MID-ATLANTIC PROCEEDINGS 1954

1954 ANNUAL CONFERENCE

MID-ATLANTIC ASSOCIATION

OF

GOLF COURSE SUPERINTENDENTS

BALTIMORE, MARYLAND

FEBRUARY 8 AND 9

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Compiled Courtesy of

WEST POINT PRODUCTS CORPORATION
West Point, Pennsylvania

LIST OF THOSE ATTENDING
MID-ATLANTIC ASSOCIATION OF GOLF COURSE
SUPERINTENDENTS

Lord Baltimore Hotel
Baltimore, Maryland

February 8 and 9, 1953

1. William E. Ambrose, Building T-5252, Aberdeen Proving Ground, Aberdeen, Maryland.
2. C. B. Arthur, F. W. Bolgiano & Company, Washington, D. C.
3. Edward K. Bender, 506 Midland Road, Route 1, Silver Spring, Maryland.
4. Charles P. Betschler, Hillendale Country Club, Towson 4, Maryland.
5. Mide Bonavita, Cypress Cove Country Club, Franklin, Virginia.
6. F. J. Brennan, Goulds Pumps, Inc., Seneca Falls, New York.
7. L. W. Brown, G. L. Cornell Company, Bethesda, Maryland.
8. L. M. Burkholder, Fairfax Country Club, Fairfax,Virginia.
9. J. L. Cleary, W. A. Cleary Corp., P. O. Box 749, New Brunswick, New Jersey.
10. J. J. Cockriel, Glenwood Golf Club, Richmond, Virginia.
11. Bill Compton, Prince Georges Golf Course, Landover, Virginia.
12. Sam D. Conger, DuPont Company, P. O. Box 1918, Greenboro, North Carolina.
13. G. L. Cornell, G. L. Cornell Company, 4715 Miller Avenue, Bethesda 14, Maryland.
14. Francis M. Coupe, 962 N. Longfellow Street, Arlington, Virginia.
15. Eugene Crutchfield, Box 134, Cockeysville, Maryland.
16. John L. Daley, U. S. Naval Academy, Annapolis, Maryland.
17. John Z. Davis, Vienna, Virginia. R. F. D. #3.
18. Tom Dawson, Jr., Country Club of Virginia, Richmond, Virginia.
19. Raleigh W. Dawson, 6110 Tilden Lane, Route 4, Rockville, Maryland.
20. Wilson Disney, F. W. Bolgiano & Company, Washington,D. C.
21. James Wm. Duke, Dover Brook Golf Club, Greenspring Avenue, R. F. D. 7, Baltimore, Maryland.
22. David A. Edgar, Elkridge Club, Woodbrook, Maryland.
23. Bob Elder, U. S. Golf Association, Green Section, Beltsville, Maryland.
24. R. B. Essex, Columbia Country Club, Chevy Chase 15, Maryland.
25. M. E. Farnham, Philadelphia Country Club, West Conshohocken, Pennsylvania.

26. O. B. Fitts, National Capital Toro, Inc., Silver Spring, Maryland.
27. Reginald D. Giddings, Seaford Golf Club, Seaford, Delaware.
28. Wojoech F. Gransky, Aberdeen Proving Grounds, Aberdeen, Maryland.
29. Fred W. Grau, West Point Products Corporation, West Point, Pennsylvania.
30. J. C. Harper, U. S. Golf Association, Green Section, Beltsville, Maryland.
31. Frank J. Haske, 4715 Miller Avenue, Bethesda, Maryland (G. L. Cornel Co.).
32. Charles H. Heintzeman, Jr., Memorial Stadium, Baltimore 18, Maryland.
33. Carroll E. Hitchcock, Pikesville 8, Maryland.
34. R. L. Holmead, National Capital Toro, Inc., Silver Spring, Maryland.
35. Jack T. Howard, 135 E. Washington Street, Hagerstown, Maryland.
36. Wayne Jerome, Congressional Country Club, Route 3, Bethesda 14, Maryland.
37. M. P. Johnson, F. W. Bolgiano & Company, 411 New York Avenue, N. E., Washington 2, D. C.
38. Pulmar C. Jitt, Allview Golf Course, Ellicott, Maryland.
39. J. M. Keegan, American Agricultural Chemical Company, 4711 68th Place, Landover Hills, Maryland.
40. Russell W. Kerns, Green Hill Club, Salisbury, Maryland.
41. Tom M. Kerr, Lexington Golf Club, Lexington, Virginia.
42. Ennis H. Kidwell, F. W. Bolgiano & Company, 411 New York Avenue, N. E., Washington, D. C.
43. William Klomparens, The Upjohn Company, Kalamazoo, Michigan.
44. John M. Leavell, Andrews Air Force Base, Washington, D. C.
45. Henry S. Lee, 11420 Luxmanor Road, Rockville, Maryland.
46. William A. Lenz, 4th & C Streets, Sparrows Point, Maryland.
47. C. W. Lindsay, Fountain Head Country Club, Hagerstown, Maryland.
48. E. F. Nuckole, Lexington Golf Club, Lexington, Virginia.
49. W. W. MacVicor, Sparrows Point Country Club, Sparrows Point, Maryland
50. Tom Mascaro, West Point Products Corporation, West Point, Pennsylvania.
51. John McCleaf, Hershey Estates, Hershey, Pennsylvania.
52. Hugh McRae, 3029 Klingle Road, Washington, D. C.
53. John Milan, 2111 Garrison Blvd., Baltimore 16, Maryland.
54. John Howard Mitchell, 201 E. Randall Avenue, Norfolk 3, Virginia.
55. Col. H. B. Musser, Pennsylvania State College, State College, Pennsylvania.
56. O. J. Noer, Milwaukee Sewerage Commission, Milwaukee, Wisconsin.

