WEED PREVENTION IN FOREST NURSERIES

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The nurseryman's primary objective is to produce first-class planting stock as economically as possible. At many nurseries, however, weeds are a major obstacle in obtaining this goal. Weeds compete with seedlings for light, water, and nutrients and reduce seedbed densities. Weed competition also causes seedling top and root stunting in various degrees and results in large variations in seedling size at lifting. Minimizing weed competition would reduce or possibly eliminate time and costs involved in seedling grading. Uniform seedling size aids in ease of field planting and increases survival. In heavy weed infestations, handweeders pull up considerable numbers of seedlings with the weeds, resulting in lower densities. Hence, weedy nurseries not only have the added expense of hand labor but also produce seedlings of lower quality and require more acres to reach production goals.

In order to maintain a relatively weed-free nursery, a nurseryman must follow a comprehensive year-round weed control program. Successful weed control programs are based upon prevention. Prevention is best accomplished by (a) making sure that new weed seeds do not enter the nursery in contaminated mulches, with cover crop seeds, or on machinery; (b) preventing weeds in the nursery from going to seed; and (c) preventing the spread of vegetatively reproduced perennial weeds.

PREVENTING THE INTRODUCTION OF WEEDS

In 1975, several nurseries used methyl bromide to sterilize soil on more than 70% of their production area. Because introduction of new weed seeds was not prevented, these same nurseries spent more than $900 per acre for handweeding.

Mulches

A main source of introduced weeds is straw mulches. Bland (1973), evaluating the cost of mulching materials in loblolly pine (*Pinus* taeda L.) seedbeds, compared pine straw with several other natural and synthetic mulches. Pine straw mulch on the average increased weeding times by 105 man hours per acre. At $2.40 per hour for hand labor, this amounts to an extra cost of $252 per acre.

In hardwood seedbeds, the additional weeding cost is even greater since chemical weed control has limited use. In one study on sycamore (*Platanus occidentalis* L.) and sweetgum (*Liquidambar styraciflua* L.) seedbeds, unmulched plots were compared with plots mulched with pine straw (South, 1975). The pine straw mulched areas required 200 more man hours of handweeding per acre (an additional expense of $480 per acre). The advantage of soil sterilization with methyl bromide (costing $S00 per acre) was lost when the weed-contaminated mulch was used.

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A few authors have recommended fumigating mulch to eliminate weed seed and pathogens (Carter and Martin, 1967; Geron, 1974), but reports on actual. results are nonexistent.

In 1976, experiments involving fumigated and unfumigated pine straw mulch on both fumigated and unfumigated nursery soil were carried out at two Alabama nurseries. Methyl bromide was applied to plastic covered mulch piles at the rate of one pound per 20 cubic feet. After 48 hours, the plastic was removed and the mulch piles were allowed to air. Half of the 50 x 6 foot plots were fumigated at the rate of one pound of methyl bromide per 100 square feet.

At the Miller nursery, fumigating the mulch reduced the weeding time by 58% (Table 1). Fumigating the soil resulted in only a 28% reduction in weeding time. It therefore appears that at this location the majority of the weed seeds were not soil borne but were introduced in the pine straw mulch. At the Hauss nursery, fumigating the mulch was equally as effective in controlling weeds as fumigating the soil. Although providing the same amount of weed control, soil fumigation costs approximately $450 more than mulch fumigation. The cheapest method of controlling weeds at both nurseries involved the use of herbicides, but several weed species not controlled by herbicides would be controlled by fumigating the mulch with methyl bromide.

These experiments showed the introduction of weeds by pine straw mulch to be a significant factor. To prevent increased weeding, fumigation of weed infested mulches or substitution of sterile mulches should be considered. Fumigation of straw mulches is especially important when growing hardwoods since herbicide use is limited. Nurserymen who use wood chips, bark, or sawdust mulches which are comparatively free of weed seeds should stock pile the material in a weed free area.

Table 1. Handweeding times and total costs for mulch treatments at Hauss and Miller Nurseries in Alabama for 1976.

Treatment	Hauss Nursery		Miller Nursery	
	Handweeding Times (hours/acre)	Total Cost[1/] (dollars/acre)	Handweeding Times (hours/acre)	Total Cost[1/] (dollars/acre)
No Herbicide Used				
Unfumigated Soil				
Unfumigated Mulch	53.0	127	80.4	193
Fumigated Mulch	38.7	143	33.7	131
Fumigated Soil				
Unfumigated Mulch	40.4	597	57.5	638
Fumigated Mulch	30.8	624	28.3	618
Herbicide Used				
Unfumigated Soil				
Unfumigated Mulch	34.6	117	3.8	43

1/ Costs: Hand Labor--$2.40 per hour; Soil Fumigation--$500 per acre; Mulch Fumigation--$50 per acre; Herbicides--$34 per acre.

