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J. D. Mann
W. B. Storey
L. S. Jordan
B. E. Day
H. Haid

See next page for additional authors

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WILMINGTON, DELAWARE 19899
New evidence . . .

Light Dependency In Seed Germination

When land is made weed-free by chemical control methods, particularly with contact herbicides, the weed-free condition is best maintained by not disturbing the soil. Such disturbance can lead to germination of a new crop of weed seeds that otherwise would remain dormant.

Seed dormancy is evidently an excellent survival mechanism, from the point of view of a plant species. There are several methods of breaking dormancy in various species, including chilling, freezing, abrasion, leaching, oxygen, and light. These studies involved only the light requirements.

Small seeds

A large percentage of small-seed species require both moisture and a small amount of red light in order to start the germination process. Such requirements are well suited to the needs of our typical weeds, which are invaders of disturbed soil. They guarantee that seeds will germinate after disturbance, but that a reservoir of viable ungerminated seeds will remain in soil below the top inch or two. Light requirement is typical of small-seeded, rather than of large-seeded species. The red wavelengths involved can penetrate about one inch of sandy soil, thus activating just those seeds that can manage to emerge.

A great deal is already known about some aspects of this light control. The red light is detected by a pigment, “phytochrome,” that, although present only in minute concentrations within the seed, has nevertheless been extracted and purified recently by USDA researchers. When a molecule of phytochrome absorbs red light (660 millimicrons), it is converted to another form known as Pt. This new form of the pigment now absorbs far-red light (735 millimicrons; a very deep and dull color), with a subsequent reversion to the original light-absorbing form, known as Pfr. This back-and-forth interconversion has been demonstrated both with the purified phytochrome and with light-requiring seeds.

Grand Rapids lettuce seed is the classical material for such studies because it is one of the few agricultural varieties in which light requirement has not been bred out of the species during domestication. When Grand Rapids seed is kept moist, but completely in darkness, only 5% to 30% of the seeds germinate, no matter how long the germination test is carried out. For a given batch of seeds, the light-independent germination is very reproducible, if incubation temperature is kept constant. However, when these imbibed seeds are given a few minutes of either filtered red light, or room illumination containing red light, and then replaced in darkness, essentially complete germination occurs. If, soon after the dose of red light, another dose of filtered far-red light is administered, no stimulation of germination occurs. After the radicle protrudes through the seed coat, neither red nor far-red light has any further effect upon growth.

Red illumination

All evidence indicates that Pfr (the product of red illumination) is the active compound. But the steps leading from Pfr to germination are relatively unknown. Recent research by other scientists has shown that when oxygen was kept away from the seeds, Pfr had no effect. Seeds were given a dose of red light, and kept under nitrogen gas for several hours; then Pfr was converted to Pfr with a dose of far-red light, and seeds were put back into ordinary air. These seeds behaved as though they had never been exposed to red light at all; in other words, they had failed to “escape” from the reversal by far-red even though it was given many hours after the red treatment.

In control seeds kept in air after red treatment, “escape” from far-red reversal occurred in only 4 to 8 hours (about 80% escape).

This means that one of the steps leading from Pfr to germination can be blocked by lack of oxygen. However, anoxia is rather nonspecific and the use of more specific types of inhibitors is needed to pinpoint which reactions are involved. One such inhibitor, CIPC, is a carbamate herbicide related chemically to IPC, swep, and barban (“Carbyne”).

EFFECT OF INHIBITORS UPON PHYTOCHROME-INDUCED INCREASE IN GERMINATION RATE

<table>
<thead>
<tr>
<th>Inhibitor</th>
<th>Time of additon (hours)</th>
<th>Percent germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-8, FR-28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ext. 1 None</td>
<td>30 ppm 0</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96</td>
</tr>
<tr>
<td>CIPC 30 ppm</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>A-2-C 30 ppm</td>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>87</td>
</tr>
<tr>
<td>A-2-C 30 ppm</td>
<td>3</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>89</td>
</tr>
<tr>
<td>Ext. 2 None</td>
<td>30 ppm 0</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>94</td>
</tr>
<tr>
<td>Puromycin 300 ppm</td>
<td>0</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>PPA 10 ppm</td>
<td>0</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>86</td>
</tr>
<tr>
<td>Ext. 3 None</td>
<td>30 ppm 0</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96</td>
</tr>
<tr>
<td>PPA 10 ppm</td>
<td>0</td>
<td>711</td>
</tr>
<tr>
<td></td>
<td></td>
<td>67</td>
</tr>
</tbody>
</table>

* “R-8, FR-28” indicates seeds exposed first to red light after 8 hours of inhibition and then to far-red light 20 hours later. Similarly, “R-8, FR-28” indicates an additional exposure to red light after 28 hours, subsequent to leaching away of inhibitors. Dark-germinated seeds, not given any exposure to red light, gave 98% germination. † 30 ppm PPA caused severe inhibition of radicle elongation.
It blocks protein synthesis and causes a dramatic shortening of mitotic chromosomes (figure 1)—perhaps by acting at a critical step in the process of protein synthesis.

**Genes**

The genes of the chromosomes in the nucleus are composed of DNA, but they direct the synthesis of proteins outside of the nucleus, in the cytoplasm. The intermediary here is known as “messenger RNA”—a sort of mirror image copy of DNA that acts like a blueprint to direct the types and sequence of amino acids to be incorporated into a protein. A good analogy would be to think of the DNA as a central filing system of designs drawn in India ink, and the messenger RNA as blueprint copies of the designs, so that other factors in the cytoplasm can assemble the nuts and bolts (amino acids) in the proper sequence.

**Inhibitors**

In these studies, the effects of substituting other inhibitors for anoxia were tested. The two most important inhibitors used were CIPC and PFPA. PFPA (para-fluorophenylalanine) is a relative of the naturally occurring amino acid, phenylalanine. It inhibits translation in a manner that subsequently led to germination after PFPA had been leached from the seeds—even though Pr, by this time was no longer present.

In the summary (figure 2), CIPC and anoxia are shown as preventing the synthesis of a messenger RNA required for eventual germination. Pr is also required to cause synthesis of this messenger RNA. But if the “reading” of the messenger RNA blueprint is temporarily delayed by PFPA, azetidine-2-carboxylic acid, or puromycin, enough Pr-induced messenger RNA accumulates during this period to cause eventual germination when the inhibitors are finally removed.

Seeds of some other lettuce varieties, as well as other plant species, do not normally require light for germination. But many such seeds can be made light-requiring by keeping them warm and moist. These conditions cause a functional anoxia, since respiration increases with elevated temperature, but diffusion of oxygen through intact seed-coats does not. During this high-temperature incubation, messenger RNA that was already present in the dried seed was destroyed without being used to make protein. When the seeds were cooled down, they required synthesis of new messenger RNA for germination, and this synthesis required the presence of Pr.

**Summary**

In summary, seeds that require light to initiate germination are probably those which are deficient in a particular kind of messenger RNA. Phytochrome, when in the active Pr state, stimulates the cell nuclei to release the messenger RNA. In turn, the messenger RNA causes the production of certain (unknown) enzymes that start the seed irreversibly on the road to germination.

The influence of phytochrome is not limited to seed germination. A remarkable variety of botanical phenomena show responses to red and far-red light. For instance, fall-blooming plants need a long night to convert their leaf buds to flower buds. The leaves are the receptor organs, and the leaves in this respect are sensitive to a red light interruption of the dark period; photosynthesis is only indirectly involved. Formation of red pigments (anthocyanins) in seedling turnips and corn requires red light. Even the formation of unsaturated fatty acids in linseed requires red light. It is possible that a similar mechanism, concerned with phytochrome-controlled synthesis of specific messenger RNA’s, is involved in all cases.

*J. D. Mann is Assistant Biochemist; W. B. Storey is Horticulturist; L. S. Jordan is Associate Plant Physiologist; B. E. Day is Plant Physiologist; and H. Haid is Laboratory Technician, Department of Horticultural Science, University of California, Riverside. This work was supported in part by National Institutes of Health Grant No. GM-12664.*
Kentucky bluegrass seed is used extensively for lawn planting in New York. Since some varieties of this species are more desirable than others, it is important to be able to determine if a seed sample is correctly labeled as to variety. This helps the buyer to get pure seed of the variety he wants.

Seed analysts have had considerable success in distinguishing seed of the variety, Merion, from seed of common Kentucky bluegrass. However, many new varieties are now on the market and some of them are more difficult to distinguish from Merion than common. Some new varieties are similar in seed characteristics which make it difficult to identify them by looking at the seed. For this reason, research was undertaken to develop methods of identifying varieties by use of seedling plants grown under controlled conditions.

Seedlings were grown in a growth chamber with continuous light and with a temperature of 70°F. Within 5 weeks of the time the seeds were planted, varieties were observed to differ in several respects. The most striking difference was in the color of the leaf sheath which surrounds the lower part of the stem. Plants of some varieties developed a very bright red color reaching from the soil level an inch or more up the stem. Of the 11 varieties tested, 2 were classed as having very bright red stems, 5 were classed as having red stems, 2 were classed as having moderately red stems, 1 had a slight reddish color, and 1 had only green color. Even though this very noticeable red color develops under growth chamber conditions used it fails to develop to any extent in the field or greenhouse. This probably accounts for the fact that no mention is made of lower leaf sheath color in descriptions of 13 Kentucky bluegrass varieties in a recent United States Department of Agriculture publication.

Varieties also varied noticeably in growth habit and height. Plants of some varieties were tall and upright and had few tillers. Others were short and had many tillers resulting in a bushy appearance. Counts of tiller number were made on plants of each variety. Merion plants had four times as many tillers on the average as Newport plants. Varieties also differed in number and length of rhizomes. These are horizontal underground stems from which new plants develop. They are valuable in that they help to thicken the sod and fill in bare spots. In general, varieties with many tillers formed few rhizomes and those with few tillers formed many rhizomes.