57. C. M. Paggott, Purcellville, Virginia.
58. Raymond E. Parr, The Evening Sun, Baltimore, Maryland.
59. A. Luck Payne, Purcellville, Virginia.
60. Rear Admiral John S. Phillips, Army Navy Country Club, Arlington, Virginia.
61. Marcus R. Pleasant, Formington Country Club, Charlottesville, Virginia.
62. Robert Pollock, Jr., c/o American Cyanamid Company, 1217 Hill Street, York, Pennsylvania.
63. A. E. Rabbitt, Bureau of Yards and Docks, Navy Department, Washington, D. C.
64. Al Radko, U. S. Golf Association, Green Section, Beltsville, Maryland.
65. James A. Reid, Suburban Club of Baltimore Co., Pikesville 8, Maryland.
66. Joseph A. Reposkey, Talbot Country Club, Easton, Maryland.
67. Jim Roach, E. Mill Road, Flourtown, Pennsylvania (Sunnybrook Golf Club).
68. J. W. Reynolds, Monacan Hills Country Club, Manakin, Virginia.
69. Benson R. Robinson, 4305 Furley Avenue, Baltimore 6, Maryland.
70. W. H. C. Ruthvin, Box 118, Alliston, Ontario, Canada.
71. James Seacrist, Hagerstown, Maryland.
72. Charles Schalestock, 13104 Midway Avenue, Rockville, Maryland.
73. J. C. Schread, New Haven, Connecticut.
74. William C. Schreiber, Cedar Point Golf Course, Patuxent River, Maryland.
75. Richard Scott, Rolling Road Golf Club, Catonsville, Maryland.
76. Robert Scott, Baltimore Country Club, Baltimore 10, Maryland.
77. L. R. Shields, Woodmont Country Club, Rockville, Maryland.
78. Fred M. Slack, Officer's Golf Club, Fort George G. Meade, Maryland.
79. T. R. Sleichter, U. S. Naval Academy, Annapolis, Maryland.
80. Noel D. Smith, National Gallery of Art, Washington, D. C.
81. Robert W. Smith, Baldwin, Maryland.
82. J. B. Spillman, American Cyanamid Co., 315 Gralan Road, Catonsville, Maryland.
83. Ernest E. Stanley, Special Services Golf Course, Quantico, Virginia.
84. E. R. Steiniger, Pine Valley Golf Club, Clementon, N. J.
85. S. A. Sweeney, Prince Georges Golf Course, Landover, Maryland.
86. George Taylor, Baltimore News Post, Baltimore, Maryland.
87. James E. Thomas, Army Navy Country Club, Arlington, Virginia.
88. Stephen Tobash, Officer's Golf Club, Fort George G. Meade, Maryland.

89. Marion P. Toms, Congressional Country Club, R. D. #3, Bethesda, Maryland.
90. Frank W. Tull, Hercules Country Club, Wilmington, Delaware.
91. Richard Watson, Chevy Chase Club, Chevy Chase, Maryland.
92. Paul Weiss, Jr., 1123 H Street, Sparrows Point Country Club, Sparrows Point, Maryland.
93. Paul E. Weiss, Lehigh Country Club, R. D. #2, Allentown, Pennsylvania.
94. Walter A. West, P. O. Box 180, Thurmont, Maryland.
95. Wm. J. Whitarer, 900 Maine Avenue, S. W., Washington,D. C.
96. Robert L. Williamson, Ft. Leslie D. McNair, Washington,D. C.
97. William H. Wilmot, Summit Hall Turf Farm, Gaithersburg, Maryland.
98. Laurince Wisner, The Officer's Club, Aberdeen Proving Ground, Aberdeen, Maryland.
99. A. T. Wicher, Baltimore Toro Company, Baltimore, Maryland.
100. W. E. Zimmerman, 150 Overlook Dr., Bloomfield, New Jersey.
101. J. Wm. Leverton, Glenwood Golf Club, Richmond, Virginia.
102. Robert E. Scott, Bonnie View Country Club, Baltimore, Maryland.

BERMUDA AND ZOYSIAGRASS MANAGEMENT - Panel Discussion

Dr. Fred V. Grau, Leader

Panel Members: Charles Schalestock
Bob Elder
Bob Shields
Jack Harper

The discussion was introduced with a few Kodachrome slides shown by Dr. Grau. The slides illustrated the successful use of locally adapted strains of bermudagrass in the vicinity of Washington and Baltimore. From this beginning came a lively discussion by the panel members, in which the following ideas were developed.

Advantages of bermuda

Bermuda is a natural weed control...It reduces the need for irrigation water...There is grass to cut in the summertime. Golfers have grass when they want it. ...There is a saving in machine maintenance because the more dense turf cuts down on dust, which is hard on machines...There is a more uniform turf. Bermuda covers more rapidly and heals more quickly...The initial cost of establishment is the last cost; bermuda does not have to be reseeded periodically...It provides a better lie for the ball...There is no mud with bermuda. Crabgrass dies at the first frost and leaves mud. Bermuda may go brown after the first, second or third frost, but there is good clean "cushion" in the turf...Winter color is not important at all for a person who wants to play golf. Even bentgrasses and bluegrasses will go brown in the winter in this area. Color, if desired, can be added in the form of a dye. A true golfer wants a true "lie" and doesn't care particularly about the color of the grass...Bermuda is a natural warm-season companion to Poa annua which is the natural winter grass in this area under close mowing and generous feeding...Bermudagrass improves the soil, giving better percolation to the water...It improves resiliency which is of great advantage to players who complain that the fairways in the summer are hard on their feet...Turf is more beautiful in the summertime when more people can enjoy it...With the coming of Caddy-carts and power carts it is important to have an extremely wear-resistant grass like bermuda ...From the superintendent's point of view, he can fertilize in the summertime and thus have better distribution of labor.

Disadvantages of bermuda

It is hard to establish on large areas...It needs more nitrogen than most grasses...It is aggressive and may get into traps and greens...There is a shortage of planting material and more nurseries are required... Bermuda is coarser and harder to cut...It must be cut more frequently...It develops a mat, but this is not an insurmountable problem...The wear and tear during the winter may injure a stand of bermuda unless it is protected in some way...Winter-kill becomes severe at times.

Zoysiagrass

Zoysia is preferable to bermuda in some cases...It tends to start a little sooner in the spring and stops growing a little later...It has more of a place on the home lawn where fool-proofness and ability to grow under neglect is important...It is more tolerant of shade...It is not as dense as bermuda; therefore the cool-season grasses can grow with it better...It does not invade so readily because it is less aggressive... It is slower than bermuda, takes longer to establish a turf...It is more costly and it may require somewhat more water...An advantage is that zoysia is easier to control and it will invade bermudagrass under some conditions.

Location

Bermudagrass belongs on the tees and fairways...Zoysia belongs on the aprons, collars, around the traps, in wet areas, and on shady tees...Of the improved strains U-3 is the most popular bermuda in this area because it is winter-hardy...Meyer (Z-52) zoysia is the best known at the present time, but new selected types are rapidly coming to the fore. There are many locally selected, perfectly adapted types such as populate the fairways and tees at the Army-Navy Country Club, where 100% goosegrass has been changed to 100% bermuda in four years...At the Naval Academy bermudagrass is kept out of the greens by extra feeding on the greens and extra watering.

Planting time

The best time to plant these grasses is in the spring or early summer, from May to August. It changes all of our previous concepts of planting...The cool-season grasses are planted to greatest advantage in the late summer and early fall...Dormant planting of zoysia and

bermuda can be successful...In fact, an experiment set up at Beltsville by Dr. Grau and Al Radko has shown 96% survival without any protection or any watering. This was with Meyer zoysia...Plugs are best to plant when the material is dormant. This way planting can be carried out throughout the entire year and this gives the superintendent a grand opportunity to utilize his labor most efficiently...In some cases where these grasses are planted late in the summer on a clean seed bed, mulching over the first winter will help them to survive...Tiffine (Tifton 127) was mentioned as having a great possibility in this area.

