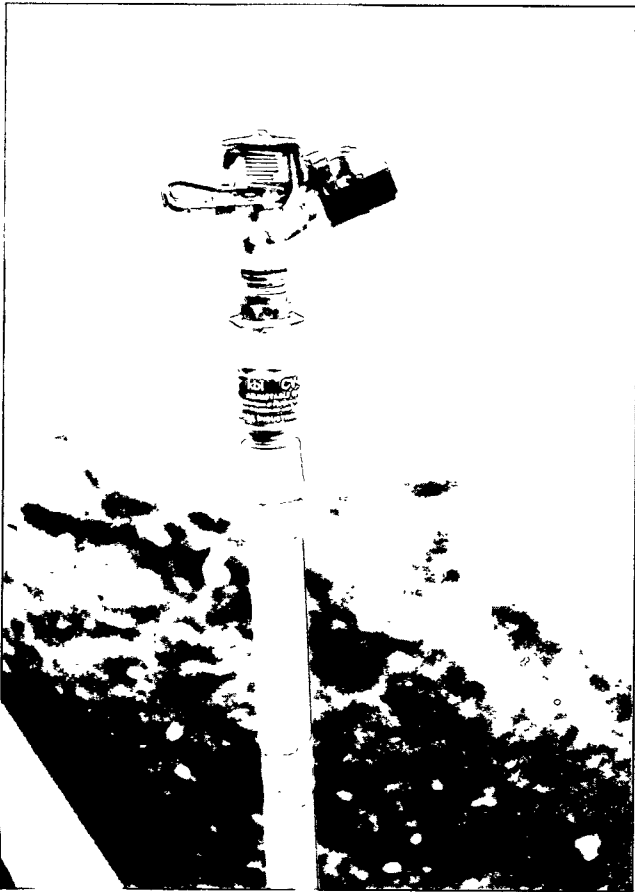
The Toro Co.
8111 Lyndale Ave. S
Minneapolis, MN 55420
(612) 887-8813

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.



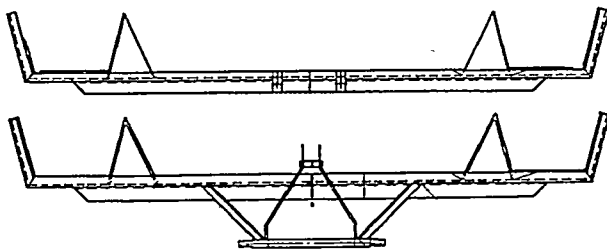
King Brothers Industries
27781 Hopkins Ave.
Valencia, CA 91384
(805) 257-3262

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

General Irrigation Co.
P.O. Box 776
Carthage, MO 64836
(417) 358-8171

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

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

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

Irridelco 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

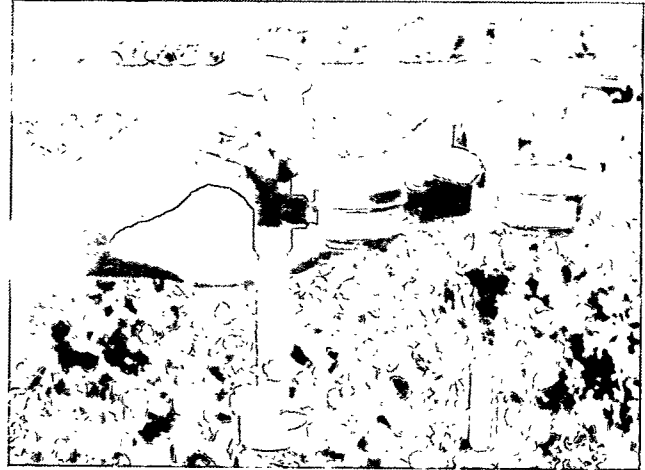
Rainbow Irrigation Systems
P.O. Box 70
Fitzgerald, GA 31750
(912) 423-4341