For instance, Merion with four times as many tillers as Newport averaged only 0.6 rhizomes per plant as compared to 1.3 per plant for Newport. Both tillers and rhizomes are stems. Thus, it might be expected that one might be formed at the expense of the other. Merion and Windsor, which are similar in many respects, differed not only in rhizome number but also in rhizome length. In one experiment 70 per cent of Windsor plants had rhizomes an inch or more in length as compared to only 6 per cent of Merion plants.

Differences among varieties in leaf width and in angle of leaves with the stem were noticeable. Newport and Merion had relatively wide leaves and Prato had narrow leaves. Prato leaves averaged 80 per cent as wide as Newport leaves. An ordinary protractor was used to measure the angle formed between the second leaf and the stem of 100 plants of each of 6 varieties. Of these varieties Newport had the widest average angle, 54°, and Beau­mont had the most acute angle, 13°.

The possibility of distinguishing varieties by means of cell patterns of upper leaf surfaces was also investigated. Prints of the leaf surface were made using a method suggested by the late Professor Stoddard of the Connecticut Agricultural Experiment Station. This consists of painting the leaf surface with cellulose acetate (clear nail polish). This material hardens making a replica of the leaf surface. This is stripped from the leaf, mounted on a glass slide, and observed under a microscope. Varieties were found to vary in size and shape of cells, size of stomata, and in presence or absence of leaf hairs. This method is more time consuming than direct observation of plant characteristics. Thus, its greatest usefulness may be in classifying plants difficult to classify by other means.

Since Kentucky bluegrass varieties vary in disease resistance, testing for resistance to specific diseases can be helpful in classifying plants as to variety. For instance, Delta is described as being resistant to powdery mildew.
To determine how useful this resistance might be in identifying plants of Delta, plants of six varieties were exposed to mildew infection in the greenhouse. More than half of the plants of Merion showed moderate to severe mildew infection. None of the Delta plants had enough mildew to place them into these categories although some plants had very small mildew areas. Thus, many of the Merion plants could have been distinguished from Delta plants by reaction to this organism. Plants of Beaumont, Delft, Newport, and common were somewhat less susceptible to mildew than Merion but were much more susceptible than Delta.

Since the purpose of this research was to develop practical methods of testing seed stocks, experiments were conducted to determine how accurately contamination of one variety in another could be detected. Three seed samples were used and plants were grown in a growth chamber 5 weeks before being classified as to variety. One sample was a mixture of Merion and common Kentucky bluegrass. Another sample was a mixture of Merion and Delta and the third was a mixture of Merion and Newport. Plants were judged on the basis of stem color, leaf width, angle of leaf with the stem, tiller and rhizome number, and growth habit. By use of all these characteristics, it was possible to recognize individual plants of each variety. This resulted in nearly 100 per cent accuracy in distinguishing Merion plants from plants of other varieties. This research has resulted in a useful and practical method of testing seed stocks to determine if they are correctly labeled as to variety.

—Farm Research, Vol. 32, No. 1, Page 14, April-June, 1966
The Effects Of Nematocides On Turfgrass Growth

J. TROLL and R. A. ROHDE

Associate Professors, Department of Plant and Soil Sciences and Department of Entomology and Plant Pathology, respectively.

Tarjan and Cheo (6) obtained a significant reduction of parasitic nematodes after an application of nematocide drenches to established bentgrass, although no information was given on growth grasses. In another study, applications of chemicals to established turf were shown to control parasitic nematodes for as long as 4 months, but again effects to the grass were not described (3).

Powell (5) suggested that nematodes were a major factor in the decline of a lawn in Athens, Georgia. The turf did not respond to an application of fertilizer, but improved after a nematocide was applied. Christie and Perry (1) found a marked improvement in plant growth and an increase in the spread of grass by rhizomes after an application of a nematocide to Bermuda grass.

The most striking improvement to turf vegetation of nematocides to nematode-infested Kentucky bluegrass was reported by Perry, et al. (4). The growth of bluegrass plants was greatly improved through the use of all nematocides tested. The color of the grass in the treated plots was reported to be deeper green, and the leaves longer and broader. The roots of treated plants penetrated deeper into the soil than the controls.

The present investigation was undertaken to determine any relationship between the rate of nematocide application, nematode reduction, and density of the stand.

MATERIALS AND METHODS

Nematode experiments were conducted on a 45 x 60 foot area containing a mixture of 'Merion' Kentucky bluegrass (Poa pratensis) and 'Pennlawn' creeping red fescue (Festuca rubra) interspersed with a small amount of clover and other weeds. The stand, established for at least 4 years, was growing in Walpole fine sandy loam. Fertilizer and lime were not applied to the turf before or during this experiment. The area had received approximately 17 pounds of ground limestone and 20 pounds of 10-10-10 fertilizer the year before.

The 45 x 60 foot area was divided into three 45 x 20 foot blocks. Each block was then divided into 5 x 5 foot plots, making 36 plots within each block, for a total of 108 treatment sites. The turf area was mowed to 1/2 inches, then aerificed. Grass clippings and turf plugs were raked off.

The nematocides tested were: O,O-diethyl O-coumarin-3 yl phosphorothioate (Niagara 9227) (N-9227); O,O-diethyl O-p-(methylsulfinyl)phenyl phosphorothioate (Meta-Systox-R) (methyl demeton-R); 2,4-dichlorophenyl methanesulfonate (Shell SD 7727) (SD 7727); 1,2-dibromo-3-chloropropane (DBCP) (Nemagon); O,O-diethyl O-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate (diazinon A1619) (D-A1619) and diazinon 500 (D-500) which chemically is the same as the A1619 formulation except for its emulsifying agent. Each chemical was applied at the manufacturers' suggested rates to four plots within one block, one-half the suggested rates were applied to four plots within the second block, and double the suggested rates were applied to four plots within the third block. Four of the plots within each block were used as controls and four were fertilized with a complete fertilizer.

Nematocides were thoroughly mixed in 2 gallons of water and applied by hand with watering cans. The plots were then watered for 24 hours with a sprinkler having an outlet pressure of 50 pounds per square inch.

The turfgrass area was mowed weekly with a 20-inch reel-type mower set at 1 1/2 inches.

One month after chemical application, a grass catcher was attached to the mower, and clippings from two cutting passes in each treatment site were collected weekly for 5 weeks. A sixth harvest was made 26 days after the fifth; grass samples were oven-dried, weighed, and recorded.

Two months after application of the chemicals, each plot was examined for nematodes. Four soil plugs, each 3/4 inch in diameter and 6 inches long, were taken at random from each plot with a soil probe and mixed. Nematodes were extracted from a 50-gram aliquot of soil from each plot by the sugar flotation method and counted. All parasitic nematodes were identified to genus.

Three days after the last harvest, two plugs, each 4 inches in diameter and 6 inches deep, were obtained from each plot. The roots in each plug were washed free of soil, oven-dried and weighed. All data were analyzed statistically by means of covariance to adjust treatment means between yields as dependent variables and nematodes as independent variables. None of the data were significant below the 5% level.

RESULTS

All fertilizer treatments significantly increased the mean grass clipping weight (Tables 1, 2). Clipping weights from all plots treated with B-25141, at the suggested and double the manufacturers' suggested rates, also showed a significant increase. There were only slight differences, however, in the clipping weights from other treatments.

Nematodes belonging to the genera Pratylenchus, Tylenchorhynchus, Paratylenchus, Criconemoides, and Tylenchus were distributed rather evenly over all treated areas. At the one-half dosage, the lowest number of nematodes was extracted from D-500 and B-25141 plots, but the only significant growth increase occurred in fertilized plots. Fertilizer was the only treatment that improved the color of the turf, and improved color was still apparent at the time of the last cutting.

SD 7727 applied at double the manufacturer's suggested rate caused a speckled chlorosis of the grass leaves. Plants outgrew the injury within a few weeks. Root weights were not affected by any nematocide treatments.

Results of soil pH and fertility tests, taken at the conclusion of the experiment, are shown in Table 3.

DISCUSSION AND CONCLUSION

B-25141, applied at the suggested and at double the dosage rate, was the only nematocide that significantly increased the average clipping weights.
Table 1. Average number of parasitic nematodes recovered from the soil, average clipping weights, and the average root weights of a Merion-fescue grass mixture treated with suggested rates of nematocides.

<table>
<thead>
<tr>
<th>Plot treatment</th>
<th>Dosage in 2 gal. of water/plot</th>
<th>No. nematodes</th>
<th>Avg. clipping weights six cuttings (in grams)</th>
<th>Avg. root weights (in grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-9227</td>
<td>22.5 cc</td>
<td>72</td>
<td>15.25</td>
<td>13.49</td>
</tr>
<tr>
<td>B-25141</td>
<td>7.5 cc</td>
<td>46</td>
<td>15.00*</td>
<td>16.91*</td>
</tr>
<tr>
<td>Methyl demeton-R</td>
<td>.3 cc</td>
<td>76</td>
<td>12.58</td>
<td>15.91</td>
</tr>
<tr>
<td>SD 7727</td>
<td>35.0 cc</td>
<td>143</td>
<td>14.18</td>
<td>16.94</td>
</tr>
<tr>
<td>DBCP</td>
<td>10.7 cc</td>
<td>95</td>
<td>14.81</td>
<td>15.02</td>
</tr>
<tr>
<td>D-A1619</td>
<td>22.5 cc</td>
<td>103</td>
<td>14.68</td>
<td>16.72</td>
</tr>
<tr>
<td>D-500</td>
<td>22.5 cc</td>
<td>68</td>
<td>13.05</td>
<td>13.11</td>
</tr>
<tr>
<td>Fertilizer (10-10-10)</td>
<td>0.5 lb</td>
<td>125</td>
<td>27.56*</td>
<td>9.36</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td>173</td>
<td>13.24</td>
<td>19.97</td>
</tr>
</tbody>
</table>

* Analysis of co-variance indicates a significant difference at the 5% level. Data are the means of four replications.