Planting methods

The most economical use of material is to plant sprigs in a clean seed bed, such as a nursery...One square foot of sod torn into sprigs can easily plant 60-80 linear feet of row. The sprigs may be set in rows 12-18 inches apart and 8-10 inches apart in the row... Another method of planting is to shred the sod into sprigs and broadcast them, disc them in, and firmly roll them. Keep them wet, of course, until established...Sprigs tend to spread faster than plugs...The nursery should be no larger than can be adequately taken care of...A two-inch plugger on a tee is not much good; a larger plug is much better...Each tee could have a nursery of improved grass on the back for plugging into the tee and for use on the adjoining fairways...Strips of sod came into discussion but do not find much favor. A washboard effect tends to develop...Fertilizer under the plugs and good firming of the plugs helps to insure success...On fertilization almost everyone agreed that these grasses should be fed at least twice a month throughout the season, when they are cut at one-half inch or lower. In other words, these grasses can utilize tremendous quantities of nitrogen in order to make them respond...Close-mowing is a "must" in order to develop most satisfactory turf. Clippings should be removed...Flexicombs should be used to keep the mat down...Everyone agreed that periodic cultivation is a "must" in developing the most satisfactory turf under nearly all conditions.

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INSECTS AND THEIR CONTROL

John C. Schread
Connecticut Agricultural Experiment Station
New Haven, Connecticut

JAPANESE BEETLE

Turf is often partially or completely destroyed by white grubs, the most common of which is the Japanese beetle. Eggs are deposited in thrifty well-kept turf. They hatch into white grubs that feed on the roots of the grass. At first, irregular brown patches appear. Ultimately, however, the turf may be destroyed completely. Maximum injury occurs during the spring months prior to the completion of a one year life cycle.

For many years lead arsenate applied at the rate of 10 pounds per 1000 square feet was the most practical control measure for Japanese beetle and related grubs. With the advent of chlordane and DDT in recent years, an amazing development of faster acting and longer lived insecticides began.

Chlordane is highly toxic to the Japanese beetle. It is remarkably fast acting providing a more rapid kill of grubs than DDT. It may be applied to infested turf as a dust at the rate of 5 pounds of 5 per cent dust per 1000 square feet. Also as a 50 per cent wettable powder or 48 per cent emulsion. The former at the rate of 1/2 pound in 25 gallons of water and the latter at the rate of 1/2 pint in the same quantity of water per 1000 square feet of infested turf. Fertilizers may be mixed with chlordane dust when both treatments are applied in the same season. Lime should not be used with chlordane or DDT.

Treatments will provide accelerated kill of grubs if timed to precede a rainstorm or when artificial watering is resorted to. Chlordane will remain toxic to grubs in the soil for 5 years or longer.

DDT may be used as a supplementary treatment for grub control at the rate of 6 pounds of 10 per cent dust or 1-1/5 pounds of 50 per cent wettable powder in 25 gallons of water per 1000 square feet. Detailed directions for the use of chlordane are applicable to a treatment with this insecticide.

Hairy Chinch Bug

During seasons of hot, dry weather the hairy chinch bug multiplies rapidly, reaching epidemic status by midsummer. It appears that all varieties of grasses grown commonly in the home lawn are susceptible to attack by this insect. Bentgrasses as well as young bluegrass and fescue are more severely injured than other grasses.

The presence of the insect may be detected by examining the turf at the ground level. The small (1/3 to 1/6 inch in length) black, fast moving adults with white patches on the outer margins of the wings and the brick-red young will be seen scurrying through the grass. All stages of the pest suck the life giving juices from the grass causing brown, irregular shaped areas in the turf, growing larger as the season progresses. Sun-drenched turf in quiet and protected places is sometimes more severely injured than turf areas in semi-shade.

Chlordane applied as a 5 per cent dust or 48 per cent emulsion has given good control of chinch bug. Five pounds of 5 per cent dust per 1000 square feet of turf (200 pounds per acre) or 8 ounces of emulsion in one and one half gallons of water per 1000 square feet (2.5 gallons in 6 gallons of water per acre) applied as a mist rather than a coarse spray will destroy the chinch bugs in a day or so and prevent reinfestation for some time.

Ants

There are several species of ants found in turf. One occurs more commonly than the others and is currently known as the cornfield ant. This species builds small single or multiple cratered cones or anthills in turf which under favorable conditions multiply unbelievably fast. Frequently infestations of this species follow severe injury by Japanese beetle grubs.

Control is simple. Each colony may be treated with 50 per cent wettable chlordane at the rate of 1/8 teaspoon per anthill and watered in by a watering can or other convenient equipment. When colonies are abundant and the spot treatment method becomes laborious the entire turf area may be sprayed with chlordane 50 per cent powder or 48 per cent emulsion. Four ounces of either formulation in two gallons of water applied to 1000 square feet and followed by thorough drenching of the turf with water will destroy all ant nesta and

should prevent re-establishment of the insects for the balance of the season. Other species of ants that may occasionally infest turf can be effectively controlled by chlordane as described above.

Sod Webworms

There are about one hundred species of sod webworms in North America, one or more of which occur wherever grass grows. Some species attack corn, wheat, oats, cranberry and tobacco. However, a large percentage of them are primarily grass feeders.

Because of the habit of these insects in feeding at the bases of the grass plants, infested turf may take on a rather moth-eaten appearance. Small irregular brownish areas appear where the larvae feed at night. During the day, they conceal themselves in silklined tunnels at the surface of the soil or immediately below. Adults of the sod webworms are dirty gray to yellowish brown moths.

The insects are more abundant and do more damage in years of deficient rainfall. Severe outbreaks throughout the country in the past coincided with droughts. Bentgrass and young bluegrass are more seriously injured by sod webworms than other grasses. There are two to three generations a year, being most troublesome during the months of July, August and September. Each brood must be controlled as it appears.

Chlordane is an effecient control measure in ridding greens of sod webworms. Used as a 50 per cent wettable powder, the insecticide should be sprayed on the grass foliage in late afternoon or early evening at the rate of 5 ounces in 4 gallons of water applied to 1000 square feet of infested turf. When this procedure is followed maximum control should be attained in a minimum of time. Light precipitation following treatment does not appear to reduce materially the toxic action of chlordane for this purpose.

Cutworms

As in the case of sod webworms, cutworms frequently (especially during dry seasons) injure turf seriously. There are a number of species involved, some of which are more destructive than others. There may be several generations a season. The larvae remain concealed just below the surface of the ground during the day coming out at night to feed. Irregular closely crop-

ped brown spots develop in the turf especially noticeable in golf course greens, grass tennis courts and bowling greens.