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

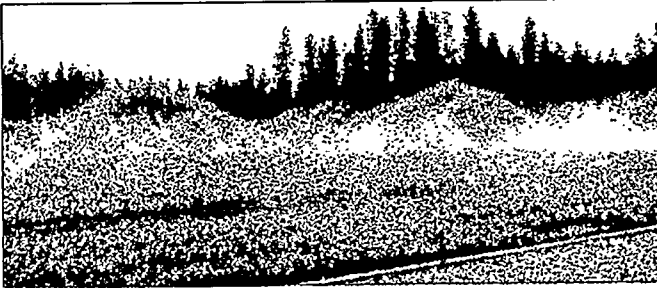
Ironmeter Co.
P.O. Box 2424
Riverside, CA 92526-2424
(714) 689-1701

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

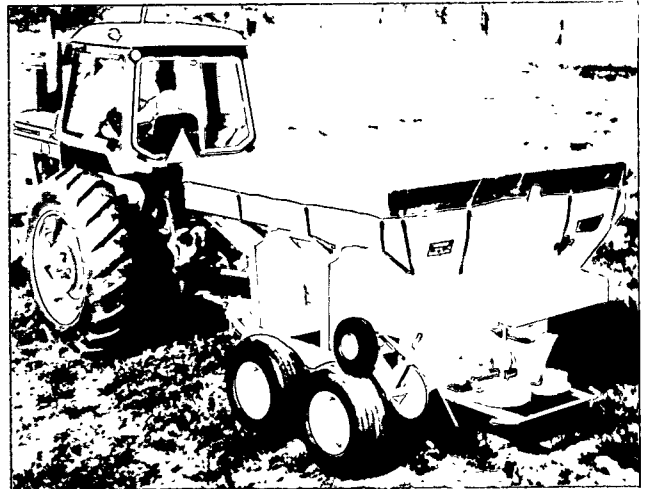
5.2 Applying Dry Fertilizers and Pesticides



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 S0L 1S0
(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 Riburn, 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-AI, 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

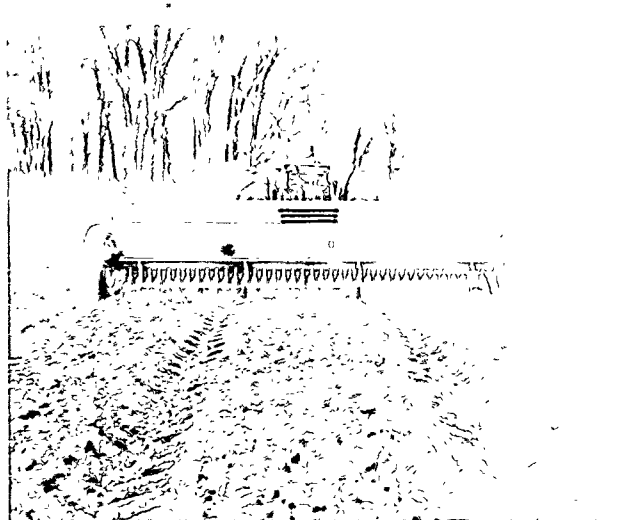
P.&H. Mfg. Co.
P.O. Box 549
Shelbyville, IL 62565
(217) 774-2123

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 Pl.
Surray, British Columbia
Canada V36 5K1

Jet Co., Inc.
Highway 169 N
Humbolt, IA 50548
(515) 332-3117

Kep Industries, Ltd.
P.O. Box 395
Kerrobert, Saskatchewan
Canada 50L 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

Stoltzfus 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

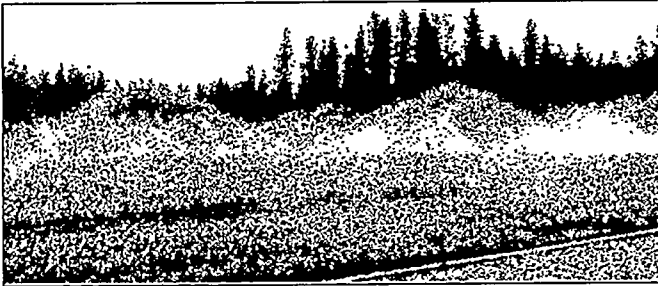
Vicom Farm Machines, Inc.
2885 Charlestown Rd.
Lancaster, PA 17603
(717) 872-8661

