SOIL STERILIZATION PRACTICES IN TURF

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THE control of soil borne pests is becoming one of the most critical problems in turf management. The propagation of turfgrass nurseries, the construction of golf greens and tees, and the establishment of improved lawns are examples of situations where these pests are threatening. Soil sterilization practices hold the answer to such problems in many cases and should be more widely utilized as a turf production tool.

What Is Soil Sterilization?

At one time soil sterilization referred largely to the control of weed pests. Today, this field has been broadened to include eradication or control of any major class of soil borne pests. Included would be weeds, weed seeds, nematodes, insects, and plant diseases as they occur in the seed or plant bed prior to planting. The control of nematodes or broadleaf weeds in established turf would be considered as nematocidal and herbicidal rather than sterilization problems.

Soil sterilants may be classified as selective or non-selective. Selective type materials are effective against only certain kinds of pests. For example, some chemicals will control weed seeds in the soil but not nematodes. Some sterilants are even more specific, being effective against broadleaf weeds, but not grasses. On the other hand, non-selective materials render the soil sterile to all forms of living matter. There is need in turf for both selective and non-selective types of sterilants depending upon the proposed use of the turf and the particular pests involved.

Sterilants may be classified further as temporary or permanent. A temporary sterilant will kill the pests involved in short order. Soon thereafter the material will lose its effectiveness through decomposition, vaporization, leaching, or soil fixation. On the contrary, the effect of the permanent soil sterilant is retained in the topsoil for a long time. This long period of residual sterility renders the soil unfit for use for such an extended period that this class of sterilants is usually impractical where efficient turf propagation or production is involved. As a result this discussion will deal only with the temporary class of sterilants.

Talk before 10th Annual Southeastern Turf *Conference, Tifton,* Georgia, 1956.

Where Is Soil Sterilization Needed?

Obviously sterilization is not needed everytime a new turf is planted. It would not be practical to recommend methyl bromide sterilization of a forty-acre nursery of zoysia or bermudagrass if broadleaf weeds were the principal pests. One of the 2,4-D type herbicides applied after planting would offer by far the simplest and cheapest control. There are many cases, however, where the problems are more complex and where soil sterilants are needed.

In fact, sterilization should be considered in planning for the development, and construction, or renovation of any turf project. If after careful examination no serious pest problems exist, or if anticipated problems can be satisfactorily handled otherwise, sterilization will not be needed. The "ounce of prevention" afforded by sterilization may seem costly. Nevertheless, if this process is omitted and serious pest problems later develop, other corrective measures may prove far more expensive in the long run, and turf quality may never reach its potential.

Weed control is probably the primary need for soil sterilization in turf. Common bermudagrass, nutgrass, dallisgrass, and other Paspalum species, pennywort, water sedge, and dichondra are major noxious weeds in turf. All are more or less difficult to control. Most of these are perennials which spread from both seeds and vigorous growing rhizomes. In addition there are many common, but less serious weed pests which will be controlled incidentally by suitable sterilization measures. Where these and other serious weed pests occur, soil sterilization should be considered an essential part of the propagation program.

Nematodes are now recognized to be serious parasites on turf grasses in the Lower South. The well known "root knot" group of nematodes has been a serious parasite on many kinds of plants for years, but has not been a problem in turf. Recent work in Florida has shown that sting (*belonalaimus gracilis*), stubby-root (*Trichodorus spp.*), lance (*Hoplolaimus coronatus*), dagger (*Xiphenema americanum*) and ring (*Criconemoides spp.*) hematodes are encountered frequently in areas of damaged or reclining turf. All major species of turf grasses appear to be susceptible to damage. Undoubtedly other parasitic species will be found as this new field of turf investigation continues.

In areas where proper diagnosis has established nematodes to be parasitic on turf grasses, it may be futile to attempt turf reestablishment without nematode control. Fortunately a number of good nematocidal type sterilants are available. As nematode damage becomes more extensive, more consideration will need to be given to the use of such materials. While information is relatively limited as to the ecology of these worm-like microbes, it is known that they may be readily disseminated by the movement of topsoil and topdressing materials, sod, and other forms of turf and equipment.

Normally insects are not considered important in the consideration of soil sterilization in turf. In general, most insect pests can be controlled by routine insecticide measures. Nevertheless, certain soil borne insects are becoming of considerable importance in turf propagation. Ground pearls are becoming more prevalent and damaging to centipede and zoysiagrass turf in Florida, Georgia, and Alabama. Since conventional insecticides have not given control of these subterranean scales, soil sterilization is being considered. In cases where St. Augustinegrass is being replanted in areas formerly destroyed by chinch bugs, soil sterilization may be used as a safeguard against reinfestation.

Plant diseases are not known to cause serious concern in turf propagation at the present time. Accordingly, disease control does not compel serious consideration in the selection of soil sterilants although some of the materials effective on other classes of soil borne pests are also good fungicides.

