CHAPTER 4—SEEDBED PREPARATION

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INTRODUCTION

The success of seed sowing, germination and consequent seedling growth depends to a great degree upon the quality of soil preparation. Nursery areas that have been in seedlings the preceding year require different methods of seedbed preparation than areas that have been in cover crops or lying fallow. The use of fumigants before sowing creates some confounding problems. These are discussed in the following sections.

SOIL PREPARATION FOLLOWING COVER CROPS

A common practice in the South is to leave the land fallow over winter after the cover crop is partly or completely turned under during the fall. The plant stubble or uncovered material provides some degree of protection against water and wind erosion. This protection is important as the winter's green-manure crops are frequently not used before seedbed preparation because of the damping-off potential caused by decaying vegetation. Additional protection of land to be fallowed over the winter may be provided by the use of middle-buster plows set up to leave furrows at 3-foot centers on the contour. This practice may also result in the control of nutsedge because the tubers will not survive repeated freezing.

FERTILIZATION

The nutrient requirements for seedling crops should be based on periodic soil analyses, the soil texture, and the type of preceding cover crops. Fertilizers may be applied either in the fall or early spring. Fall fertilization, particularly with nitrogen, provides nutrients for the microbial decomposition of the cover crops. Fall-applied nutrients may become part of the organic complex, be absorbed as part of the cation exchange system, form chemical complexes with other mineral elements, or be lost through volatilization, erosion or leaching.

Fertilizer treatments usually consist of: (1) 100 to 150 pounds per acre of ammonium nitrate (34 to 50 pounds per acre of actual nitrogen); (2) a low level of a balanced fertilizer such as 500 pounds of 10-10-10 per acre; or (3) a combination of N and P such as 150 to 200 pounds of diammonium phosphate per acre.

CULTIVATION

Fallow land should be cultivated in early autumn for fall sowing of longleaf and white pine, eastern redcedar and occasionally other species; and in late winter or early spring for spring sowing of most other species. Soil should not be plowed if too wet or too dry. If it is too wet, puddling or cloding may occur in the fine-textured soils. If too dry, it is difficult to break up clods or plow to the proper depth. Plowing should be about 10 inches deep to break up or prevent a pan in the rooting zone. In soils which form pans due to clay, iron or compaction, subsoiling to 18 or 24 inches may be necessary.

The optimum plowing depth of 10 inches is affected by the type of plow used and the proximity and type of subsoil. Moldboard plows can expose acid subsoil material and create undersirable texture of the seedbed surface soil. After plowing, the soil should be harrowed or double-disked to cut up and disperse the bulky cover crop residues. Harrowing may precede the plowing if cover crop residues are too bulky for plowing. Light harrowing to a depth of about 2 inches during winter will help eliminate winter weeds, but may result in wind or water erosion.

Leveling with a land leveler or drag-plane before seedbed preparation is essential to eliminate small depressions, provide a relatively uniform surface, and permit the soil to settle before the preparation of the seedbeds. This combination of harrowing, plowing, harrowing and leveling should provide a well-aerated soil of good tilth and, if not sandy, with a crumb, granular or weak sub-angular or block structure in the lower surface.

SOIL PREPARATION WHEN SEEDLINGS FOLLOW SEEDLINGS

The time interval between completion of lifting in the spring and seedbed preparation is usually only 4 to 8 weeks. Several operations must be completed during this period: grading or leveling (to eliminate high areas and depressions created by lifting of seedlings or by soil erosion), fertilization, plowing and harrowing, chemical treatments, and seedbed preparation. Fertilizer treatments must be based on analyses of soil samples collected in late fall or early winter. Since adverse weather can be expected about one-half of the time between lifting and spring sowing, careful scheduling is essential to complete soil preparation without damage to the soil structure.

FUMIGATION OR OTHER CHEMICAL TREATMENTS BEFORE SEEDBED PREPARATION

Do not assume that seedlings grown on recently cleared land are not attacked by parasitic organisms. Some of the first occurrences of black-root-rot in southern nurseries point resists the penetration of the fumigant. There can be more of a buildup of the fumigant at or below the injection line for liquid fumigants than for gas fumigants. As the surface of the soil is approached from the point of injection, the concentration of the fumigant decreases. An excellent job of controlling the pathogenic organisms in the 2- to 12-inch range is possible with the proper fumigant.