For quick kill, chlordane 50 per cent wettable powder used at the rate of 5 to 6 ounces in 2 gallons of water applied to 1000 square feet of infested turf will give good control. When the treatment is made late in the day, dead and dying cutworms will be found on the surface of the turf the following morning.

INSECT PESTS OF TREES AND SHRUBS

Birch Leaf Miner

The birch leaf miner would appear to be more abundant and consequently more injurious to birch foliage during the past few years than heretofore. The birch species most seriously damaged are the gray birch Betula populifolia, white birch B. papyrifera and the European white birch B. alba. The insect passes the winter as a mature larva in an earthen cell in the soil beneath the trees. In the spring it transforms to an adult sawfly. It is black in color and about 1/16 of an inch long. Eggs are deposited in young leaves only. As a result all of the leaves are infested in the spring. Later in the season only the new leaves in the tops of the trees or on young sprouts are infested. There are several generations of sawflies during the growing season.

For years incotine sulfate gave good control. Recently it has been shown that Malathion and Lindane used at the rate of one pint of emulsion in 100 gal. of water when the birch leaves are inhabited with eggs and larvae in May will destroy the population. One treatment well timed between May 15 and 25 is all that may be necessary to control the first brood. Treatments made July 1 and again 10 days to 2 weeks later should control the second brood of miners.

Boxwood leaf Miner and Psyllid

Boxwoods are frequently damaged by leaf miner and Psyllid. The adult of the boxwood leaf miner is a delicate orange yellow midge or fly about 1/8 inch long. It lays its eggs during late May and early June in boxwood foliage. As the miners develop they create blister-like swellings on the underside of the leaves. There is only one generation a year. The adult of the boxwood Psyllid is grayish-green in color and about 1/10 inch long. The first brood is active during May

causing a cupping of the terminal leaves of infested boxwoods. Later the greenish colored nymphs with waxy-like pellets adhering to their body disperse throughout the plants.

Nicotine sulfate has given good control in the past. Experiments conducted since 1950 have demonstrated the effectiveness of DDT emulsion at the rate of 1 pt. per 100 gal. of water in controlling adult leaf miners or Malathion or Lindane emulsion at a comparable dose for control of the miners in the leaves. Psyllids were best controlled with Lindane and Nicotine sulfate at dosage levels suggested for leaf miner. Treatments to control boxwood pests should begin about mid-May. Re-treatment four weeks later may be pursued if necessary.

Andromeda Lace Bug

Andromeda (Pieris japonica) has recently become infested with a new species of lace bug (Stephanitis globulifera Mat.) There are several broods of the pest from May to October inclusive. The adult resembles the species of lace bug commonly found on Rhododendron; however, the head and wing markings are much darker in color. Individuals average about 1/8 inch in length. Egg laying and discoloration of foliage caused by the insects follow much the same pattern associated with other species of lace bug found on different plants.

Control of the pest has been achieved through the use of Chlordane, Aldrin, Dieldrin, Lindane and Malathion emulsions at the rate of one pint to 100 gal. of water. The first treatment should be made May 15 to 25. A second treatment may be made 4 weeks later.

Strawberry and Taxus Weevils

The strawberry root weevil and the black-vine or Taxus weevil are closely related species that may seriously injure or kill hemlock, arbor vitae and Taxus. The larvae of the first species destroys the roots of hemlocks whereas the adults girdle the twigs of arbor vitae. The foliage and roots of Taxus are damaged by the black-vine weevil. It would appear that the latter type of injury is the most serious, resulting in complete loss of many valuable plants during the growing season. Each species has but one generation a year.

Chlordane applied to the soil at the base of the trees as a 5% dust at the rate of 5 lbs. per 1000 sq. ft. of ground area will destroy the larvae and adults of both

pests.

Taxus Scale & Mealy Bug

Lecanium fletcheri a soft-bodied scale is frequently an important pest of Taxus. Certain varieties of yews such as T. hatfieldi and T. brevifolia appear to be more susceptible to epidemic outbreaks of the pest than others. Eggs begin to hatch in late June and continue to do so for about 4 weeks. The young scales feed on the new branches and foliage and develop very slowly until autumn. In the following spring feeding is resumed and continues until the scales reach maturity. A species of mealy bug closely related to Comstock's may be found on most any Taxus. T. capitata and T. brevifolia are indicated as somewhat more susceptible to attach than others. There are two generations of the pest a year. The crawling stages of the summer brood are present from before the middle of July through early August. The young of the second or fall brood hatch during September. They may or may not disperse from the egg mass during the autumn. Notwithstanding growth does not begin until the following year. On reaching maturity in late spring the females create masses of pinkish eggs which are intermingled with waxy or cottony-like secretion. A week or ten days passes before they begin to hatch.

Control of both pests may be achieved through the use of several or more compounds. Horticultural dormant miscible oils applied in the spring after danger of freezing weather has passed will kill the overwintering scales and mealy bugs. Later in the season newly hatched scales and mealy bugs can be controlled with summer oils. Similar results may be achieved through the use of Malathion, TEPP, Parathion, and DDT emulsions and wettable powders. Emulsions may be used (per 100 gallons of water) at the rate of 1/2 to 1 pint of the first three materials and 1 quart of the fourth, also 2 lbs. of wettable powders. Nicotins sulfate, 1 to 2 pints plus 1 to 1 1/2 gallons of summer oils will control young mealy bugs. Oils may damage evergreens hence caution must be exercised in their use.

Mites

Spruce mite, two spotted mite, clover mite, boxwood mite, azalea mite and others are perennially responsible for varying degrees of injury to arbor vitae, hemlock, blue spruce, azalea, boxwood, lawns, etc. Much of the unsightly damage caused by mites to trees

and shrubs in recent years has for the most part arisen as a result of the use of DDT and other compounds for the control of insect pests. The insecticides have not only killed the pests but they have likewise destroyed their insect enemies and those of the mites as well. Consequently injurious species of mites uninhibited in their development now appear to be more serious pests than ever in the past.

For years controls applied to mite infestations seemed to have been somewhat incomplete in their effectiveness. As a result considerable off-colored foliage could be seen most anywhere throughout the summer months. Fortunately during the past several years specific miticides have been developed which are remarkable in holding down mite populations.

Among the newer miticides may be mentioned Aramite, Ovotran, Dimite, and chlorobenzilate. All of these and others as well may be used to control one or more species of mites.

They may be used on mite infested trees and shrubs as emulsions at the rate of 1 to 2 pints in 100 gallons of water or 8 to 16 ounces per gallon of water in mist blowers; the lesser dosages for light infestations and the stronger dosages for heavy mite populations. Wettable powders may be substituted for emulsions.