Table 2. Average of parasitic nematodes recovered from the soil, average clipping weights, and the average root weights of a Merion-fescue grass mixture treated with double the suggested rates of nematocides.

<table>
<thead>
<tr>
<th>Plot treatment</th>
<th>Dosage in 2 gal. of water/plot</th>
<th>No. nematodes</th>
<th>Avg. clipping weights six cuttings (in grams)</th>
<th>Avg. root weights (in grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-9227</td>
<td>45.0 cc</td>
<td>76</td>
<td>12.88</td>
<td>25.74</td>
</tr>
<tr>
<td>B-25141</td>
<td>15.0 cc</td>
<td>181</td>
<td>17.93*</td>
<td>25.01</td>
</tr>
<tr>
<td>Methyl demeton-R</td>
<td>0.6 cc</td>
<td>157</td>
<td>13.05</td>
<td>20.13</td>
</tr>
<tr>
<td>SD 7727</td>
<td>70.5 cc</td>
<td>90</td>
<td>14.15</td>
<td>24.47</td>
</tr>
<tr>
<td>DBCP</td>
<td>21.5 cc</td>
<td>65</td>
<td>13.57</td>
<td>20.50</td>
</tr>
<tr>
<td>D-A1619</td>
<td>45.0 cc</td>
<td>28</td>
<td>13.90</td>
<td>24.77</td>
</tr>
<tr>
<td>D-500</td>
<td>45.0 cc</td>
<td>42</td>
<td>13.77</td>
<td>24.66</td>
</tr>
<tr>
<td>Fertilizer (10-10-10)</td>
<td>0.5 lb</td>
<td>207</td>
<td>26.67*</td>
<td>18.05</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td>252</td>
<td>13.43</td>
<td>17.41</td>
</tr>
</tbody>
</table>

* Analysis of co-variance indicates a significant difference at the 5% level. Data are means of four replications.

Table 3. Results of chemical soil tests from Merion-fescue turfgrass plots treated with nematocides*.

<table>
<thead>
<tr>
<th>Test</th>
<th>Recommended rate</th>
<th>One-half rate</th>
<th>Double rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.8</td>
<td>6.6</td>
<td>6.8</td>
</tr>
<tr>
<td>Calcium</td>
<td>high</td>
<td>medium high</td>
<td>medium high</td>
</tr>
<tr>
<td>Potassium</td>
<td>medium high</td>
<td>medium high</td>
<td>medium high</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Magnesium</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
</tbody>
</table>

* Test conducted on combined random samples of soil from each area to which different chemical rates were applied.

The mean clipping weight from all plots was significantly increased by fertilizer, although the mean number of parasitic nematodes recovered from these plots was higher than those from most nematocide-treated areas. Under the conditions of this experiment, a reduction of parasitic nematodes by nematocides did not necessarily increase turf clipping weights, while fertilizer applications always increased grass growth.

There was no correlation between the nematode counts and root weights from the plots that received fertilizer. Apparently the fertilizer was used by the plants for the production of top growth rather than root growth. These inconsistencies in nematode counts, root weights, and top growth seem to indicate that the stimulation of grass growth was not entirely related to a decrease in parasitic nematodes.

There are a number of possible reasons for the discrepancies in the results. A possibility, as proposed by Hollis (2), is that stimulation of turfgrass growth may have been brought about by the effects of soil fertility and its interaction with the nematocides. The fertility of all the plots was fairly high, and application of some of the chemicals may have increased the availability of nutrients for plant utilization. It is also possible that the nematocides reduced parasitic nematodes, and at the same time increased nutrient availability, both of which could
have stimulated plant growth. The difficulty encountered in trying to determine the effect of nematodes on turfgrass grown in the field points out the need to control many variables, if proof of nematode effects on turf is to be established.

Literature Cited


—Plant Disease Reporter, July 1966 Vol. 50, No. 7, Page 491

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Names applied to pesticides are confusing. A major reason is that there are differences in usage between the many agencies, organizations, and individuals who write or speak about pesticides. This can lead to hazardous situations.

Knowing what chemical—what active ingredient—is in a product is basic to proper and safe use. Therefore, names on labels that identify active ingredients should be the starting point in an understanding of names applied to pesticides.

Registered trade-marks and trade names, however, may or may not identify active ingredients. People ask for “Raid,” “Isotox,” “Weedone.” But these names do not identify a single product—they do not identify active ingredients—nor a special use.

To identify many active ingredients, present regulations require complex chemical names on labels. This is because no well-known or coined common names acceptable to the Pesticide Regulation Division are available. This is unfortunate and confusing. The public loses confidence in people employed to help them. Here, for example, is what happens.

A housewife is told to buy Diazinon*, a registered trade name. Or, her instructions may suggest diazinon, an Entomological Society common name. She goes to get the pesticide. What’s wrong? Just this!

Stores may carry a product with the active ingredient identified as o, o-diethyl o-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate. The word Diazinon (or diazinon) is not on the label—regulations do not require it. Neither housewife nor clerk can find any Diazinon (or diazinon) in the store. He tries to sell her something “just as good” (probably containing Diazinon [or diazinon] although he doesn’t know it). She flounces out, mad at everybody.

State recommendations may name Kelthane*, a registered trade name, as an important chemical in a general purpose product. USDA publications may use the Entomological Society name, dicofol. Neither name is required on labels by government regulation. A gardener looking for a product containing Kelthane or dicofol may find one containing this chemical identified only as 4,4-dichloro-alpha-methylbenzhydrol. In pesticide indices, both 4,4-dichloro-alpha-(trichloromethyl) benzhydrol and 1, 1-bis(chlorophenyl)-2,2,2-trichloroethanol also are found.

Even the chemists are confused. Pity the poor gardener.

Names on Labels

Paragraph 362.7 (b) of the Regulations for the Enforcement of the Federal Insecticide, Fungicide and Rodenticide Act reads as follows:

“(b) Names of ingredients. The well-known common name of each of the listed ingredients must be given or, if an ingredient has no common name, the correct chemical name which conforms most closely with generally accepted rules of chemical nomenclature. If there is no common name and the chemical composition is complex, the Director may permit the use of a new or coined name which he finds to be appropriate for the information and protection of the user.

If the use of a new or coined name is permitted, the Director may prescribe the terms under which it may be used. A trade-mark or trade name shall not be used as the name of an ingredient except when it has become a common name.” (italics added)

Acceptable Common Names

Let me repeat. Regulations of the USDA Pesticide Regulation Division require that officially accepted common names be used in the active ingredient lists on labels to identify compounds with complex chemical names. The chemical name may appear in parentheses, or an asterisk may refer to it.

Common names of economic poisons (pesticides) officially acceptable to PRD are those approved by the former Interdepartmental Committee on Pest Control, the K62 Committee of the American Standards Association and/or the International Standards Organization. A few well-known common names have been given semi-official standing and may be employed; lindane is an example.

Trade and coded names and trade-marks are not allowable in ingredient lists. Some names employed originally as trade names are given official status as com-
Common names. When this occurs, they lose their identity as registered trade names. Malathion and simazine are examples.

The table below lists some coined common and well-known names that have been officially accepted by the Pesticide Regulation Division. These names must appear in active ingredient statements on labels of all products containing chemicals identified by these names.

### Other Common (coined) Names

The Entomological Society of America, Weed Society of America, and American Phytopathological Society have coined common names or preferred designations for compounds having complex chemical names. These coined names, then, are required in manuscripts submitted for publication. This avoids repeated use of chemical names and, in some cases, trade names.

<table>
<thead>
<tr>
<th>Some Common Names Required in Ingredient Lists on Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>aldrin I endosulfan I ovex A</td>
</tr>
<tr>
<td>allethrin I endoethall H</td>
</tr>
<tr>
<td>amiben H endoethion I</td>
</tr>
<tr>
<td>amitrole H endrin H</td>
</tr>
<tr>
<td>atrazine H erbon I</td>
</tr>
<tr>
<td>barban H ethion I</td>
</tr>
<tr>
<td>binapacryl A fenuron H</td>
</tr>
<tr>
<td>bromacil H ferbam F</td>
</tr>
<tr>
<td>captan F folpet F</td>
</tr>
<tr>
<td>carbarlyl I glodin F</td>
</tr>
<tr>
<td>carbophenothion I glyodin F</td>
</tr>
<tr>
<td>chloranil F gradi1mt A</td>
</tr>
<tr>
<td>chlorazie H hetachlor I</td>
</tr>
<tr>
<td>chlorbenzide A heptachlor I</td>
</tr>
<tr>
<td>clordane I isocil H</td>
</tr>
<tr>
<td>cyproid H isodrin I</td>
</tr>
<tr>
<td>dalapone H isomaron I</td>
</tr>
<tr>
<td>demeton I lindane I</td>
</tr>
<tr>
<td>dicamba H linuron I</td>
</tr>
<tr>
<td>dicapton I linuron I</td>
</tr>
<tr>
<td>dichlobenil H malathion I</td>
</tr>
<tr>
<td>dichlorone F maneb F</td>
</tr>
<tr>
<td>dicryl H methoxychlor I</td>
</tr>
<tr>
<td>dicryl H methoxychlor I</td>
</tr>
<tr>
<td>dimethoate I monuron H</td>
</tr>
<tr>
<td>dimethrin I monuron H</td>
</tr>
<tr>
<td>dioxythion A nabam H</td>
</tr>
<tr>
<td>diphacane R nabam F</td>
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<td>diphenamid H naled I</td>
</tr>
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<td>diquat H neburon H</td>
</tr>
<tr>
<td>diuron H norbormide R</td>
</tr>
<tr>
<td>dodine F norea H</td>
</tr>
<tr>
<td>A—acaricide H—herbicide R—rodenticide</td>
</tr>
<tr>
<td>F—fungicide I—insecticide S—synergist</td>
</tr>
</tbody>
</table>

USDA, HEW and Department of Interior agencies and other federal research and educational groups employ these unofficial common names in publications. State pest control guides make use of these common names approved by organizations. Meanwhile, these same common names may or may not appear somewhere on labels or in advertising.