Organisms near the surface are controlled only if a lethal concentration of the soil fumigant is maintained in the top 1 inch of the soil. A polyethylene tarp or comparable material must be used to maintain a gas-tight cover for methyl bromide formulations. A tarp is also desirable for some liquid fumigants. Two-mil tarps are more effective than 1 mil, permitting lower treatment dosages.

With strip fumigation, it may be possible to use the same tarp twice, provided any breaks or openings are sealed before reuse. Solid tarp fumigation procedures have several advantages over the older strip methods. These include a lower probability of contamination of fumigated soil and completion of fumigation in one operation. Tarp removal by hand is a tedious and laborious operation. The wringer from an old clothes washing machine can be mounted on trucks or tractors and used to roll the tarp into the truck or into a trailer. A special tarp roller developed by the Forest Service can be made in a machine shop. Specifications are available from the W. W. Ashe Nursery, Brooklyn, Miss. or from USDA Forest Service, Southern Region, Cooperative Forestry Staff Unit, Atlanta, GA. Disposal of polyethylene tarps is a problem. They should be buried in an approved sanitary land fill.

For most injected liquids, a seal is made with a drag or a cultipacker. The soil on top can be compacted to serve as a moisture seal. Where only nematodes are of concern, this seal is usually effective. If weeds or diseases are the problem, a water-seal or preferably a gas-tight cover must be used (Howe 1965). When a soil-surface water seal is specified, irrigate or water the site frequently within 6 to 12 hours on coarse-textured soils, and water fine-textured soils every 2 to 6 hours to keep the surface moist enought to seal in the vapors formed when the chemicals contact the moist soil.

The fumigation period continues as long as the fumigants remains in the soil. At temperatures of 60 °F or above, the soil should be moist and undisturbed for a minimum of 7 days. Colder soils require a longer fumigation period, i.e., at least 2 to 3 weeks depending upon the temperature. In fall or winter applications, the fumigation period should extend until spring. The soil should be undisturbed during this period.

At the end of the fumigation period, aerate the soil by cultivation, e.g. harrowing or disking. Repeated cultivation will help release the fumigant and is especially desirable if heavy rains occur during the fumigation period. Continue aeration until the fumigant has completely escaped from the soil. This is accomplished by allowing 1 week between the first cultivation and planting, for each 10 gallons of fumigant per acre.

RELATIONSHIPS BETWEEN FUMIGANTS AND SOIL CONDITIONS

The effectiveness of the fumigation is influenced by soil temperature, moisture content, texture, structure and organic matter content. Methyl bromide mixtures are influenced more by soil temperature and moisture content than are other fumigants. Soil temperatures at the 6-inch depth must be between 50° and 85°F. Within this range, the chemical becomes more effective as the temperature increases.

The moisture content of mineral soil must be 5 to 30 percent. Above this moisture level, the fumigant may not penetrate the soil adequately. When the soil moisture is below this level, weed seeds and disease-causing organisms are more resistant to the fumigant and the gas may move through and out of the soil too rapidly for most effective control. If the soil can be squeezed into a coherent ball, it is too wet; if it runs freely through the fingers or if dusty, it is too dry. Ideal soil moisture is present when the soil crumbles when worked with the hands.

The soil air space, which is a function of texture and structure, influences the effectiveness of the fumigants. Sandy soils have a preponderance of macropores while fine-textured (clayey) soils have a preponderance of micropore space. Clayey soils also have a greater total pore space. When a volatile fumigant is placed at a point in the soil, its movement is almost entirely through the soil air space. The molecules of the fumigant move from zones of high concentration to zones of low concentrations and they will continue to move through the soil until they react with the soil components or escape from the surface. They may be partly dissolved in the soil water or may react with components of the solid phase of the soil. The effectiveness of a volatile gaseous soil fumigant such as methyl bromide is primarily in the soil water space surrounding the soil particles where many fungus propagules, weed seeds, and practically all nematodes occur.