In addition to killing many of the crawling stages of mites, Ovotran also destroys the eggs. Hence this miticide would appear to be desirable for general use. It may be applied to mite infested trees and shrubs at the rate of 2 lbs. of wettable powder per 100 gallons of water or by mist blower.

Miticides should be applied to trees and shrubs as required during the spring and summer. Occasionally a fall treatment may be necessary. When insecticides such as DDT are sued to combat insect pests, one of the miticides discussed may be included in the spray program. Hence destructive insect populations are retarded and injurious mites are kept under control.

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TURF CONFERENCE SPEECH

by

O. J. Noer - September 22, 1953

I presume a resident of Alaska, of Arizona and of Florida would have a different answer to the question, "What makes grass grow?" The Alaskan would emphasize warm weather; in warm sunny Arizona, water would be stressed. Florida always has plenty of sunshine and ample rains, but the soil is white sand, so growth is dependent upon plenty of plant food. Water, temperature and food are important. To have good turf it is necessary to make conditions right for its growth. In the first place, it is necessary to select the right grass. It must be suited to the climate and adapted to the particular spot. For shady areas shade tolerant grasses must be used.

About 500 grasses have been identified in the U. S. The ones which are suitable for use on turf areas can be counted on the fingers of two hands. So choice is limited. In the south warm-season grasses such as bermuda, carpetgrass, St. Augustine, etc. are used. In the north we depend upon the so called cool-season grasses; principally the bluegrasses, the fescues and the bentgrasses.

Night time as well as day time temperatures are an important factor in plant and grass growth. Very frequently on seeded areas the seedlings do not fare as well as expected, even though day time temperatures are in a favorable range. The nights are too cool. Grass requires an ample supply of water. Grass evaporates about 500 pounds of water for each pound of dry matter that is produced. Soil condition is a very important factor. The need for a fertile soil is stressed, sometimes above everything else. The term is broader in scope than just plant food content. Very often we receive samples of soil for analysis because grass is not satisfactory. They ask what fertilizer is needed in order to grow good grass on the green. Sometimes we don't even analyze the sample because the soil is suited to make brick rather than to grow grass. A fertile soil must do more than furnish plant food. First, it must be well drained and when considering drainage, one should think in two terms; surface and under drainage. Good surface drainage comes first, because the quickest way to remove surplus water is by run off. After that comes good under-drainage.

The soil should have the proper physical make-up. Soil isn't just so much dirt. Actually it is a mixture of a solid, a liquid and a gas. The solid is the mineral particles and the organic matter, the liquid is the soil moisture which surrounds the particles and carries the food which is taken in through the root system. Organic matter enables soil organisms to operate and hence makes the soil a dynamic rather than a static medium. The soil solution at any one time never contains enough food to sustain growth for a long period of time. The amount of soluble phosphorus is rarely more than three or four pounds per acre. A fertile soil, from the standpoint of plant food, is one which can release insoluble nutrients rapidly and convert them into compounds which the grass can absorb and utilize.

What the layman believes about growing grass from seed is fallacious. He thinks the more seed used, the better the stand of grass. At one time it was regular practice to use 600 pounds of seed to the acre on new lawns around government buildings in Washington, D. C. Apparently, some enterprising seedsman did a good job of selling those in charge. Instead of getting good turf they ended up with crabgrass, clover, knotweed, and everything but good turf. It was demonstrated that with ample soil fertility and a good seed bed there was no point in using seeding rates in excess of 40 to 120 pounds per acre for a bluegrass-bent mixture. It is important to bear this in mind especially with Merion bluegrass and polycross bent. With Merion bluegrass, commanding a price of 3 to 5 dollars a pound or more, and with polycross selling for 7 to 10 dollars a pound, the cost of seed may exceed the value of the land. A seeding rate of 1 pound per thousand square feet has produced an excellent cover of polycross bent. This is approximately 40 pounds to the acre, so at 7 dollars a pound that means $280 an acre for the seed alone, and if one were to use 2 pounds of seed to 1000 square feet the acre cost becomes $560. Land usually costs less than that. If one were to build a golf course and have to pay $560 an acre for the land, I think there would be something said by the membership as to the amount of money being spent; yet there is no quarrel at the cost of excessive seeding rates.

I visit Door County, Wisconsin frequently. Beachgrass grows in the dry sand along the shore of Lake Michigan seemingly without water. The sand is loose and absolutely dry. Since no plant can grow without water, I began to do a little digging and when I got down to about 12 to 14 inches I discovered the long rhizomes which are responsible for the spread of this grass.

The sand below contained a bit of moisture. The beachgrass adapts itself to the local environment with respect to moisture. Many of uou wonder why we do not use pure sand for building greens. Sand is as bad as other classes of soil particles, and will pack and make a compact surface, especially when it is wet. Yet when dry, it is loose and friable. Notice the deep footsteps out from the water's edge where the surface sand is dry. Walking there is difficult but not on the tight wet sand.

Several months ago, I visited a golf course in Florida. The greens were pure sand and yet they were as hard as the floor upon which I am standing. Balls bounced to thirty feet into the rough. Surfaces were extremely hard because the sand particles were fine and uniform in size. The first time over with the Aerifier, we couldn't get any deeper than 1 1/2 inches. Once when I was in Cleveland I happened to notice the poor grass along the edge of the practice green at the Country Club. Naturally, I was curious and wondered why the grass was poor along the edge and good out beyond. I used a profile sampler to examine the soil and found pure sand to a 5 inch depth. The sand accumulation was the result of practice pitching out of the adjoining sand trap. The grass was struggling and failing to exist during the hot weather because sand did not hold enough water. The grass could have been maintained by more frequent watering. Sand in itself has such a low water-holding capacity that it is necessary to water more frequently than otherwise would be required. When the Scotch professionals first came to America they thought that sand was all that was needed because that is what they used for greens in Scotland. Quite naturally, they attempted to follow the same practices over here. After a year or two, grass started to die because of the imbedded sand layers. It happened during the hot weather. Soil plugs taken from the green would break at the sand layer because roots stopped there. When the sand layer was near the surface, grass wilted first and then died. In Scotland when the mid-day temperature reaches 75 to 80, I'm told there is a big headline across the paper of a heat wave. In Iowa, Illinois, Ohio etc., it is a relief to have summer temperatures drop to 80 degrees.

In the old days, when we had no cultivating tools, we would topdress greens more frequently than otherwise necessary in order to build a deep layer of good soil above the sand layer. Now we can cultivate soil parts at the sand layer except in the chocolate drop-like mounds where the sand was mixed with the soil on the Aerifier spoon.

Anybody who can grow grass at Pine Valley can succeed anywhere. In 25 years I have never seen a bad green on the course. Steiniger is capable, but the uniformity of the soil and its excellent quality is part of his secret in growing and keeping good grass.