Common names established by professional societies do not have official acceptance by the Pesticide Regulation Division. They are not acceptable in lists of active ingredients on labels. They still may have status as registered trade names. Of course, such common names may become officially acceptable at some future date. Until then, using these unofficial common names is convenient, but only adds to the confusion.

TEPP, PMA and NAA are examples of initials in common use. For the professional, each one identifies a special chemical. A few are recognized by the general public. Such designations are not acceptable in ingredient lists. They may or may not appear somewhere else on labels. But, regulations do not require it.

Professional research, extension, and other workers do become acquainted with these unofficial coined names and initials. They have many sources of information for clearing up any confusion. The non-professional pest control operators and custom applicators usually are well informed.

The general public continues to be highly confused. Here are some suggestions to help the situation.

### Guidelines for the Use of Pesticide Names

1. Identify pesticide chemicals by the officially accepted common names required in active ingredient lists on labels.

2. As new common names appear in ingredient lists, start the educational process through repeated usage, but, at first, employ some associated designation. For example, write, or say, carbaryl (Sevin*), dichlorbenil (Casoron*), dodine (Cy–prex*). Be consistent.

3. Place an asterisk or ® on each trade name, at least the first time it appears, to set it apart from common names. Refer the reader to a readily noticed “Trade Name.”

4. Always identify unofficial, common names or other designations with trade names: mevinphos (Phosdrin*), dinocap (Karathane*), SMDC (Va—pam*, VPM*). Remember, these unofficial names are not acceptable in ingredient lists; they may or may not appear elsewhere on the label.

5. Urge early acceptance of common names to identify complex chemicals in ingredient statements on labels. They will soon become well-known if suggestions 1 and 2 are carried out.

6. Write and speak so as to lessen confusion. Be consistent. Work towards greater uniformity in identifying chemicals. Your words cross political boundaries!

*Trade name
Turfgrasses and Ground Covers

for Parks and Recreation Areas

Because more emphasis is being devoted to the development of parks and recreation facilities, and because they are more heavily used than in the past, the establishment and maintenance of good turfgrasses and ground covers are of prime importance. Proper planting and care of grasses and covers can make recreation facilities attractive and more enjoyable to the users.

Plan Turf Areas Early

The establishment of turfgrasses should be planned in the early stages of park or recreation area development. Once a facility is in use by the public, it is much more difficult to establish a good turfgrass lawn. Planning should encompass proper site grading, proper soil preparation (including the liberal use of commercial fertilizers), and selection of the best turfgrass species.

Quality of the soil will influence the amount and kind of commercial fertilizer required and also selection of grass species. Another major factor determining grass selection is the planned usage of the area.

"End Use" Recommendations

For a general playground, a turf mixture of bluegrass and creeping red fescue, or a straight seeding of Alta or Kentucky-31 tall fescue can be used. If the soil is reasonably good, and in an open area, a bluegrass and red fescue mixture will provide a beautiful turf. However, if the soil is a heavy clay or is extremely sandy, such a mixture will be difficult to establish, and straight seedings of Alta or Kentucky-31 fescue might be considered.

For picnic and limited-use areas in open, wooded spaces, Alta or Kentucky-31 fescue will not establish a good stand of grass. Neither can a good, full turf be expected of Kentucky bluegrass. For these spaces, a half-and-half mixture of Kentucky bluegrass and creeping red fescue is recommended. In many little-used wooded areas, the use of ground cover plants rather than turfgrasses might be better.

In the more heavily used turfgrass areas, it is important to establish a maintenance program that will include annual applications of commercial fertilizer and possible use of turf aeration equipment to help relieve soil compaction.

Many of the most usable park areas may be subject to floods. This must be considered when planning for turfgrasses. What happens to a good stand of tall fescue if floods deposit a layer of silt over all or part of the area? In most cases, the stand of grass, whether tall fescue or bluegrass, will be lost if 2" to 3" of sand or silt are deposited. Most grasses, though, can recuperate from deposits of 1½" to 1" of sand or silt.

Do not use cheaper mixtures
that include timothy, brome-grass, or legumes for seeding and establishing turfgrasses for parks and recreation facilities. Such mixtures result in rough, clumpy turfs, which can be dangerous in heavily used play-grounds.

**Kentucky Bluegrass Best**

To summarize procedures for establishing turfgrasses, when drawing up the original plans for development of the facility and its plantings: (1) include an item in the budget specifically for turfgrass establishment; (2) allow for adequate site and soil preparation; (3) be sure specifications include provision for a liberal quantity of a complete commercial fertilizer to be thoroughly incorporated into the seedbed before planting; and (4), consider how each area is to be used, and select the species of grass most suited to conditions. Remember that Kentucky bluegrass is still the best all-around permanent turfgrass throughout much of the country. Since bluegrass does not develop well in shaded areas, creeping red fescue can be added to these seedings. For the more heavily used areas, consider a heavy seeding of Alta or Kentucky-31 fescue. No other species of grass need be used along with tall fescue. Develop an annual maintenance program for turf areas, particularly those used most heavily, including the use of commercial fertilizer, possible use of turf aerification equipment, and overseeding where necessary.

**Best Ground Covers**

Though turfgrasses make the best and most solid ground plantings, there are many areas where turfgrasses cannot be used and where the use of other ground cover plants will add to the attractiveness of park and recreation facilities. In addition to more than 30 years of turfgrass research, Iowa State University has established plots to observe various herbaceous and woody plants that may have a place as ground covers under Midwest conditions. In the most recent plots, established slightly more than 10 years ago, these plants are tested for winter hardiness, drought resistance, effectiveness as ground covers and general adaptability to Mid-west situations. Some plots are in open sunny locations; others are partially shaded and have tree root competition.

There are several annual plants that have the distinct advantage, for a ground cover, of giving a show of bloom during a good part of the growing season. The annual known as the Dahlberg daisy (Thymophylla ten-niloba) performs best in the open sun, on a bank, or in similar areas. Once it starts to bloom in late spring, it will produce a profusion of yellow flowers until frost. It is best to start these plants indoors and set them out after danger of severe frost is over.

**Annuals Provide Color**

Another annual ground cover is the marigold Tagetes signata pumila ursula. This dwarf annual gives excellent color all during the growing season. It is easily started from seeds, and quickly develops into a good cover.

Alyssum is also a good ground cover. The variety, Carpet-of-Snow, has showy, white flowers. The variety, Royal Carpet, has equally attractive red flowers. Another annual, alyssum, Alyssum maritimum, is one of the best of this genus for reseeding itself.

We are all familiar with petunias. These annuals do very well as a ground cover when set out early in the spring. If given a good start, they will bloom and grow profusely all summer long and will often bloom until after the first two or three heavy frosts.

A creeping form of zinnia also works very nicely as a ground cover plant. This is the genus Sanvitalia.

Still another familiar plant is the rose moss, genus Portulaca. Once established, it seems to reseed readily. This plant will perform very well in hot, dry soils and even appears to be able to grow in partial shade.

These annuals that readily reseed themselves are well adapted to park areas having steep banks that are difficult to mow and of little use. If they are started from plants and given a little extra care during the first year to establish them, many will reseed with little or no further care.

**Herbaceous Perennials**

Prostrate thyme (Thymus ser-pyllum) is one of the herbaceous perennials that provides a good ground cover. This is a very low grower and is excellent for planting between paving blocks, along rock walls, or on rock ledges. It can also be used in sunny areas for a ground cover. Prostrate thyme is occasionally injured by low temperatures during the winter, so it might be reserved for the more sheltered areas and for use in the southern Midwest. Some winter injury has been observed in Iowa trial plantings.

An old favorite among the herbaceous perennial ground covers, but one that is still widely used, is ajuga. This plant, like prostrate thyme, is on the climate borderline in central Iowa. Ajuga reptans has, however, survived most winter seasons without a great deal of injury.

Another herbaceous perennial that has long been well known as a ground cover is Vinca minor, also known as periwinkle or creeping myrtle. It prefers dense or partial shade and reasonably good soil. It will remain green if placed in a location that receives winter shade and will probably perform best in sheltered areas of the central and southern Midwest. It may be subject to some winter injury unless it is in a protected area or covered for the winter by snows or mulches. This ground cover, which produces lavender-blue flowers in May and June, is especially sensitive to winter injury if grown in the sunlight.

Moss pink (Phlox subulata) has also performed very well in Iowa State’s ground cover plots. This plant prefers full sunlight and grows in almost any soil. Moss pink grows about 6” tall and produces masses of pink
flowers in late April or early May. The plants, which form small mounds of foliage that grow together into a solid carpet, can be used on banks, rock hills, and similar locations. Some persons may object to moss pink, because the cover occasionally looks slightly ragged after it blooms.

The herbaceous perennial, lily-of-the-valley (Convallaria majalis) is a plant that deserves consideration where there is a rich humus soil and dense or partial shade. Wooded bottom land areas are suitable. Once established, plants form a solid mass of broad, upright leaves that bear white, bell-shaped, fragrant flowers in the spring or early summer.

The violets, genus Viola, are found in many different species that perform well as ground cover plants. A number of species grow wild in the woods, and some spread so quickly that they could become weed problems. They are excellent, though, for wooded areas where there is no concern about their spreading into the finer turfgrass areas. They are completely hardy under Iowa conditions.

**Fleece Flower Is Aggressive**

The fleece flower (Polygonum reynoutria) is quite vigorous and makes a fine ground cover if planted in an area where it can be contained. This species grows 12" to 14" high, so it cannot be called a low ground cover plant. The fleece flower grows best in full sun. It is quite aggressive and can invade flower beds and lawn areas unless it is restricted. It can be used to provide a solid cover for a bank or other out-of-the-way spot, where there is not too much worry about its spreading.