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 Fukaekita 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

Miocron 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

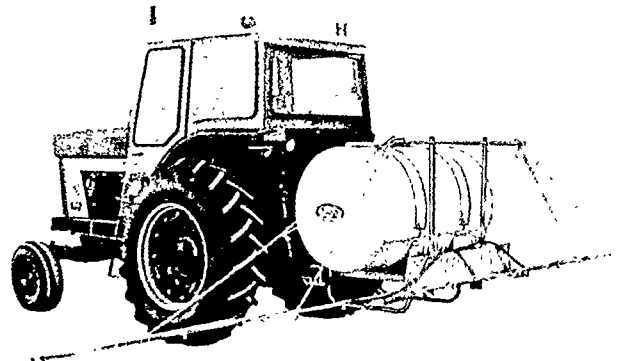
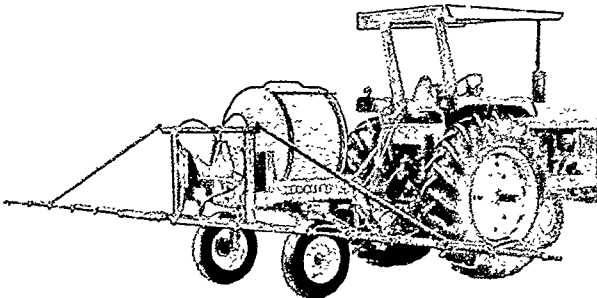
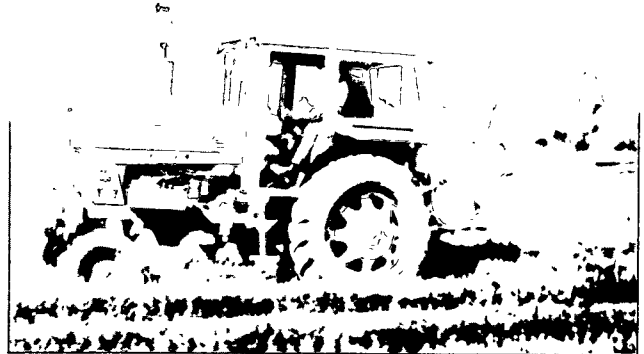
Sauze Technical Products Corp.
212 Oak St. Ext.
Plattsburgh, NY 12901
(518) 561-6440

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.

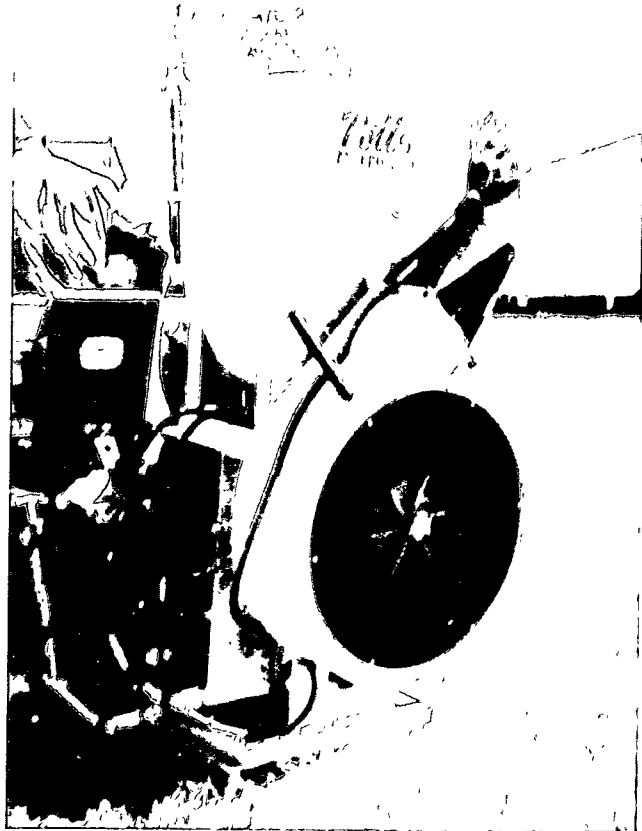


Boom Sprayers:

Ace Supply P.O. Box 1098 315 N Kit Ave. Caldwell, ID 83606-1098 (208) 459-0731	Continental Belton Co. P.O. Box 660 920 E 6th St. Belton, TX 76513 (817) 939-3731	John Blue Co. P.O. Box 1607 Huntsville, AL 35807 (205) 721-9090	Side Winder P.O. Box 818 Minden, LA 71058-0818 (501) 935-1970
Ag-Chem Equipment Co., Inc. Suite 100 5720 Santana Dr. Minnetonka, MN 55343 (612) 933-9006	Dempster Industries, Inc. P.O. Box 848 711 S 6th St. Beatrice, NE 68310 (402) 223-4026	KBH Corp. P.O. Box 670 Clarksdale, MS 38614 (601) 624-5471	Summers Mfg. Co. 3338 Railway Ave. Maddock, ND 58348 Devils Lake, ND 58301 (701) 438-2855
Agrotec, Inc. P.O. Box 49-T Highway 35 N Pendleton, NC 27862 (919) 585-1222	Durland-Wayland, Inc. P.O. Box 1404 Lagrange, GA 30241 (404) 882-8161	Raven Industries, Inc. Plastics Div. P.O. Box 1007 205 E 6th St. Sioux Falls, SD 57117 (605) 336-2750	Tyler E Highway 12 Benson, MN 56215 (612) 843-4000
The Broyhill Co. N Market Square Dakota City, NE 68731 (402) 987-3412	Fimco, Inc. First and Court Sts. Sioux City, IA 51101 (712) 258-0171	Rears Mfg., Co. 2140 Prairie Rd. Eugene, OR 97402 (503) 688-1002	Wilmar Mfg., Co. P.O. Box 957 Wilmar, MN 56201 (612) 235-0767
Chem-Farm, Inc. P.O. Box 6510 4901 N St. Joseph Ave. Station B Evansville, IN 47719-0510	Forestry Suppliers, Inc. P.O. Box 8397 205 W Rankin St. Jackson, MS 39284-8397 (800) 647-5368	Reddick Equipment Co., Inc. P.O. Box 71 Williamston, NC 27892 (919) 792-1191	Tanks and Accessories: Raven Industries, Inc. Plastics Div. P.O. Box 1007 205 E 6th St. Sioux Falls, SD 57117 (605) 336-2750
	General Supply Corp. P.O. Box 9347 303 Commerce Park Dr. Jackson, MS 39286-9347 (601) 981-3382	Rickel, Inc. P.O. Box 626 Salina, KS 67401 (913) 823-6222	

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 ATV's. 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 Fukae Kita 2 Chome
Higashinari-ku, Osaka
537 Japan

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

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

Cooper, Pegler & Co., Ltd.
2 Victoria Gardens
Burgess Hill, West Sussex
RH159LA, England

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

Fimco, Inc.
First and Court St.
Sioux City, IA 51101
(712) 258-0171

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

Hardi, Inc.
477 Exeter Rd.
London, Ontario
Canada N6E 2Z3
(519) 685-6730

H.D. Hudson Mfg., Co.
500 N Michigan Ave.
Chicago, IL 60611
(312) 644-2830

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

Rears Mfg. Co.
2140 Prairie Rd.
Eugene, OR 97402
(503) 688-1002

Robert H. Laning and Sons, Ltd.
289 Lemon St.
Waterford, Ontario
Canada N0E 1Y0
(518) 443-8601

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

Side Winder
P.O. Box 818
Minden, LA 71058-0818
(501) 935-1970

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.