The greens have been good at Des Moines, Iowa even though Bill Keating considers it to be somewhat of a bastard grass. The greens are Metropolitan bent which has a tendency to mat and fluff at the top. But he built the greens with a lot of gravelly material in the bottom. Since then he has used a consistently uniform topdressing and has prevented the development of thatched layers.

I have never seen bad grass on the greens at Milwaukee Country Club in 20 some years. I can tell you when Charles Gardner was the Superintendent, and I can point out when Fred Haselow took over by the character of the soil. The top layer is the Ted Booterbaugh regime. Charlie was a great believer in sand, so he used pure sand. When he left, Fred took over and found it necessary to water very often to prevent wilting. Because of sand's low water-holding capacity he used humus, to create a better water-holding capacity and was heavy handed with peat. When Ted Booterbaugh took charge the greens were so spongy that players complained about them as a putting surface. Each time they became saturated with water maintenance was difficult. Ted switched to a mixture which consisted of about 2 parts of good coarse sharp sand, one part of loam soil, and one part of organic material. The change created an excellent putting surface.

Early in July I was in Chicago and found deep roots on the greens at one course. They were well over 16 inches deep. There is about 50 percent by volume of solids in the soil, about 25% by volume of moisture, and about 25% of air to furnish the oxygen that roots require. Roots will survive in a saturated soil for a short time, a little longer than a human, but eventually they behave as we do. Let somebody hold your head under water for a few minutes, then the undertaker will do the rest. Grass can live without air somewhat longer, but if roots are deprived of oxygen they soon succumb. When roots are confined to the top inch you are in for a headache during hot weather.

Last year we had a bad hot summer. I was in Cincinnati when the temperature was about 105 to 110 with humidity almost 100%. This was probably as fine an example of Pythium injury to bent that I have ever seen. Streaks

are very characteristic of Pythium when it is rampant. We do not have a fungicide that will stop Pythium, about all one can do is to use a little hydrated lime, and then go to church and pray for a change in weather.

Copperspot has a coppery, red appearance which is characteristic of this disease. We have some fungicides such as PMAS and several others which will control and prevent copperspot.

I was in Baltimore during early June and while I was there I saw some greens in which fertility levels were different. One got nothing but liquid fertilizer. They were depending upon the extravagant claims made by the producer. Don't misunderstand me, I'm not here to condemn liquid fertilizers because I think they may have a place. The only thing is that you can't expect 1/4 pound of nitrogen to be as effective as 1 pound.

There is another green in Baltimore which was receiving nothing but liquid fertilizer at the rate recommended by the manufacturer. An adjoining green received fifty pounds of verta green which is a 5-10-5 along with 100 pounds of organic fertilizer containing 6% of nitrogen. You can see the difference as far as color is concerned. The green receiving liquid fertilizer was crying for more nitrogen despite the manufacturer's belief that it was receiving enough.

The Plots at Lansing, Michigan are Washington bent which is very susceptible to dollarspot. No fungicide was used all year. All plots received ample quantities of phosphate and potash. The only difference was in the level of nitrogen that was used. On the no nitrogen plots scars from dollarspot were numerous. When three pounds of nitrogen per thousand square feet was used per season not quite as much dollarspot but still the scars are present. With 7 pounds of actual nitrogen per thousand square feet there was almost no dollarspot. The last plot received 9 pounds of nitrogen and has no dollarspot scars.

There was a great deal of injury in the spring of 1953 from leafspot principally of the helminthosporium type. In areas where we are having a lot of trouble with leafspot, there is a trend toward a grass like Merion. We are not having much success with Merion when we try to seed it into existing turf or when we use it in mixtures with other aggressive grasses. Our best stands are obtained when we start from scratch in bare ground and use a seeding rate of 1 pound per 1000 or 40 pounds per acre. An example of curvelaria type leafspot is on a patch of velvet bent on a green in New

England. In this case it is my belief that the leafspot is the primary cause of injury. With this kind of a situation some of the fungicides, such as PMAS and Actidione, appear to have a place.

In this case leafspot was secondary and not the primary cause of damage. An excessive surface thatch and several other things weakened the grass to the point where leafspot took over and finished the job. In May when I was in Buffalo I saw this very bad injury. It was due to leafspot of the helminthosporium type. In less than two hours the grass changed from good green color to bad color. The bastard type Virginia bent is known to be very susceptible to leafspot. This was the first time I have ever seen the blue greasy appearance of the turf in the spots where leafspot fungus was active. The greens were badly thatched, very acid and low in magnesium and potash. We got them to quickly aerify and follow with a Verti-cut machine in order to remove some of the surplus grass, then apply dolomitic type limestone, modify the fertilizer program to increase the dosage of potash, and change the kind of nitrogen. I haven't been back, but I received a letter from the chairman in September and he said that the greens came back and that they were much better all season than ever before. Here again, the search for a fungicide to stop leafspot would have been a hopeless task. The thing to do is to put first things first, get rid of the things that are weakening the grass and then the fungicide will have a chance to do an effective job and perform as it should.

When I was in Toronto a few weeks ago, one of the clubs complained that the holes do not heal after aerifying. The same thing occurred with the old hollow tined forks. Cutworms resided in the bottom of the holes during the day and then came up at night to feast on the grass around the holes. That's why holes were not disappearing. To prove it, I took my knife, cut out one of the holes and here is what I found down at the bottom, a nice big, fat, juicy cutworm. What they should have done was to put on a little Chlordane to get the cutworms under control before aerifying and then the healing process would have taken place as expected.

When we put the Verti-cut machine on a green in Buffalo and removed the surface thatch we uncovered an old snow mold scar, which we could not see before. If you can't afford to buy a Verti-cut machine--you can make one out of an old mower. This was done by Feringa in Grand Rapids when one of his Washington bent greens became so bad members complained. He conceived the idea of

using pieces of welding rod on the blades of an old discarded Ideal reel. He removed the bed knife and quickly removed the surplus grass. The operation was performed in the spring and the green was unplayable until mid-July because of the damage he did. So he was not too popular during May and June. When LeRoy Jones, of the Lansing Country Club, saw the machine he was impressed with what it was doing. He used an Ideal also because with it the bed knife can be removed quickly. He took drill rods, welded them 2 inches apart and staggered them 1/2 inch on each succeeding blade. But before welding them on, he ground them to knife edge thinness on an emery wheel. A door sash weight was placed out in front to hold down the mower. His home made contraption did a good job. The stolons removed from one green were enough to plant 18 greens. I think the Verti-cut machine probably does a little better job because of the design of the knives, but those of you who don't have the money can make a machine, even though you are not apt to save any money by doing so.