Soil texture influences moisture content. At field capacity, soil moisture content for medium sands, fine sandy loams and silt loans will be about 7, 15 and 20 percent respectively. Therefore, the total number of fumigant molecules in the water phase increases as the texture changes from sandy to loamy to clayey.

Sandy soils have a single-grained to light granular structure as compared to a blocky or cloddy structure for the more compact, finer textured soils. Fumigants will usually not move through hard compacted clods of soil. Therefore, fumigation is more effective if the soil is thoroughly pulverized before treatment. Otherwise, when the clods break down, they will release weed seeds, nematodes, and the fungi. Because these undesirable organisms would be growing in a relatively sterile soil, they would develop more rapidly then normal. This situation is one of the chief causes of failure of fumigants to function properly in fine-textured soils. However, pulverization of the soil harms desirable soil structure, soil productivity and seedling growth. Pulverized soils tend to lose their structure, erode rapidly and become compact after heavy rains.

ORGANIC MATTER

Large amounts of raw or undecomposed organic matter may trap a high percent of the fumigant molecules and reduce their activity. Parasitic micro-organisms may be protected inside undecomposed plant components. The soil should be plowed long enough before fumigation to allow the organic material to be well decomposed at the time of treatment. Green-manure crops break down soil fumigants more readily than decomposed organic matter.

The effects of organic matter on fumigation are different under dry versus moist or saturated conditions. Organic matter will adsorb and break down soil fumigants, and the reaction is irreversible. Under both dry and saturated conditions, organic matter will adsorb higher amounts of the fumigant leaving very little to be dissolved into the soil water space for effective control of nematodes, parasitic fungi and weed seeds. Under moist conditions, organic matter does not adsorb the chemical as readily or to the extent that it does under the other two conditions. In fine-textured soils that are high in organic matter, higher dosages of fumigants are usually needed.

Fumigation in nurseries is complicated by a higher level of organic matter than is found in most agricultural soils. Fumigation must be done in the fall before much of the organic material has started to break down, or in the spring before the soil temperature has reached an optimum level and while the soil moisture may be too high.

The nursery manager should not be locked into the use of only one fumigant, as the effectiveness of the various fumigants differs for various conditions. For example, Telon C-17 and Vorlex can be used in colder soils than methyl bromide formulations, but 3 to 4 weeks or longer must elapse before seeding. Therefore, the manufacturers recommend that liquid soil fumigants be applied in the fall. The reason for this is that the soil temperature is usually higher; there is not the problem of high soil moisture that frequently occurs in the spring; and there is plenty of time (all winter) for the material to be effective and yet be dissipated by spring (Howe 1965). Likewise, nursery managers should not be "locked in" to spring fumigation.

CONDITIONS FOR SUCCESSFUL CHEMICAL TREATMENTS

Failures of fumigation have been as spectacular as successes, although not as frequent. More often, fumigation is only partly successful. Successful treatments depend highly on the following related factors although all of the conditions may not guarantee success or, more often, may not exist when fumigation is done. Effective soil fumigation is controlled mainly by the combined effects of physical (soil), biological (target pests) and chemical (fumigant) factors interacting at the time of fumigation.

1. Select a fumigant for a specific target organism(s), i.e., weed control or nematode or fungi control, or a combination of these.
2. Select the best season or time of year to fumigate (table 4-3).
3. Select the most effective, efficient, and safe method of application. Use good, safe application equipment and proper safety equipment for the job.
4. Determine proper dosage rates for the target organism(s) and soil conditions. Labels are written based on experimental results over a wide range of soil and environmental conditions. Adjust the dosage rate to control the specific target pest(s) and soil conditions within the maximum rates listed on the label.
5. Fumigation is most effective on sandy and light loamy soils. More care must be taken in the fumigation of fine textured soils.
6. The soil temperature at the 6-inch depth must be above 50 °F; and preferably above 70 °F for effective fumigation.
7. Soil moisture must be adequate; neither too dry nor too wet (5 to 30 percent moisture content).
8. Apply the fumigant to the required soil depth needed to obtain desired results.
9. Use an effective surface seal (i.e. polythylene tarp with methyl bromide) to contain the fumigant in the soil.
10. Use an adequate period of fumigation.
11. Aerate the soil to eliminate all of the fumigant before seeding. Additional aeration is necessary when ectomycorrhizae are inoculated.
12. Do not contaminate fumigated soil by mixing it with nonfumigated material. This is particularly important when using the strip method of fumigation.
13. In the long range planning of soil management procedures, exclude sawdust applications from the rotation year in which fall fumigation is scheduled. Doing so will result in greater efficiency of the fumigant and therefore reduce the need to apply it as frequently.