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

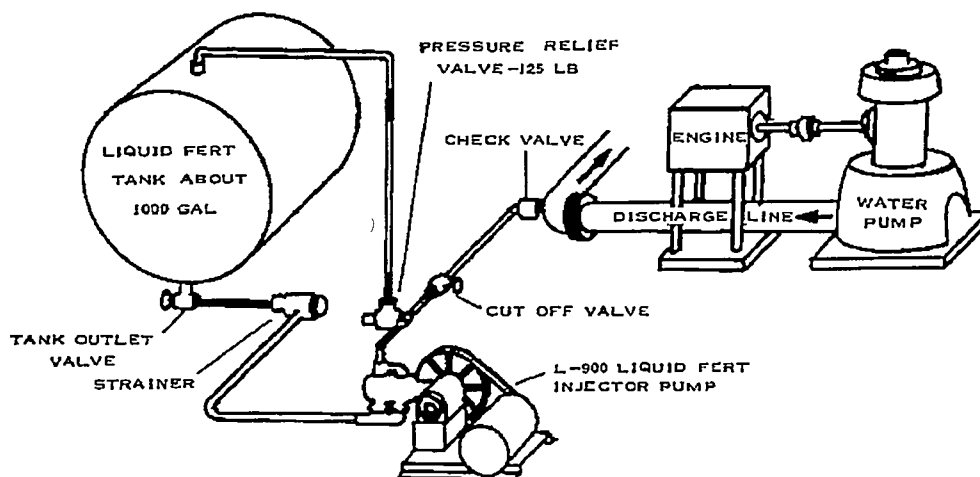
Pak-Mark is a foam system that marks borders on the path of spraying. It can be used as a guide when spraying to prevent overlapping or misses.

Spraying Accessories:

Rears Manufacturing Co.
2140 Prairie Rd.
Eugene, OR 97402
(503) 688-1002

Liquid Injection Equipment

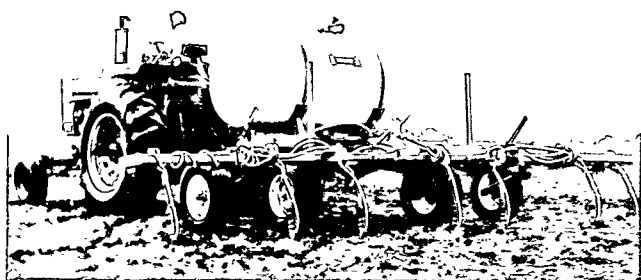
Some nurseries use irrigation injector systems to apply fertilizers, herbicides, and other pesticides to crops. Liquid formulations are commercially available, or water-soluble chemicals can be used to make a concentrated fertilizer solution. Injection systems usually consist of a large tank with a mixing 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			

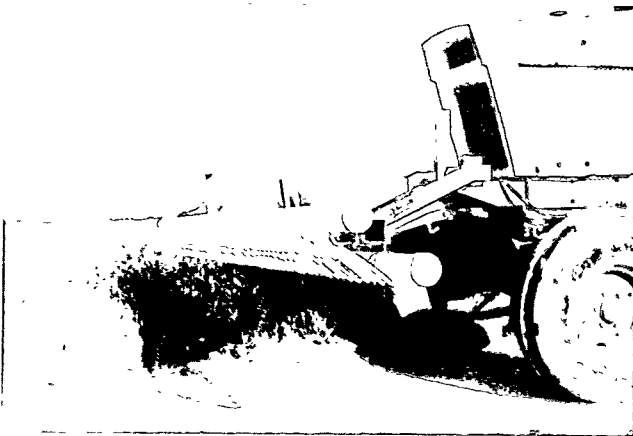
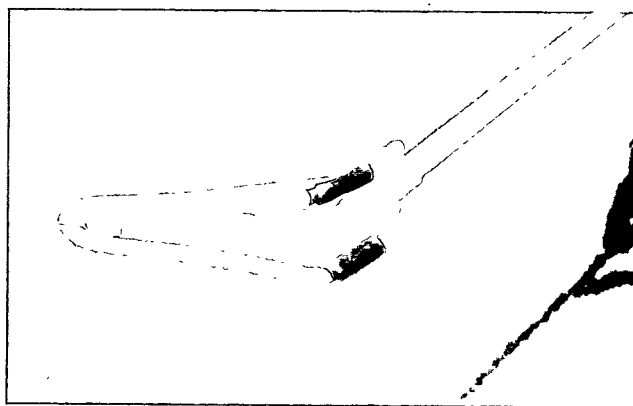
Liquid Fertilizer Injectors

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