Irrigation Water

Irrigation water can also be a major source of introduced weeds especially when irrigating from a lake, pond, or river. Screens can be used at the intake pipe to reduce the up-take of large seeded weeds. Although this may require frequent cleaning, it is easier to remove the weed seed from screens than to remove weeds from seedbeds. Nurserymen who irrigate from ponds should keep the pond edges free of weeds. When installing a new nursery, a deep well should be preferred over surface water sources.

Cover Crop Seed

When growing cover crops, care should be taken to prevent sowing weed seed along with crop seed. Such infestations can be prevented by always using certified seed. At one nursery, the use of cheaper uncertified seed resulted in a large infestation of morningglory. Regulations require certified seed to be free of primary noxious weeds and to contain only small amounts of common weeds. The percentage of common weeds must be shown on the certification tag. Seed with the lowest percentage of common weeds should be preferred. Savings cannot result from the use of less expensive uncertified seed.

Machinery

Weed seed, rhizomes and tubers are easily introduced by machinery. Frequent washings reduce the amount of weed seed introduced by soil carried on tillage equipment, tractors, and tractor tires. Weed seeds are often spread by combines used for harvesting cover crops. For this reason, it is better to leave cover crops unharvested unless combines are carefully cleaned before use.

Wind

Wind will constantly introduce weed seeds, but the amount can be reduced by planting windbreaks between the nursery and adjacent sources of weeds, such as farmlands. Windbreaks will also help to protect the nursery from high winds that blow mulch off beds, blow plastic off fumigated soil, and cause excessive drying of the beds.

PREVENTING WEEDS FROM GOING TO SEED

Preventing weeds from going to seed in the nursery is an important management practice. Weed populations of future years greatly depend upon the number of seed produced during the current season. If one yellow nutsedge (Cyperus esculentus L.) plant is allowed to mature, it can produce more than 2,420 seed. A mature purslane plant (Portulaca oleracea L.) can produce over 52,000 seed, a single redroot pigweed (Amaranthus retroflerus L.) 117,000 seed or more (Stevens, 1932). The importance of preventing a single weed from maturing and producing seed in the nursery cannot be overemphasized.

Riserline

At many nurseries, the beds with the heaviest weed populations are adjacent to the riserlines, often a result of the inability to fumigate next to

the risers. Weed growth on these areas is often left unchecked until operation of the irrigation lines is impaired or else the area becomes unsightly.

Weed-free riser lines are characteristic of a well managed nursery. Appropriate preemergent herbicides should be used soon after the seedbeds are formed. Later in the season, when weeds appear in the two and three leaf stage, they should be sprayed with an appropriate postemergent herbicide. Shields can be fashioned on spray rigs to prevent drift that could injure young pine seedlings. Herbicides with soil persistence of more than one year should be avoided since cultivation often moves soil from riserlines into seedbeds.

Fencerows

Mature, seed producing weeds can often be found around fencerows, ditch banks, and buildings. These areas are best kept weed-free by regular cultivation or by using appropriate non-selective herbicides. If this is impractical because of excessive erosion, a thick perennial vegetative cover could be established. Managed properly, this cover would exclude other weeds while not producing unwanted seeds or vegetative parts (Aldhous, 1972).

Seedbeds

In the Southeast, handweeding and chemical weed control are presently the major methods used to prevent weeds from going to seed in nurserybeds. Fumigants (methyl bromide, Vorlex, Vapam) are often used prior to sowing for control of both disease and weed germination. EPTC (Eptam) can also be used two weeks prior to sowing for control of weeds in pine seedbeds, but stunted pine seedlings may occur (Merkle, 1974). In ᵍediately after sowing and mulching, diphenamid (Enide 50W) can be used on both loblolly and slash pine seedbeds for control of most grasses. After seedling establishment, trifluralin (Treflan) and diphenamid (Dymid 80W) can be used on loblolly and white pine (Crowley, 1974). Through the efforts of the Forest Nursery Weed Control Cooperative, three other preemergent herbicides for pine seedbeds are at various stages of the registration process. Registration of effective and safe postemergent herbicides will require several more years of research by the Cooperative.

Even after pre- and postemergent herbicides are registered, frequent handweedings should continue to ensure that no weeds escape and produce seed. The frequency of handweeding is most important. It is strongly recommended that weedings be carried out at three to four week intervals. Handweeding only once every six to eight weeks involves 30 to 100 percent more work for the season because of the increased number of weeds and their greater size (Aldhous, 1961).