The water man should be instructed during dry periods to set the sprinklers out around the edges in order to keep a plentiful supply of moisture on the banks and slopes so that dry soil beside the green will not pull water from the putting green proper. That will help avoid mower injury along the edge of the green and on the aprons. I was in Cape Cod in July, during very dry weather, which is unusual, but this man was smart enough to keep the collars, the aprons and slopes well wetted so he would have no trouble around the edge.

An example of fairy ring on a green--see first a circular spot. The fairy ring organism is of the mushroom type. It lives on dead rather than living organic matter. The dead grass is not directly due to the fungus. When fairy ring is present, cut out a piece of soil from the infected spot. It will have a mushroom like smell. If the organism is particularly aggressive you will see the white thread-like mycelium in the soil. The fungi requires a source of energy material, just as you and I do. The source of energy for the fairy ring fungus is the dead organic matter in the soil. It lives on the dead organic matter and competes with the grass for the soil moisture and nitrogen. When the fairy ring is greener some of the fungi have died and the mycelium bodies are undergoing decay by soil bacteria with the liberation of the nitrogen that it contains for use by the grass. When the grass is brown the fungus has robbed the grass of all the soil moisture and the nitrogen. Then the grass withers, turns brown, collapses and dies. We need to find a

good fungicide which will stop and kill the fungus in the soil. We have them, but rates needed will kill the grass too, so we might just as well let the mycelium have a good time instead of playing havoc with them and the grass. The only successful way to combat fairy ring has been to fork to get air and water into the soil and to use a little hydrated lime to accelerate the decomposition of the organic matter in the soil.

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WATER SYSTEMS FOR GOLF COURSES

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Because each Course presents problems peculiar to itself and differing from other Courses, it is not possible, in our talk today, to give you specific recommendations as to the type or size of System you should consider the best for your particular Course. Much depends on the location and capacity of your source of supply, the distances and elevations to be reached by the system as well as the length and sizes of pipe already installed or to be installed.

To make a proper selection of the right type and size pump - and to decide if more than one pump should be used - it is essential that the pumpman understands clearly what the Superintendent wishes to accomplish.

And this should cover not only his immediate requirements but also any possible expansion for the near future.

Frequently it is possible to make a pump selection which can be designed to meet the immediate requirements -- and with minor changes to provide for more capacity and higher heads for future expansion, without discarding the original pump. This is true particularily where centrifugal pumps are concerned.

Too, many installations can be better handled with two smaller pumps, rather than one large pump.

Centrifugal pumps lend themselves well to working out combinations; they can be installed and piped up to operate -

in series - where the first pump delivers into the second pump in order to get higher pressure.

in parallel- where two or more pumps work side-by-side to get more capacity in gallons per minute at the same pressure.

independently- where one pump may handle large capacity at low or moderate pressure and another pump may handle smaller capacity at higher pressure to reach the more distant or higher elevations.

TYPES OF PUMPS

There are a number of different types of pumps which may be used for Golf Course installations.

Today, the most commonly used type - where the source of water supply and other conditions are suitable - is the centrifugal pump. There are also the piston and plunger types of various sizes and capacities which are used for what is termed "shallow well or suction" conditions. These may be used where the source of water supply is at a depth below the pump of around 20 feet and the suction line is short.

Then, when your source of water supply is from wells, where the depth to water is greater than 20 feet to 25 feet we have the

Deep Well cylinder or rod pump (rarely used today)
Deep Well Jet Pump - for capacity up to about 20 gallons per minute.
Deep Well Turbine Pump
Deep Well Submersible Pump

SOURCE OF WATER SUPPLY

If the pump can be located so that the elevation of the pump above the low water level - when pumping or during dry periods - is not greater than 20 to 25 feet and the suction line is not longer than 50 feet, a suction type pump may be considered.

Good practice permits the use of a centrifugal pump

where total suction lift - elevation plus pipe friction - does not exceed 15 feet. Careful selection depending on the design of the centrifugal pump - for certain combinations of capacity and head permit using the centrifugal pump for lifts as great as 20 to 22 feet.

Where the centrifugal pump can be located below the level of the water - so that the supply flows to the pump by gravity - you have the ideal conditions for this type.

Where you have a lake, stream, reservoir or pond,first consideration should be given to the centrifugal pump.

Where the pump must be located more than 20 feet above the low water level or the suction line to the pump is greater than 50 feet, one of the Deep Well type pumps must be considered.

When your water supply must be taken from wells - driven or drilled wells - the first consideration in selecting the proper pump must be the volume of water produced by your well. This is also called the well "in-put".

About the only way to get correct data as to volume of the well is by a pumping test - run for sufficient time to determine the in-put and the draw-down of the particular well.

The Well Driller who puts down your well - if properly equipped and qualified to run such tests - or someone brought in to run such a test is the one best qualified to supply accurate data.

It is a mistake to invest in any pump having capacity greater than the in-put of your well. A 100 gallon per minute pump on a 50 gallon per minute well is a mistake.

Where the source of water supply from a deep well is less than your requirements the only alternative is to pump at the maximum well capacity and store up water in a reservoir or storage tank of sufficient capacity to meet your peak requirements.

PIPING LAYOUT

Correct Pipe Sizing or Pipe Layout is the most interesting and most involved study for Golf Course installations.

In many cases, the real cost of delivering water to the point of use is extremely high because of excessive pipe friction due to improperly sized pipe.

When you are considering a new installation be sure you have a study made of the best possible pipe-layout before selecting your pump or purchasing pipe.

This involves considerable work and a number of calculations but all the fellows in the pump business are qualified and interested in making such a study for you.

Where you have a survey or map of your Course so that distances and elevations can be determined it should be made available.

Before purchasing pipe for your installations the study and at least a tentative selection of pump and motor or engine should be made.

Where you wish to add to an existing installation - or to install a new pump on an old system, accurate information as to all pipe sizes,and reasonably accurate data as to distances and elevations should be provided.

It is helpful, where an old pump installation is to be replaced, to permit the pump man to check type, size and speed of the old pump and record suction lifts and discharge pressures before dismantling.

A comparison can then be made between the service you have been getting and the improvement which might be made by a new installation.

Lack of sufficient pressure when the water reaches your sprinklers at either greens or fairways can develop very unsatisfactory results. It is my understanding that the leading Sprinkler Manufacturers recommend a minimum capacity of 15 GPM and a minimum pressure of 35# at their nozzles to accomplish the desired results for green sprinkling.Greater capacity and higher pressures are desirable under certain conditions and can be provided by selection of the proper pump.

Proper sizing of pipe will avoid excessive pressure and capacity in the areas close to the pump and too low pressure and loss of capacity at the distant areas.

ELECTRIC SERVICE LIMITATIONS

Most Golf Courses with which I am familiar today use Electric Motors for their pump operation.

The combination of a good centrifugal pump direct connected to the proper size and type of electric motor probably gives you Superintendents the least problems of satisfactory operation and maintenance.