SEEDBED PREPARATION

Seedbed preparation is the last activity before ectomycorrhizal inoculation or sowing. The following work will have been done earlier: plowing and disking of cover crops and fallow areas, leveling the soil, fertilization, liming, and chemical treatments, including fumigation and were at the Ashe and Hauss nurseries which were established on virgin forest soils. Many nurseries are on very fertile agricultural lands that were at one time limited to production of only one or two crops. Biotic populations under either forest conditions or intensive farming practices may or may not be detrimental to pine seedlings.

In many instances the invasion of a nursery by pests is a sign of exhausted soil fertility, unwise use of fertilizers, excessive watering, poor drainage, poor soil tilth, or the use of field peas or other cover crops susceptible to pathogenic invasion. These problems may result in epidemic populations of introduced organisms. In established nurseries, problems due to biological causes can be diagnosed by observation and close examination of the seedlings. In new nurseries, soil samples should be checked for nematodes and the more common pathogens. Two approaches to the use of fumigants, biocides or eradicants are: (1) treat all soil before each seedling crop, or (2) treat soil only when there is evidence of potential problems.

FUMIGANTS

A soil fumigant is a chemical that is applied to the soil to reduce or eliminate one or several forms of plant or animal life. The chemical must be volatile and of low solubility in water. The vapor or gas must move through the soil and be independent of the water phase (Foster 1959). Soil fumigation is one of the oldest ways to control soil pests. In the late 1880's, carbon bisulfide was used in Europe on hundreds of thousands of acres. Wakeley (1954) recommended the use of carbon bisulfide to control larvae of the prionid and may beetles (june bugs) and the harvester or mound building ants. The use of chloropicrin revived interest in fumigation after World War I and during the 1930's and 1950's other fumigants were developed. See Chapter 18, section on "Pesticide Safety" before using pesticides.

Names and formulations of pesticides change frequently. Check the current edition of the *Farm Chemicals Handbook* (Berg 1984) for trade, common and chemical names. Not all fumigants are effective against all soil organisms as each fumigant has a place, but none does it all. Fumigants used in nurseries may be grouped according to types of organism controlled (tables 4-1 and 4-2).

Formulations of methyl bromide have consistently been the most effective fumigants. Dowfume MC-2 (methyl bromide + 2 percent chloropicrin) at rates of 320 to 435 pounds per acre generally provides the best weed control of any fumigant. Unfortunately, no fumigant will kill weed and grass seeds with thick or impervious seedcoats. Occasionally the fumigant appears to act like a seedcoat-eroding chemical, providing some degree of scarification. The seeds germinate readily and profusely after fumigation; for example, morning glory and coffeeweed.

Dowfume MC-2 provides better control of nutsedge within the zone of fumigation than other fumigants. This fumigant almost completely eliminates most fungi and nematodes but the sterilized soil provides an ideal environment for reinvasion by pathogenic soil pests, weeds and grasses. Populations of plant pathogens may build up faster than antagonistic soil microorganisms, resulting in some root rot within a few months after fumigation.

The residual effect after removing the tarp is practically nil. In addition, several soil pathogenic fungi have very tough spore stages (sclerotia, clamydospores, etc.) that are resistant to many soil fumigants. These fungi require stronger fumigants (e.g., Dowfume MC-33) and higher dosage rates for effective control. Reinvasion of

Table 4-1. — Fumigants for control of weeds, root rots and nematodes.

Must use under a tarp 1/	Use a tarp for effective weed control 1/
METHYL BROMIDE	
Dowfume MC-2: (98% methyl bromide and 2% chloropicrin)	Vorlex:
Dowfume MC-33: (67% methyl bromide; 33% chloropicrin)	Bunema:
	Metam-sodium: e.g. Vapam
	Dazomet: e.g. Mylone

1/ Polyethylene, Visqueen or other plastic cover: 2-mil thickness is most effective.