There are two sedums that have performed very well in the ground cover plots. One is Sedum spurium, which withstands hot, dry locations in full sun. The other is Sedum acre, a plant that grows about 1" tall and is covered with yellow flowers in the spring. Like the other sedums, it should have full sun. A very rugged ground cover plant that has been used extensively on highway embankments and road cuts in recent years is crown vetch (Coronilla varia). One selection, developed at Iowa State University and quite hardy for local conditions, is Emerald crown vetch. It has the ability to grow on steep banks in poor soil, clay soil, and other types of soil commonly found on road cuts and embankments. It is a legume and likes full sun, but is a little slow in becoming established. Once established, this plant will compete with all weeds and form a solid, dense cover. With showy, lavender flowers in the spring, the plant grows 18" to 24" tall and is propagated primarily by seeds.

**Woody Plants As Ground Covers**

There are several woody plants, mostly evergreens, that perform very well as ground covers. Euonymus fortunei coloratus, known as wintercreeper, seems to be hardy in the trial plots. It is fairly well adapted to full sun, but if planted in sunny locations, will turn quite brown during the winter months and lose most of its leaves much earlier than if it is planted in semishady or shady locations.

Two low-growing evergreen junipers make good ground covers. Andorra juniper forms an ample cover in full sun. Some persons object to the purplish color that it develops during winter months, though others find this winter coloring attractive.

Prostrate juniper (Juniperus horizontalis) is the second low-growing evergreen juniper. There are some selections or varieties of this plant that retain their green color during the winter months. These, too, are low growing, with a height of about 12".

Another evergreen that looks very promising in the trial plantings is Pachistima canbyi. Pachistima is a fine, low-growing, broadleaf evergreen that should be used more widely as a ground cover than it is. It performs in full sun, partial shade, or full shade. In central Iowa, it is sometimes subjected to slight winter damage at the tips of new shoots, but damaged areas can be sheared or pruned off in early spring and the plants quickly recover. Damage does not occur every winter. Once established, pachistima forms a solid mass that eliminates weed problems.

Rock spray (Cotoneaster horizontalis) is a deciduous shrub that deserves serious consideration for sunny or partially shady locations where the soil is reasonably rich. A fine shrub for bank covers or open spaces, it grows about 2 ft. tall. Leaves are small, shiny, and green, and after the plant blooms, red berries last until after freezing, attracting birds.

Two other woody plants suited for ground cover use on steep banks or out-of-the-way locations are Japanese honeysuckle (Lonicera japonica) and Hall's climbing honeysuckle (Lonicera japonica halliana). Both plants could become weed problems if placed in areas where they cannot be controlled if they start growing too vigorously.

**Wise Selection Paramount**

As we develop plans for our parks and recreation areas, serious consideration should be given to the use of ground cover plants in locations that will not be heavily used, and where it would not be convenient or possible to establish good turfgrass. By wise selection of ground cover plants, we can add large splashes of color to parks and cover some blighted areas with plants that will provide an attractive appearance, making these spots more enjoyable. On some steep banks or hillsides, where nothing but weeds and brush grow, or where the soil is bare, we can plant ground covers that produce a thing of beauty, particularly when flowers are in bloom.

Plan ahead for the establishment of ground covers in places where they will be most helpful and useful. Select the plants suited for the situation, give them a little extra care for the first year or two, and then these areas can become low maintenance ones.
Stripe Smut Of Turf And Forage Grasses ... It's Prevalence, Pathogenicity And Response To Management Practices

P. M. HAlsKý, C. R. Funk, and S. Bachelder

1 Paper of the Journal Series, College of Agriculture and Environmental Science, Rutgers University, New Brunswick, New Jersey.
2 Respectively, Department of Plant Biology, Department of Soils and Crops, and Extension Service.

Stripe smut is a widespread and destructive disease of turf and forage grasses. On a worldwide basis the fungus is reported to parasitize some 34 genera of grasses comprising more than 100 individual species (8). Physiologic specialization also is well established in this organism. Within the species "striiformis" are found six physiologically distinct varieties, namely agrostidis, dactylidis, hoci, hordei, phlei, and poae (2, 3, 8). Generally, it is recognized that these varieties of stripe smut are pathogenically distinct. Five of them are reported from New Jersey as shown by the collection data in Table 1. Among the common turfgrass species infected with stripe smut were creeping bentgrass (Agrostis palustris) and Kentucky bluegrass (Poa pratensis). In creeping bentgrass the disease was observed in plots of Seaside and Penncross. In the bluegrasses stripe smut occurred in various degrees of severity as indicated by the data in Table 2.

In diagnosing smutted grass specimens we observed that sori (Fig. 1) of stripe smut (Ustilago striiformis (West.) Niessl) were macroscopically indistinguishable from those of flag smut (Urocystis agropyri (Preuss) Schroet.). Microscopically, however, the spore balls of Urocystis were readily differentiated from the single telosporae of Ustilago. Critical examination of spores was imperative since both fungi infect Poa pratensis and Agropyron repens. Thus, of 45 collections examined microscopically, 36 were Ustilago striiformis, 7 were Urocystis agropyri, and 2 were mixed infections with spores of both fungi being present in the sori. The phenomenon of mixed infections has also been observed by Clinton (1) who reported that Ustilago striiformis sometimes occurred with Urocystis agropyri in the same host plant.

Table 1. Varieties of Ustilago striiformis collected on turf grasses in New Jersey during 1958-65.

<table>
<thead>
<tr>
<th>Variety of U. striiformis</th>
<th>Grass host</th>
<th>No. collections</th>
</tr>
</thead>
<tbody>
<tr>
<td>var. agrostidis</td>
<td>Agrostis palustris</td>
<td>10</td>
</tr>
<tr>
<td>var. agrostidis</td>
<td>Agrostis alba</td>
<td>1</td>
</tr>
<tr>
<td>var. dactylidis</td>
<td>Dactylis glomerata</td>
<td>7</td>
</tr>
<tr>
<td>var. hoci</td>
<td>Holcus lanatus*</td>
<td>0</td>
</tr>
<tr>
<td>var. hordei</td>
<td>Agropyron repens</td>
<td>2</td>
</tr>
<tr>
<td>var. phlei</td>
<td>Phleum pratensis</td>
<td>3</td>
</tr>
<tr>
<td>var. poae†</td>
<td>Poa pratensis</td>
<td>14</td>
</tr>
<tr>
<td>var. poae†</td>
<td>Poa compressa</td>
<td>1</td>
</tr>
</tbody>
</table>

* Repeated examination of velvet grass clones in turf and forage areas failed to reveal any stripe smut sori in this grass in New Jersey.
† Within the variety poae three pathogenic races designated P-1, C-1, and A-1 have been reported (8) on the host species pratensis, compressa, and annua, respectively.

Table 2. Susceptibility of Kentucky bluegrass varieties and selections to stripe smut during 3 years under turf maintenance.

<table>
<thead>
<tr>
<th>Variety or selection</th>
<th>Age of stand and no. of smutted tillers/sq. ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 yrs. (1962)</td>
</tr>
<tr>
<td>Dwarf†</td>
<td>0.1</td>
</tr>
<tr>
<td>Park</td>
<td>0.2</td>
</tr>
<tr>
<td>Pa. K5(47)‡</td>
<td>0.2</td>
</tr>
<tr>
<td>Pa. K1(61)‡</td>
<td>1.7</td>
</tr>
<tr>
<td>Delta</td>
<td>1.9</td>
</tr>
<tr>
<td>Newport C-1</td>
<td>1.2</td>
</tr>
<tr>
<td>Cougar</td>
<td>1.4</td>
</tr>
<tr>
<td>P-20</td>
<td>3.0</td>
</tr>
<tr>
<td>Merion</td>
<td>7.7</td>
</tr>
<tr>
<td>LSD at 5%</td>
<td>2.3</td>
</tr>
</tbody>
</table>

* This test was established in 1960. Six replications were arranged in a randomized block design. Stripe smut counts were made in October of each year.
† Experimental selection obtained from Purdue University.
‡ Experimental selections obtained from Pennsylvania State University.

VARIETAL REACTIONS IN KENTUCKY BLUEGRASS

Differences in reaction to stripe smut infection by nine varieties and selections of Kentucky bluegrass are shown in Table 2. In each of three consecutive years differences in smut incidence between varieties were highly significant. Although none of the entries tested was immune to infection, three of them, namely Dwarf, Park, and Pa. K5(47), expressed resistant reactions. Merion, on the other hand, was highly susceptible. Generally, stripe smut is considered to be a major disease of 'Merion' Kentucky bluegrass (4). In the Rutgers turf plots smut readings were made by the random positioning of a 6 x 24-inch rectangular metal quadrant and carefully counting all the smutted tillers within the square-foot area. Several readings were made in each plot. By this method stripe smut levels as high as 521 diseased tillers per square foot (or 20.5% of an average of 2540 tillers in a square foot) have been recorded in Merion turf.

Initial infections of stripe smut may arise from seedborne spores, soilborne spores or infected "seed hay." The latter is used occasionally to establish new lawns. Once a plant is infected systematically the fungus apparently produces spores perennially without reinfection. It has been reported (7) that mycelium of Ustilago striiformis can perennate inside green host tissues and subterranean parts of susceptible grasses. As a consequence of these phenomena, the amount of stripe smut progressively increases as the turf gets older. The data in Table 2 show such a buildup of stripe smut in the susceptible varieties. This escalation in smut level is pronounced in Merion, where the number of smutted tillers increased 14-fold between the third and fifth years under turf maintenance.