Cover Crops

Weed control in cover cropped areas should not be neglected. The amount of weed seed present in seedbeds will be related to the number of mature weeds in the previous cover crop. Several herbicides that can be used in cover crops have no effect upon the following year's seedling germination. Spacing of cover crop seed can also influence weed growth. Broadcasting seed such as soybeans will often be more effective in reducing weed growth than row cropping at wide spacing. Handweeding should be used in cover crops as

well as seedbeds. Weeds should be removed before they produce seed.

PREVENTING THE SPREAD OF NUTSEDGE

Nutsedge is the most troublesome vegetatively reproduced weed in southeastern forest nurseries. Yellow nutsedge and purple nutsedge (Cyperus rotundus L.) occur as problem weeds in more than half of the nurseries. Successful control of these weeds depends upon prompt treatment, since a severe infestation can quickly result from failure to control even a single plant. One tuber of purple nutgrass, planted in a loam soil in spring, had produced 1168 plants and 2324 tubers after six months (Ishii, Yamai and Manabe, 1971).

Dissemination by Cultivation

Nutsedge spreads slowly by vegetative means alone. It would spread less than 10 ft/year without help of nurserymen and their cultivation equipment (Klingman and Ashton, 1975). For this reason, special effort should be made to treat separately each area infested with nutsedge. Mapping infested areas in summer helps to identify the areas in which to avoid soil movement (thus spreading nuts) in winter after lifting. Nutsedge-free areas should be cultivated first to avoid the introduction of tubers. Time taken to prevent mechanical dissemination of nutsedge tubers will be repaid several-fold in the ease of eliminating nutsedge froma nursery.

Chemical Control

In the past, methyl bromide and EPTC have been used by the nurseryman in attempting to control nutsedge. Although methyl bromide is often effective in reducing large populations, the cost is high and some tubers always seem to escape treatment. EPTC seems only to delay the emergence of nutsedge and can result in slightly stunted pine seedlings.

Experiments with chemicals such as perfluidone (Destun), sodium azide, and cyperquat have shown promise for controlling nutsedge in pine seedbeds, but these chemicals are not yet registered for this use. Glyphosate (Roundup) has been shown to control nutsedge better than perfluidone, sodium azide, or cyperquat (Barr and Merkle, 1976). This postemergent herbicide can be used on non-croplands. With proper use, the active ingredient will translocate downward and kill the nutsedge tubers.

The best way I know to eradicate nutsedge in a nursery is by allowing infested areas to lie fallow in the spring; when actively growing nutsedge has reached the 4-6 leaf stage, apply glyphosate at 2 quarts per acre (2 lb ai/A) on a warm-cloudless morning when rain is not expected for at least 12 hours. Initial activity is fairly slow after application and may not be observed for several days. Cultivate the area two weeks after treatment to bring any late germinating, deep rooted tubers to the surface. Allow these tubers to sprout and encourage their growth by irrigation during dry periods. Make a second application of glyphosate in the same manner as the first.

Occasional plants of nutsedge can be treated with a back-pack sprayer (when using glyphosate, do not use galvanized spray equipment). Planting pines or hardwoods after treatment is completely safe since the herbicide is inactivated by contact with the soil.

SUMMARY

Many forest nurserymen in the Southeast fail to follow a comprehensive weed prevention program. More emphasis is placed on the use of fumigation and mineral spirits than on preventing the introduction, reproduction, and spreading of weeds. This is evidenced by the large handweeding requirements of nurseries where prevention is not practiced. In 1975, 80% of the southeastern state nurseries required more than 90 man-hours of handweeding per acre. In general, industry owned nurseries have more comprehensive weed control programs with only 35% of the industry owned nurseries in the Southeast requiring more than 90 hours of handweeding labor per acre in 1975.

It is no easy job for a nurseryman to transform a nursery from 300 man-hours of handweeding per acre per year to less than 90L. The nurseryman must adhere strictly to a comprehensive year-round weed control program that prevents introduction, reproduction, and spreading of weeds. Even with these efforts, several years may be required to deplete the "reservoir" of weed seeds in the soil. The nurseryman who is successful, however, will be able to produce more uniform, high quality seedlings at a lower cost.

PESTICIDE PRECAUTIONARY STATEMENT

All uses of pesticides must be registered by appropriate State and Federal agencies before they can be recommended. Since Federal registrations are constantly changing and some states also have pesticide restrictions, check with the Forest Nursery Weed Control Cooperative at Auburn University or with the Pesticide Specialist for U.S.F.S. State and Private Forestry at Atlanta, Georgia for up-to-date information. Caution: Pesticides can be injurious to human, domestic animals, desirable plants, and fish or other wildlife - if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommenced practices for the disposal of surplus pesticides and pesticide containers.

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