Table 4-2. — Fumigants for control of root rots and nematodes.

Root rots plus nematodes	Nematodes only
Telone C-17 (Nemex): (83% Dichloropropene; and 17% Chloropicrin)	D-D (Nemafene):
Soilbrom-85 (Ethylene dibromide 85): -1,2-Dibromoethane.	Diazinon
Vorlex, Bunema, Metam-sodium and dazomet when not under a tarp.	

soil pathogens may be alleviated by light application of fungicides (e.g., Captan) following fumigation. Use a preemergence herbicide before or after sowing for additional protection against weeds.

Dowfume MC-33 at rates of 320 to 350 pounds per acre provides good control of soil pathogens with tough, resistant-spore stages, slower reinvasion of pathogenic fungi, and fair to good weed control. Use either Dowfume MC-2 or Dowfume MC-33 when the ectomycorrhizal-forming fungus, *Pisolithus tinctorius*, is to be used to inoculate the seed beds. Extra precautions are needed for soil aeration before ectomycorrhizal inoculations—particularly when using Dowfume MC-33. A minimum 3-week soil aeration period is required with Dowfume MC-33. This aeration period often requires fall fumigation. Suggested guidelines and precautions for effective fumigation with methyl bromide are given in chapter 13, appendix 13-1.

Vorlex (40± gallons per acre), metam-sodium (100 to 150 gallons per acre), dazomet (300 to 500 pounds per acre) and Bunema (40 gallons per acre) have been effective fumigants in some nurseries but not in others. The effectiveness varies from year to year. These fumigants are most effective as a herbicide when injected into the soil with chisels and covered with a tarp. They may be effective as a fungicide or nematocide when covered with a drag, cultipacker or water seal. Apply metam-sodium, dazomet, and Bunema as a surface water drench. Then harrow and use a water seal. *Metam-sodium soil fumigant where applied to the soil surface may cause severe irritation to the operator of the incorporation equipment despite protective clothing.*

The fumigation period (when fumigant is chemically active) of 7 or more days should be followed by continuous aeration until the fumigant has completely escaped from the soil. Follow label instructions, e.g., if Vorlex is used, allow 1 week between cultivation (end of fumigation period) and planting for each 10 gallons per acre of Vorlex used.

Several nematocides, classified as fumigants, do not require a tarp covering (table 4-2). Each of these materials also has varying degrees of fungicidal properties and has effectively controlled root rots when nematodes were the primary causative agent.

OTHER SOIL-INCORPORATED PESTICIDES

Nematodes, *Pythium* spp. and some other light populations of fungi may be controlled with nematocides or fungicides that are not fumigants. Some contact nematcides are easier to apply and may be much less expensive than fumigants. Soil temperature and moisture are not as critical and some have no waiting period between application and sowing. A combination of ethoprop (Mocap) and fenaminosulf (Lesan) has given fair to good control of nematodes and *Pythium* spp. in some nurseries. Although these chemicals have some advantages, they are usually less effective than the broad spectrum fumigants such as methyl bromide.

APPLICATION OF THE CHEMICALS INTO THE SOIL

Chemicals may be incorporated into the soil by: (1) injection with chisels, and (2) surface application followed by harrowing and/or soil drench. Fumigants are injected through polyethylene tubing attached to chisels, shanks or cultivator teeth. Specialized equipment will inject the fumigants into the soil, lay a plastic film or tarp over the treated area and seal the edges in one operation. Other types of applicators are available for fumigants that do not require a tarp.

Injection depth has an effect on diffusion of soil fumigants. If the fumigant is injected 6 to 9 inches deep, more pathogens may be below the injection point than above it. Also, the heavy mass of soil below the injection

Table 4-3. — Comparison of fall and spring fumigation.