(Continued on Page 18)
TURF BULLETIN

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EFFECT OF MANAGEMENT PRACTICES ON STRIPE SMUT INCIDENCE IN MERION TURF

Kentucky bluegrass plots were established in March 1962 to study the effect of fertility level, cutting height, and season on the incidence of stripe smut. Cutting heights were maintained at 3/4, 1 1/2, and 2 1/2 inches, respectively. Three fertility levels were established as strips within each cutting height. These were: (a) zero fertilizer, (b) 30 pounds of 10-6-4 per 1000 square feet of turf divided into three equal applications annually, and (c) 60 pounds of 10-6-4 per 1000 square feet of turf divided into six equal applications annually. An analysis of variance of the data summarized in Table 3 indicates that these management practices did not consistently influence the amount of stripe smut in mature Merion turf once the disease was established. With respect to fertility level, the turf showed a significantly lower amount of stripe smut at high fertility in May 1965, and the same plots (high fertility) showed a significantly higher amount of stripe smut in October 1965 (Table 3). The effect of fertility level thus appears to be inconsistent. In general, more stripe smut was present at the 3/4-inch cutting height than at either the 1 1/2 or the 2 1/2-inch cuts. Since cutting height was not replicated, however, it was not possible to determine the significance of this factor.

Table 3. Effect of fertility level, cutting height, and season on stripe smut incidence in Merion Kentucky bluegrass turf.

<table>
<thead>
<tr>
<th>Pounds of 10-6-4 fertilizer per 1000 sq. ft. of turf</th>
<th>October 1964</th>
<th>May 1965</th>
<th>October 1965</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>9.2</td>
<td>9.6</td>
<td>94.7</td>
</tr>
<tr>
<td>30</td>
<td>10.4</td>
<td>42.8</td>
<td>53.7</td>
</tr>
<tr>
<td>0</td>
<td>9.8</td>
<td>134.5</td>
<td>34.8</td>
</tr>
<tr>
<td>LSD at 5%</td>
<td>n.s.</td>
<td>47.8</td>
<td>32.3</td>
</tr>
</tbody>
</table>

*The data indicate the number of smutted tillers per square foot of turf and represent an average of the smut incidence at three cutting heights (3/4, 1 1/2, 2 1/2 inches) at each level of fertility.

EFFECT OF LIQUID NITROGEN FERTILIZATION ON STRIPE SMUT INCIDENCE

In addition to determining the effect of granular fertilizer on stripe smut, another test was designed using liquid nitrogen fertilization. Three-year-old plots of Merion growing at low fertility were selected for this test. The fertilizers used were urea (45-0-0) and ammonium nitrate (33-0-0) applied June 3, 1965 as a single treatment. The rate used was 1 pound of nitrogen per 1000 square feet of turf applied as a drench. An analysis of variance of the data in Table 4 indicates that the effect of these fertilizer treatments was highly significant, whereas the source of nitrogen was insignificant. Three weeks after treating Merion plots with aqueous nitrogen, growth stimulation was pronounced. Counts made at this time indicated that the amount of stripe smut in the treated plots was significantly lower than in the unfertilized controls (Table 4). By late October, however, it became increasingly apparent that what earlier appeared to be a suppression of smut was, in fact, a temporary phenomenon resident in growth stimulation. Counts made in October indicated a significantly higher incidence of stripe smut in the treated plots as compared with the controls (Table 4). On a year-round basis, therefore, it was concluded that nitrogen fertilization did not suppress the amount of stripe smut present in mature Merion turf.

FUNGICIDE TESTS

An effective fungicidal control measure for stripe smut is not known at the present time. An earlier claim by Lukens and Stoddard (6) that disodium ethylenebis[dithiocarbamate] (nabam) was effective as a drench was not substantiated in our trials. Plots of heavily smutted 5-year-old Merion Kentucky bluegrass turf were treated with a drench of 1:400 nabam, 1:400 nabam plus 2% dimethyl sulfoxide (DMSO), and 3 pounds per 100 gallons of zinc ethylenebis [dithiocarbamate] (zineb) plus 2% DMSO. The drenches were applied in May 1965 at the rate of 1 pint of fungicide per square foot of turf and counts were made the following October. No significant control of disease was obtained with any of the treatments. The incidence of stripe smut recorded as diseased tillers per square foot of turf based on four replications was as follows: nabam 78.5, control 79.5; nabam + DMSO 78.0, control 85.5; zineb + DMSO 125.5, control 81.0. Nabam was not phytotoxic when used alone, nabam plus DMSO was moderately phytotoxic, whereas zineb plus DMSO was highly phytotoxic to Merion Kentucky bluegrass.

DISCUSSION AND CONCLUSIONS

Stripe smut is a widespread and destructive disease of turf and forage grasses in the United States (2, 3, 4, 7, 8). In forage grasses yields are reduced through the shredding and death of infected leaves (Fig. 1) and through reductions in seed yields (7). Turf areas consisting of Merion Kentucky bluegrass are often devastated by this unsightly disease (4). Of six pathogenic varieties of Ustilago striiformis described in the literature, five are reported from New Jersey (Table 1). Nine Kentucky bluegrasses were evaluated for their reaction to stripe smut and three showed field resistance to the disease. None was immune. In susceptible varieties a progressive buildup of stripe smut was observed as the age of the turf increased. This phenomenon also was commonplace in home lawns planted to Merion as evidenced by the increase in stripe smut as the turf attained maturity.

Selected management practices, such as the application of granular fertilizer, aqueous nitrogen fertilizers, and fungicidal drenches were ineffective in controlling stripe smut in Merion Kentucky bluegrass. The effect of three levels of 10-6-4 granular fertilizer on stripe smut was found to be inconsistent. Single applications of aqueous urea or ammonium nitrate also were ineffective. Claims in the literature (5) that urea is an effective treatment for stripe smut was shown to be a temporary stimulated growth response in Merion Kentucky bluegrass. Although nitrogen fertilization stimulated the production of new tillers in Merion turf, symptom expression in infected plants was not immediate. This is reflected in two trials by significantly lower stripe smut counts made in the fertilized plots in May (Table 3) and June (Table 4), respectively. In October, however, stripe smut counts were significantly higher in the fertilized plots in both tests (Tables 3 and 4).
and 4). In graminaceous smuts the phenomenon of sporulation occurring in the slower-growing tillers while the main stalks or tillers escape infection is commonplace. Fungicide trials using nabam and zineb also were ineffective in controlling stripe smut in Merion turf. A report in the literature (6) claiming control of stripe smut with nabam was not substantiated. The most promising method of controlling stripe smut at the present time appears to be through selection and breeding for disease resistance.

Table 4. Effect of urea and ammonium nitrate solutions on stripe smut incidence in Merion Kentucky bluegrass.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>June 25, 1965</th>
<th>October 28, 1965</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>Urea†</td>
<td>26</td>
<td>78</td>
</tr>
<tr>
<td>Ammonium nitrate†</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>LSD at 5%</td>
<td>11</td>
<td>27</td>
</tr>
</tbody>
</table>

* The data indicate the number of smutted tillers per square foot of turf and represent an average of the smut incidence at three cutting heights (¼, 1½, 2½ inches) at each treatment.
† Applied June 3, 1965 as an aqueous drench at the rate of 1 pound of nitrogen per 1000 square feet of turf.

Literature Cited


COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCE, RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY.

—Reprinted from Plant Disease Reporter Vol. 50, No. 5, Page 894, May 1966
Turfgrass Abstracts

HERBICIDE CLOTH BEING STUDIED FOR EFFECTIVENESS IN NEW MEXICO. Chopping weeds out of your garden may soon become a thing of the past, but don't throw away your hoe just yet. Researchers are still testing a new method of controlling weeds in your garden, but it looks promising.

What it amounts to is loosely woven cloth treated with a weed killer. You merely cover the area to be treated with the herbicide cloth.

Douglas Bryant (horticulture specialist, New Mexico State University Cooperative Extension Service) reports that studies have shown that the cloth works with 14 different herbicides.

Use of the cloth has several advantages: it would eliminate danger of applying too much or too little of a herbicide, the danger of accidental poisoning that exists with herbicides in conventional liquid form and the problem of spray drift which can damage nearby vegetation.

You can't buy the cloth yet; it's not on the market. Manufacturers are awaiting further tests on its effectiveness, economy and safety for general use.

The cloth decomposes before the end of the growing season and does not interfere with tillage in succeeding crop years. — Seedsmen's Digest, Vol. 17, No. 9, Sept. 1966, p. 16.

HOW MUCH IS A TREE WORTH? The value of a tree depends upon a number of factors, not the least of which is whether it's a park tree or an individual shade tree. It depends on the tree, on who is evaluating it, on what evaluation system (or combination of systems) is used, and on the feelings of the evaluator. Whatever can be said about tree values, the three Ohioans who addressed the question in a municipal arborist panel, moderated by New Yorker Carl Schniff, agree that tree value guides are much needed and that there is currently considerable difference of opinion on the subject.

Harold Groth, Director of Cleveland Metropolitan Parks, examined the question from the position of the park expert faced with increasing encroachment from highways, utilities, and other public and private agencies. How much is a tree worth? Where parks are concerned, Groth lamented, a tree is too often considered merely a fixture of the land with no special value at all.

Wilbur Garmhausen, Chief Landscape Architect for the Ohio Department of Highways, directed his talk to the roadside tree program. How much is a tree worth? To Garmhausen, a tree is worth its contribution to roadside beauty, to highway safety, and to maintenance reduction (he cited reduced snow removal costs where woodlands are adjacent to highways).

George Creed, landscape architect from Cleveland, offered several factors that determine the value of a shade tree, including size, form, ornamental qualities, condition, longevity, adaptability, disease susceptibility, condition, location, and species. How much is a tree worth? A complex question, which depends on numerous factors that Creed feels cannot be reduced to a hard and fast formula. Yet a formula would be a good starting point for appraisers, he adds. If it can be determined, the best basis for valuing a tree is its replacement cost. When he evaluates trees, he has used several different guidelines, and much personal judgment. — Weeds, Trees and Turf, Sept. 1966.

BLUEGRASS SEED CONDITION REPORT. Kentucky Bluegrass Other Than Merion — In the Northwest, prospective yields are generally below a year earlier. Swathing started after mid-June and combined about July 1st.