Selecting the Sterilant

Since a number of soil sterilants are available (and the number is increasing steadily) and since these materials vary

greatly in properties and usefulness, the choice of the best sterilant for a given situation may become a problem. A number of factors may enter the matter of selection. Among them would be (1) toxicity, (2) adaptability, (3) cost, (4) residual period, and (5) hazard.

1. *Toxicity*

As mentioned, sterilants vary widely in their chemical and physical properties, mode of action, and degree of selectivity. These and other factors determine the toxicity of a given material. Some chemicals are toxic in their natural forms, (ally1 alcohol, methyl bromide, D.D., etc.) Other materials depend on decomposition products for sterilization properties (vapam). With still other materials the decomposition products may be retained in the sod for considerable periods as harmful residues to certain crops. A change in the physical state of a chemical may improve the effective toxicity. Methyl bromide is formulated as a liquid, but when the pressure in the container is released, it reverts to the gaseous form and readily penetrates the upper soil layer.

The range and degree of selectivity is of paramount importance in selecting 'a sterilant. Within the herbicidal class of sterilants, materials are quite specific in the degree of control of certain weeds. Some species of nematodes react differently in their susceptibility to D.D. and E.D.B.

To avoid useless expenditure of money and labor for soil sterilization, it is necessary to have a thorough knowledge of the toxic properties of the material. In case of experiment materials, where general recommendations are not available, it would be wise to test the materials carefully under local conditions before attempting extensive usage.

2. *Adaptability*

Some sterilants are more adaptable to one kind of operation than another. Because of chemical cost, equipment involved and time and labor required, it is not practical to consider some sterilants for extensive work. On the other hand these same materials may fit readily into a soil bin or compost operation. The physical state or condition of the sterilant may render it more suitable for a particular kind of operation. For example, fumigant type materials such as steam or methyl bromide are most effective for compost or bin sterilants. Here the higher operations cost is justified by the quick, effective job accomplished. For some types of compost sterilization, solid materials such as calcium cyanamid and uramon are used. However, these materials are not effective on the more serious southern weedpests such as nutgrass and bermudagrass. In general, liquid materials are more suited for field sterilization than for bin or compost work.

Ease of application is another factor to be considered in adaptability. Some sterilants require complex and lengthy procedures such as covering the soil or applying a water seal. Other materials need specialized equipment such as release adapters in the case of gasses, and drop or plow sole applicators in the case of liquid materials. With still other chemicals only a simple spreader or sprayer may be required for application. Some liquid materials are now being applied through irrigation systems. Where adaptable

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COMING EVENTS

June 10

Central Plains Turf Foundation Field Day
Boys Town, Neb.

August 8

Rutgers University Turf Field Day
Rutgers University
New Brunswick, N. J.
Dr. Ralph E. Engel

August 15-16

26th Annual Golf Course Superintendents Field Day
University of Rhode island
Kingston, R. I.
Cr. J. A. DeFrance

September 10

St. Louis Field Day
Link's Nursery
Route 1, Conway Road
Clayton, Mo.
Leo S. Bauman

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this latter method is probably the simplest and least expensive means of applying sterilants.

3. *Cost*

Chemicals, labor and equipment must all be considered in estimating the cost of a sterilization operation. The cost will vary widely according to the chemical used, the size of area treated and the nature and degree of pests involved. Since steriliztion may affect production costs considerably, it is important carefully to evaluate this practice in terms of the value and importance of the end product. In the case of turfgrass nurseries, putting green construction and lawns planted to the more expensive grasses, sterilization costs are usually justified if the sterilant is carefully selected and effectively used. In many cases the 'initial cost of sterilization will be returned several fold in the form of improved turf quality and reduced maintenance costs.

4. Residual *Period*

This term refers to the waiting period required between treatment and planting to allow for dissipation of the sterilant. This time factor is of great importance in field sterilization because of the cost and inconvenience involved in holding extensive areas out of production during the sterilization operation. Similarly, storage space may become a factor in bin or compost sterilization if the residual period is unreasonably long.

Residual periods vary from a few hours in the case of steam to several months with the slower materials. Soil type, temperature and the method of application are factors which may affect the residual period of any given sterilant.

The residual period for the given soil and climatic complex must be thoroughly known for each chemical. Valuable turf may be killed if planted before the toxic properties of the chemical are allowed to dissipate. On the other hand, there is no point in holding up propagation any longer than necessary. Periodic planting of susceptible crops such as radishes or tomatoes in the sterilized area will indicate when planting may be started safely.

5. Human ***Hazard***

Toxicity to man and/or animals may be the deciding factor in choice of a soil sterilant. Some materials are too hazardous for use in public areas, but may be adapted to isolated field operations where specialized aplication equipment can be used. Ally1 alcohol is such a material. It is a severe lachrymator (tear producing substance), and is a deadly poison. Complete protective clothing should be used whenever ally1 alcohol is handled. Methyl bromide is also a serious poison but it is merchandized in such a form that the risk to the user is greatly reduced if normal precautions are followed. Other materials such as D.D. and E.D.B. do not offer use hazards if reasonably handled.