Fall	Spring
1. Long season i.e. ± 60 days.	1. Short season, i.e. ± 30 days.
2. Soil moisture likely to be favorable.	2. Soil moisture likely to be unfavorable.
3. Soil temperature likely to be favorable.	3. Soil temperature likely to be unfavorable.
4. Organic matter mostly undecomposed.	4. Organic matter partially decomposed.
5. More favorable for liquid fumigants that require a waiting period.	5. Not good for liquid fumigants that require waiting period.
6. Satisfactory for gas fumigant.	6. Satisfactory for gas fumigants.
7. Long period of time for reinvasion of weed seeds and soil micro-organisms.	7. Short period for reinvasion of weed seeds and soil micro-organisms.
8. Better fit with work load.	8. Very tight schedule between lifting and sowing.
	9. Only time available when seedlings follow seedlings.

aeration following fumigation. A simple bioassay may be used to test for fumigant activity in the soil; see Appendix 6-2. Usually no chemicals or fertilizers are applied between the time of seedbed preparation and sowing. Exceptions are some pre-emergence herbicide treatments such as oxyfluorfen or bifenox, which are applied on the surface of the seedbed and then incorporated into the upper 1 to 2 inches of the soil.

A few days before bed preparation, the soil should be harrowed to cut up any remaining coarse organic matter, crust or clods. Portable lateral irrigation lines should be installed after the last disking. Nearly all beds are made using regular farm machinery or special bed-making equipment. Handwork is limited to an occasional smoothing of the ends of the beds. The basic equipment consists of light- to medium-weight tractors equipped with two, small middle busters or sweeps mounted on a front end, center or rear mounted tool bar and a bed shaper. The sweeps are frequently omitted in light-textured soils. Three commercial types of bed shapers are the Whitfield bed builder, Larchmont bed former and Rototiller bed formers (figure 4-1).

The bed should be prepared when the soil is neither too dry nor too wet. If the soil is too wet, puddling, clodding or a surface crust may develop with subsequent poor germination and seedling development. If heavy soil is too dry, it will be hard to plow to the proper depth. The surface will be too loose when sandy soils are too dry.

The ideal condition is to harrow the seedbed surface no deeper than 2 inches and to leave a coarse structure in the lower layer, i.e., 2 to 20 inches for uninterrupted aeration is essential for good growth. Sandy soils with about 1 percent organic matter will have, generally, a weak granular structure. Loamy or clayey soils may have

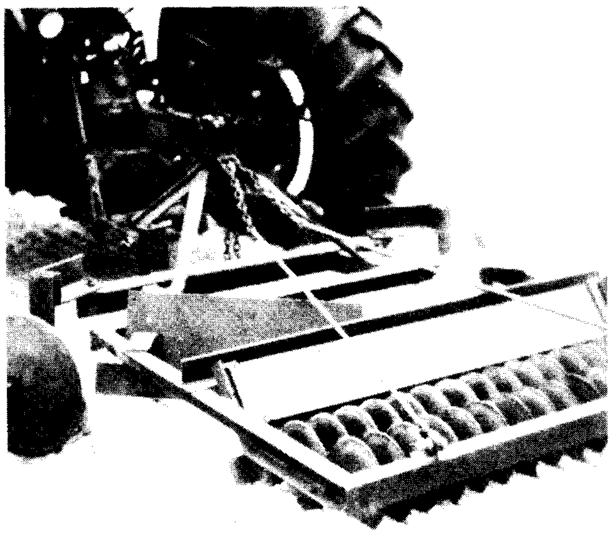

Figure 4-1. — Nursery bed builder preparing 4-foot beds.

a granular to sub-angular block structure. A granular or blocky structure is essential with those soils for good aeration, water infiltration, and root growth.

Pulverizing the soil with a rototiller destroys the granular or blocky structure. The soil is loose for only a limited time after rototilling, i.e., until rain and irrigation move fines downward, compact and clog the soil, and stop or reduce aeration. After pulverization, both loamy and clay soils develop a massive structure which is harmful to root development, and also favors the spread of pathogenic fungi. Fertilizers and chemicals can be mixed with the soil by double disking without destroying the granular or blocky structure.

Seedbeds are generally elevated 3 to 6 inches above the paths or alleys, depending on the texture of the surface and subsoil. Heavy soils with poor subsurface drainage and very level sites with poor surface drainage require beds above the paths. On soils that erode easily, and on very sandy or droughty soils, the beds should be kept low. The objective is to prevent any water from standing in depressions in the seedbeds or alleys. Both rainwater and irrigation water that does not infiltrate readily should flow off the seedbed area without eroding the bed shoulders or the paths.