Reported condition in Idaho is quite variable and generally below last year's crop. Frost caused spotted damage in May and dry weather during the growing season prevented optimum growth. June rains improved conditions in some areas, but dryland yields will be reduced because of the dry weather, frost and poor burns last fall. Yields from irrigated fields will be generally good where good burns were obtained. No insect or disease problems have been reported.

In Washington, crop conditions are generally below normal except in the Columbia Basin area where conditions are good. In Spokane Valley and Whitman County area, potential yields were reduced by April-May frosts and dry weather during growing season. Yields on dryland fields in western sector were cut sharply because of drought but fields along Washington-Idaho border received more moisture and much better yields are in prospect. In Garfield-Columbia County area crop was damaged by very dry spring and yields are expected to be below 1965. In Columbia Basin area forage growth is reported excellent and normal yields are expected.

Crop condition in Oregon is slightly below normal in the west, and in central areas conditions are about normal and yield prospects are good. Crop condition is below normal in Union County where frost and dry weather damaged the crop.

In the North Central District, crop conditions were generally below normal except in Minnesota and South Dakota where conditions were good. Dry weather during the spring growing season prevented grass from making good growth over much of the area and in a few localities late spring rains precipitated a great deal of undergrowth, making it impossible to get much seed. A comparatively small crop is expected in Missouri, Nebraska, Iowa, and North Dakota. Production is expected to be average in South Dakota with good quality. In Minnesota yields of common Kentucky bluegrass were good but very little acreage was harvested. Production of Park Kentucky bluegrass in Minnesota is expected to be about equal to last year's crop. Growing and soil moisture conditions were good over most of the producing area.

Merion Kentucky Bluegrass — Crop condition varies widely in Idaho but is generally below normal in most localities due to frost, dry weather and poor burns. Dryland and irrigated yields from stands where poor burns were obtained last fall are expect-
ed to be below 1965. Yield from irrigated fields on which good burns were obtained should equal last year's.

In Washington dry spring weather severely curtailed yield prospects on dryland fields in the Spokane Valley. Prospects for irrigated fields vary greatly but are expected to be down from 1965, especially where good burns were not obtained last fall. Drought also hurt the crop in Garfield County area and yields are expected to average below last year. Yields equal to last year are expected in the Columbia Basin.

In Oregon prospects vary by area but are generally fair to good. Condition is about normal in central Oregon, slightly below normal in the west due to spring frost, and below normal in Union county because of severe freezing and very dry spring weather.

Harvest in California started about two weeks earlier than last year. Slightly better than average yields are expected as weather conditions were generally favorable. — *Seed World*, Vol. 99, No. 2, Aug. 12, 1966.

**WETTER WATER SLAKES SOIL.** To make water wetter, to make it penetrate soil faster and wet more uniformly, Robert A. Moore, of Aquatrols Corp. of America, Camden, N. J., recommends adding soil wetting agents to water. Explaining that the tension forces of plain water inhibit penetration of small (capillary) pores in soil, he counselled that "only a few thousandth of one percent of wetting agent is needed to reduce tension forces by 60% or more."

"A soil treated with wetting agent also holds water at lower tensions," he continued, "thereby increasing the availability of water and nutrients, and enabling plants to go up to twice as long between waterings." Moore recommended use of soil wetting agents in street tree plantings and in shopping mall plantings where treatment allows water to penetrate dense balls to the plant root zones. Wetting agents can be added to mulches to help keep them in place, drain more reading and uniformly, and to increase plant response from improved water supply.

When balled nursery stock is treated before shipment, watering is more effective and stock arrives and keeps fresher, Moore stated. He also emphasized the benefits of "puddling-in" with wetter water. "The complete wetting and rapid penetration of soil and tree ball eliminates air pockets and allows the tree to be set at final grade. No settling occurs." How much do wetting agents increase soil penetration? According to the man from Aquatrols, wetter water moves through the soil profile in about 2 hours as opposed to 24 to 48 hours for untreated soils. "Wetter water assures the most desirable type of soil moisture condition: good penetration into dry areas, rapid drainage of excess moisture in wet areas." — *Weeds, Trees and Turf*, Sept. 1966.

**HERBICIDE SPRAYS.** A principal means of applying phenoxy herbicides is the spray application of emulsions, large quantities being used for brush and weed control on power-line, pipe-line, and highway rights-of-ways; for weed control in rice, sugar cane, sorghum, corn, small grains, and pastures, for the control of undesirable hardwoods in pine and hardwood forests; and for weed control in lakes, ponds, rivers, and drainage ditches. When phenoxy herbicides are sprayed in these areas, whether by aircraft or ground equipment, volatility and wind drift may lead to contamination of adjacent areas. Volatility can be controlled by using low volatile esters or high molecular weight amine salts of the herbicides. Control of wind drift is a more difficult problem, but even here much progress has been made recently.

The drift of a particle, such as a droplet of herbicide spray, is the distance a crosswind will blow the particle while it falls from the spray nozzle to the ground. Obviously, smaller particles will drift farther than the larger, since they take longer to fall, as can be calculated from Stokes' law. Table 1 gives figures for drift of spray droplets of various sizes from heights of 5 feet (as in air-blast roadside spraying).

Table 1

<table>
<thead>
<tr>
<th>Diameter of Particles in Microns</th>
<th>1 Mile Per Hour</th>
<th>5 Miles Per Hour</th>
<th>10 Miles Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>7 ft. 6 in.</td>
<td>37 ft. 6 in.</td>
<td>75 ft.</td>
</tr>
<tr>
<td>300</td>
<td>9 in.</td>
<td>4 ft. 3 in.</td>
<td>8 ft. 4 in.</td>
</tr>
<tr>
<td>600</td>
<td>3 in.</td>
<td>1 ft. 1 in.</td>
<td>2 ft. 1 in.</td>
</tr>
<tr>
<td>800</td>
<td>2 in.</td>
<td>6 in.</td>
<td>1 ft. 3 in.</td>
</tr>
</tbody>
</table>

*One Micron = 1/1,000 millimeter (1/25,000 inch).

The principal elements in the control of the droplet-size distribution of a spray pattern are: design of the spraying tip, physical properties of the sprayed material, and the shear (or disintegrative) forces which the sprayed material meets moving through the air. — *Hercules Chemist*, No. 53, Sept. 1966, p. 2.

**VERTICAL MULCHING AIRS SOIL.** Wayne C. Morgan, of the Agricultural Extension Service, University of California, second speaker on this symposium, advised that poor irrigation practices, too-rapid water runoff, and grass competition often work to the detriment of trees planted in turfgrass areas. What will help correct this problem? Vertical mulching, the extensorner answered, enthusiastically.

Drill 18 in. deep holes with a 2 in. or 3 in. augur, one per sq. ft. within the drip line, and fill with sawdust, shavings, and fertilizer. Results have been apparent within two weeks, Morgan reported. Vertical mulching provides channels for water and nutrients to enter the soil, allows for a more favorable rooting medium, and adds moisture holding capacity.

The practice benefits not only established trees but also newly planted balled trees. For these, he recommends slanting the hole across existing soil into the ball of the transplanted tree. The Californian added this caution: unless there is a real need for water, air, and nutrients, there is no need for
vertical mulching. Not much, if any, improvement will result when trees are normally healthy.

Anchor man on the panel, Jack Wikle, horticulturist with the Davey Tree Co., Kent, Ohio, traced the evolution of Davey practices from complete cultivating of soil around trees, through the trenching technique, to the current widely-employed practice of "perforation feeding"—Davey's term for vertical mulching. — Weeds, Trees and Turf, Sept. 1966.

PHOSPHORUS COUNTERACTS HIGH, LOW SOIL TEMPERATURES. Grain producers in the Great Plains may soon be able to prevent one form of crop stunting, that caused by high or low soil temperature in the face of a phosphorus deficiency.

ARS soil scientist J. F. Power of the Northern Great Plains Research Center found, in tests at Mandan, N. Dak., that barley growth is inhibited significantly when available phosphorus is at a low level and soil temperature varies only a few degrees from 59 degrees F.

In most of the grain growing areas of the Great Plains, the temperature of the soil at plow depth is normally between 50 and 75 degrees F. from the time plants begin to enlarge until grain is nearly mature.

Power grew barley in Parshall silt loam at six different soil temperatures, ranging from 45 to 80 degrees F. He grew half the plants in soil with 7.6 parts per million of available phosphorus; the other half, in soil with 3.8 p.p.m. of available phosphorus. Of the plants grown on each soil, some received no fertilizer. Others received superphosphate at rates equivalent to either 80 or 160 pounds per acre.

Plants on soil low in available phosphorus, with no additional fertilizer, grew poorly at all soil temperatures. On soil high in available phosphorus, with no additional fertilizer, plants grew well when soil temperature was at the optimum 59 degrees. On soil high in available phosphorus, with additional superphosphate added, plants grew well over a wide range of soil temperatures.

As might be expected, barley made its top yield under the best conditions: Soil high in available phosphorus, fertilized with 160 pounds of superphosphate per acre, and maintained at a temperature of 59 degrees.

These combinations of available soil phosphorus, added superphosphate, and soil temperature produced yields of at least 80 percent of the maximum:

- Low available phosphorus; 80 pounds superphosphate per acre; soil temperature between 55 and 61 degrees F.
- Low available phosphorus; 160 pounds superphosphate per acre; soil temperature between 51 and 69 degrees F.
- High available phosphorus; 80 pounds of superphosphate per acre; soil temperature between 56 and 71 degrees F.
- High available phosphorus; 160 pounds superphosphate per acre; soil temperature between 51 and 74 degrees.

MANAGEMENT. Whether to let golfers play when the "weather" is bad is a question that plagues all golf course superintendents, but one which the green chairman has the responsibility for answering, according to Wilson—Wis. "Have the courage to close the course from play during extreme weather," he says. "It is a mistake to sacrifice the yearly condition of a course for the total membership for a few that might play when frost is coming out of the greens. However, Wilson does give some tips such as, frost sometimes can be washed off with water, and an increasing number of clubs report the use of "wetter water" to prevent dew and thus frost formation when air temperatures are around or slightly below the freezing point. Wilson also suggests that when a cold spell is forecast, cups should be placed to the front part of the green, near the edge where players head for the next tee.