In the Lake States, seedbed boards were sometimes used to prevent erosion of the edges on one or both sides of the bed. In southern nurseries, the universal practice is to add a 4-inch unsown shoulder on each side of the bed, i.e., beds are built 56 inches wide rather than 48 inches (see chapter 3). These shoulders offer no obstruction to mechanical seeders. As the season advances, the shoulders gradually erode or are pushed down by equipment. Special alley plows are used to maintain or rebuild the bed shoulders (figure 4-2).

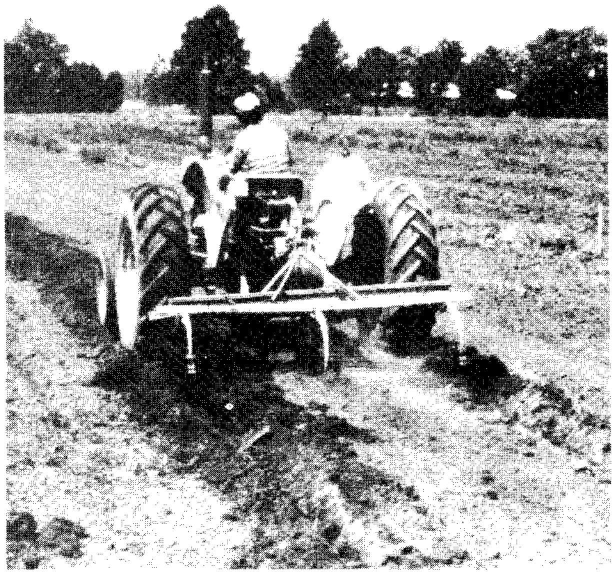

Figure 4-2. — Alley plow.

Seedbeds can be prepared in a single operation by attaching the alley sweeps to a front end or center-mounted tool bar and a bed shaper to the 3-point hitch. Some nursery workers omit the alley sweeps. Tractors and equipment are desiged to form seedbeds with 72 inches from alley centers and a flat, 56-inch seedbed between alleys. Frequently, the operation is in two stages: (1) plowing of alleys or paths to get the six or nine beds correctly spaced between lateral irrigation lines; and (2) shaping of beds between the alleys. In addition to commercially-available bed shapers, shop-made bed-formers or drags have been used to level and shape bed surfaces. The drags consist of three overlapping pieces of 3 × 12 × 60 inch rough lumber. The bed surface should be flat across the bed, but occasionally some nurseries have used somewhat rounded seedbeds on imperfectly drained sites. This condition can be created by the use of slightly concave rollers. Bed rollers, consisting of metal or wooden drums, are sometimes used to roll seedbeds before or after sowing, or both.

With optimum tilth and soil moisture, the seedbed shapers or formers leave the surface in good condition for sowing. Seedbeds prepared several days before sowing and exposed to rain and sun may become crusted. Treat crusted surfaces by dragging or light disking immediately before sowing. The need for this step will depend on soil texture. Soils with a high clay or silt content will crust sooner and may need disking again, but a very sandy soil may not need additional treatment.

SUMMARY

The success of seed sowing, germination and consequent seedling growth depends to a very great extent upon the quality of soil preparation, chemical treatment of the soil and the physical condition of the seedbed. Major points to consider are:

1. Areas where seedlings follow cover crops will require different methods of initial soil preparation than are used in areas where seedlings follow seedlings.
2. Base fertilizer treatments on previous soil analyses and land use.
3. Fertilizers and granular chemicals can be mixed well with the soil by careful disking.
4. Follow the suggestions in this chapter and in chapter 13 for application of fumigants.
5. Install portable irrigation lines (if used) before seedbed preparation.
6. Seedbeds should have a smooth and compact surface for germination of seed. The subsurface soil should be sandy or have a granular to blocky (clod) structure which is essential for good aeration and root development.
7. Too much cultivation or pulverizing of the soil will tend to destroy the soil tilth and also favor the spread of pathogenic fungi.

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