Protective covers for golf greens again were reported on by Watson—Minn. During the winter of 1965-66, and excelsior blanket (Precision-Pak) was evaluated for winter protection of a golf green. The blanket has been used successfully as a mulch on newly seeded turfgrass areas, and because of its ability to conserve moisture, it was felt that the product might provide protection against desiccation— one type of winter injury. The blanket is covered on one side with a wide mesh string net which facilitates handling and tie down.

Following treatment of the experimental green for "snowmold," demonstration plots were covered in late November, 1965. The blankets were anchored with wire staples placed approximately 12 to 15 in. apart along the edges. Results as of late March, 1966, indicate:

1. The material protects against desiccation.
2. Normal growth is stimulated well in advance of that on unprotected areas.
3. Over-succulence associated with polyethylene covers has not occurred, probably because this material does not restrict radiation.
4. The blanket is unaffected by high winds.
5. The few fibers falling from the blanket are easy to remove from the playing surface.

Extensive weather tests made by Thomas and Bear—Washington, D. C., show that the heavy use of rock salt in the wintertime along roads and parking lot areas will kill the bordering bluegrass. — Park Maintenance, Turf Annual, Vol. X, July 1966, p. 34.

PANEL AIRS TREE NEEDS. "Trees are no different from other plants in their basic nutrient requirements," Dr. Eugene B. Himelick, of the Illinois Natural History Survey, Urbana, instructed. Opening speaker on the fertilization and aeration panel arranged by the National Arborist Assn., the tree expert went on to describe results of fertilization studies in progress for four years at the Morton Arboretum, Lisle, Ill.

In tests conducted by Dr. Dan Neely, five types of fertilizers were applied to pin oak, white ash, and honeylocust by four different methods: surface application, dry in holes, solution injection, and foliar spray. Trees responded equally well to all methods but foliar application, where little benefit resulted.
Trees were measured for circumference growth and also rated for deepness of color, found to correlate closely with growth response.

Fertilizers used were ammonium nitrate, urea, P-K combination, N-P-K balanced fertilizer, and N-P-K with minor elements added. “Where nitrogen was included in the fertilizer,” the plant pathologist summarized, “similar benefits in growth were obtained, while phosphorus and potassium alone gave no significant increase over the check.”

In other tests conducted at Oregon, Ill., 6 lbs. of urea per 1,000 sq. ft. have been applied to four species. First year results show treatment increased growth 190% in walnut, 95% in sycamore, 51% in beech, and 0% in red pine. Six pounds of N per 1,000 sq. ft. is about the optimum amount for good growth response, Dr. Himelick said.

The arborist offered these suggestions for fertilizing trees: measure accurately the area in sq. ft. to be covered, using a square or rectangular grid for ease of computation; apply N at 6 lbs. per 1,000 sq. ft. by surface, hole, or injection methods; apply P and K in balanced mix every three to five years or when tests indicate a need; when applying dry in holes, drill 12 in. to 15 in. deep at 2 ft. intervals, and beware of using too much fertilizer; for soluble injections, apply 18 in. deep at 2½ ft. intervals. — Weeds, Trees and Turf, Sept. 1966.

MOWERS CARRY NEW SAFETY SYMBOL IN '66

Power mowing safety was the major concern at a government-industry seminar sponsored by the Outdoor Power Equipment Institute and the U. S. Public Health Service.

“Safety Marketing” was a new term coined, and in connection with this, a triangular shaped safety seal will appear on all 1966 power mowers by manufacturers who can certify that their machines meet new safety specifications drawn up by the American Standards Association for the Outdoor Power Equipment Institute. An expected 90 percent of the 4.7 million mowers expected to be sold this spring will bear this triangle, symbolizing increased protection from the most prevalent type of power mower accident — hand or foot injuries from direct contact with the machine. The standard also minimizes the possibility of injury from hurled objects.

In addition, “Safety News from the Outdoor Power Equipment Institute,” a newsletter, listed five points to remember before mowing, and ten steps to assure a safe lawn mowing summer. Here they are:

Before mowing—
1. Learn mower and controls thoroughly.
2. Fill gas tank before starting (never refuel hot engine).
3. Clear area of children and pets.
5. Never use electric mower when grass is wet.

While mowing—
1. Keep feet clear at all times.
2. Stay away from discharge side of mower.
3. Do not pull mower.
4. Stop engine before pushing mower across drives, walks or roads.
5. Stop engine whenever you leave the mower, even for a moment.

6. Do not unplug the mower while it is running.
7. Mow steep slopes sideways.
8. Do not allow inexperienced help to operate mower.
9. Use extreme caution with riding mowers on steep inclines.
10. Stop engine and disconnect spark wire before working on mower.

—Park Maintenance, Aug. 1966, p. 36

COLORANTS. Introducing his paper on “Evaluation of Colorants for Dormant Turf,” McBee—Tex., recognizes that in order to maintain a pleasing, green color, it is sometimes necessary to use paint or colorants. The Texas trials were conducted to evaluate the longevity and concentration required for satisfactory usage on dormant turf. The three materials studied were Stayz-Green—O. E. Linck Co., Inc.; Cadar—Chevron Chemical Co.; Luminair—National Chemical and Mfg Co. All materials were applied on Jan. 27, 1965 with a pressure-type hand sprayer at about 20 psi; they were diluted with water to apply the mixture at the rate of 4 gal., total volume, per 1,000 sq. ft. on duplicated treatments of 50 sq. ft. plots. The three tested volumes of concentrate were 1 gal./3,000 sq. ft.; 1 gal./2,500 sq. ft., and 1 gal./1,250 sq. ft. Treatments were evaluated on the day of application and on March 17. At the two lowest rates of application only two materials were acceptable, but at the highest, all rates were. No materials were acceptable for the lower rate by March 17 and all three were on the borderline of acceptability at the high rate and needed retinting. The longevity of the colorants used was highly dependent on weather conditions with rainfall and sunshine causing the greatest deterioration of color. — Park Maintenance, Turf Annual, Vol. X, July 1966, p. 35.

BETTER TURFGRASSES TO BEAUTIFY AMERICA. Feature speaker of the American Seed Research Foundation Meeting (Lawn Seed Division) was Dr. J. M. Duich, Associate Professor of Agronomy at Pennsylvania State University, who gave a very interesting slide illustrated talk on “Better Turf Grasses to Beautify America.” Dr. Duich presented slides which showed good plots and plots in which diseased areas could be seen and series of slides showing how disease areas spread. Referring to the report of the New Varieties Committee that there were no new varieties to report upon, he said that efforts must be made to find new varieties or the future of the lawn seed industry will be dismal.

More is known about Merion bluegrass today than about any other grass, Dr. Duich said, but the lawn seed industry needs more than one outstanding grass. There should be about 12 superior bluegrass varieties to be on the safe side; but today Merion is the only true one we have. Common Kentucky bluegrass is subject to disease. Merion is highly resistant. But diseases change and sometime a disease may come along to which Merion is not resistant; and Dr. Duich pointed out that unless before then other varieties can be found which will in a measure come up to the performance of Merion the turf grass industry in likely to be in trouble because they have more or less put all their eggs in one basket—Merion.

HOW TO TREAT SOIL FILLS. "Roots buried under soil fills by contractors cannot receive the normal supply of oxygen and water to maintain a healthy tree condition," John Z. Duling, Muncie, Ind., tree expert indicated. "When we find a fill or grade exceeding 6 in. over most of the root area of established trees, we recommend that plans be made to allow air and water to reach the roots in the original grade."

Where 6 in. to 18 in. of fill is in place, holes are drilled through the fill, which is then loosened with air pressure before blowing in fertilizer and sand and filling with pea gravel. "In places where the fill will be of greater depth, we recommend that an aeration system be installed," the Indiana arborist said. If the fill is already in place, it must be removed in the tree area to the original grade. "A system of field tile is laid on the grade in the pattern of a wheel with the spokes running into the base of the tree, where a tapered base of stone is laid around the tree trunk."

The area is vented to the surface, filled with 6 in. to 12 in. of stones, covered with burlap or straw, and then soil fill installed. After installation, fertilizer can be applied through the vent pipes.

Duling added that there may be a lesson to be learned from trees that have survived soil fills by developing a second root system for the new conditions. Charles Schmaltz of Rochester, N. Y., has successfully induced new root growth "by wounding the trunk or major roots just prior to applying the fill. Exposing the cambium by a notch or cut and then covering the wound with a moist medium, such as sand, or moss, results in root growth from the wound." The tree man described this as an interesting new possibility for arborists. — Weeds, Trees and Turf, Sept. 1966.

HOW AND WHEN TO APPLY LIMESTONE. Most homeowners will not have a practical machine for proper limestone application. Fertilizer spreaders do not ordinarily do a good job. Spinner type spreaders do a better job than others, but even with this type, finely ground limestone tends to bridge over the outlet. Although time consuming, spreading by hand will do a satisfactory job. If possible spread limestone in early morning or evening when the air is calm.

Although limestone can be applied any month of the year, spreading in September through November would be preferred.

Join Your Massachusetts Turf And Lawn Grass Council

For more information write:
Mas., Turf and Lawn Grass Council
att.: Dr. Joseph Troll
RFD #2, Hadley, Mass., 01035
or
George Moore, President MTLGC
1295 State St., Springfield, Mass.

The Massachusetts Turf and Lawn Grass Council is a non-profit corporation. Its officers derive no benefits except the satisfaction of keeping Massachusetts and its neighbors first in turf. It was founded on the principle of "Better Turf Through Research and Education." We must support our University to accomplish this, and we can with a large and strong Turf Council.

Membership is not restricted to Massachusetts residents or turf professionals alone, all are welcome to take part. Write today.