The modern type centrifugal pump has been designed to operate with motors of higher speeds than the older types and most commonly used today are of 3500 RPM.

The Public Utility serving you with electricity usually has certain requirements that must be met when connecting a motor to the line. In many cases only single phase current is available and the Power Company may limit you to a maximum size motor of $7\frac{1}{2}$ HP and in some cases to 5 HP.

Where three phase current is available there is much more latitude as to motor size and type.

Low line voltage is a serious factor in pump operation. It causes a reduction in speed (an important factor in centrifugal pump operation)and a reduction in power which affects any type of pump and can develop interruption in your sprinkling operations.

Low voltage can be caused by lack of capacity in the transformer serving you, or, as is most frequent, by the use of too small size of wiring, or overloading of the circuit to which your pump motor may be connected.

Ample transformer capacity and proper sized wiring are most important to a satisfactory operation of a pumping system.

To select the proper type of motor, the pump man must know the characteristics of your electric service; i.e. the voltage, cycles and phase.

For automatic start and stop operation,it is necessary that the proper motor starter and other controls be selected.

MAINTENANCE

Maintenance, I am sure, is a problem you gentlemen would be happy to do without - or at least to reduce it to a minimum.

Developments in the past fifteen years in the pump industry have been to a great extent directed to a reduction of maintenance problems in the operation of pumps and water supply systems.

Simplification of design, inter-changeability of parts and improved materials of construction have gone a long way to accomplish this.

The centrifugal pump of today is constructed of a minimum number of parts; there are few close, rubbing fits in the pump, and recently with the introduction of the mechanical seal - to replace the older type of stuffing box - maintenance has been reduced materially, providing your pumps and its driver (electric motor, gas or diesel engine) is properly and substantially installed and aligned.

With the older types of pumps you have suction and discharge valves, valve springs, stuffing box packing and glands, gears, bearings, etc. to be concerned with. Too, you have close fits to maintain and reciprocating action to contend with.

Lubrication of the centrifugal type pump is at a minimum as compared with the older piston or plunger pumps.

In Industry, the users of centrifugal pumps frequently carry on hand as a spare, a complete rotating element, consisting of a shaft, impeller, wearing rings and usually a set of bearings. This unit can be installed quickly in the existing pump with little work or delay and the original rotating element taken into the shop for overhaul. The cost of such a unit is low when a saving in time and labor is considered.

You will understand, of course, that piston and plunger pumps are still manufactured - and there are some conditions where nothing else can be satisfactorily installed; in such cases we must face the Maintenance problem, but where conditions permit, I am sure you will find the centrifugal pump to your liking.

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GRASS PLANTING - METHODS AND DEVICES

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In developing material for this presentation, a number of experiment stations and workers over the United States and Canada were contacted in an effort to derive pictures and material showing modern methods of planting grasses. Surprisingly little material was obtained. It appears as though much of the work done over the past eight years in this area has pretty well set the pace for the grass planting methods and devices.

In considering the problems of grass planting, the greatest one that faces us is not the establishment of grass in a prepared seed bed but rather establishing improved grasses into existing turf where the grass is quite unsatisfactory, developing the new turf without taking the area out of play. Golf course tees are notably difficult in this regard because under heavy watering to make the ground soft enough to insert a peg tee and constant traffic, it is difficult to maintain a turf. Once the soil is thoroughly compacted and puddled, establishing seed is virtually impossible without heroic measures. Watson, Harper, and others working at Penn State under Professor Musser and Dr. Alderfer found that there was a rather narrow zone of compaction in the top inch or two. Below that usually there is ample granular soil to support plant growth and to supply necessary oxygen to the roots. The most satisfactory establishment of grasses on compacted soils will be with some device to break through this compacted zone and get the grass started. Large lawn areas and industrial lawns present a real problem because here they want the best appearance possible and it is quite discouraging to plant expensive grass seed and then to have it turn into nothing but crabgrass and mud. The University of Maryland is a prime example in the author's experience because I have seen the grass on the front lawn steadily deteriorate ever since 1931 when I started my weed control work on the campus. This deterioration has reached the point where soon steps will have to be taken to re-establish satisfactory grasses in this area.

The alfalfa seeder or the grain drill is one of the devices that has been used to plant grasses into established turf with varying degrees of success. In some cases, the soil is so compact, such as on the

Rosebowl at Los Angeles, that an electric drill must be used to get through the compacted zone in order to set in plugs of bermudagrass.

In the preparation of a seedbed, there is an ample choice of machinery to do the job properly. Cultipackers, discs, harrows, combination cultipackers and seeders, all make the job relatively easy. The drill tends to leave the grass in rows which is not particularly objectionable if the grass is of a spreading nature because it then covers quickly. However, with bunch grasses, these rows may persist for a long time.

One of the methods of planting grass that has not been given nearly enough attention is that of the seed-hay-mulch method. Here was shown a picture of Merion bluegrass seed-hay-mulch being planted on the author's farm at State College, Pennsylvania with a heavy spike roller pressing the hay into a prepared seed bed. This has the advantage of introducing seed and mulching it at the same time to keep the soil more cool and more moist for almost certain establishment.

The author had the pleasure of working with "Doc" Keyser on the Pennsylvania Turnpike in 1941, developing a method of seeding steep banks by mixing soil, seed, and fertilizer and putting it through a gun-like machine and blowing it onto the banks in form of a thin mud. This method was highly successful but has been simplified and improved upon and is now in use by many State Highway Commissions over the United States.

In doing a new lawn for a friend in University Park last summer, the grading machinery left the lawn smooth and level but very firm and compacted. The Jr. G-L Aerifier was used twice over before making a new seeding. The pockets left by the spoons provided favorable resting places for the seed and it was well that this happened because this was the only grass that survived the extremely dry summer of 1953. It looks as though here we have a principle that can be widely used.

Nature created honey-comb soil at this time of year by the process of alternate freezing and thawing. This provides very favorable resting places for seed so that when the warmer weather comes, the ice melts and the soils flow back together. The seed is perfectly buried but nature provides this condition for only a few days during the year. We must learn to imitate nature and provide "honey-comb soil" at any time. Fortunately now with machinery like the Aerifier and

similar implements, this can be done at any time we want it. It is being successfully used on almost all turfgrass areas across the United States. Several pictures were shown depicting the use of these implements in planting grasses, both experimentally and in actual practice. An outstanding example was Occidental College in Los Angeles, California, where the only grass that survived band practice, wind storms and rain storms was that which was lodged in the Aerifier holes. Many golf courses have used these implements to introduce seeds through a heavily matter turf so that the roots quickly came in contact with the soil. Pictures were shown that were taken in Texas, Beltsville, Maryland, and other places. The use of the Aerifier and similar types of machines on slopes where it is difficult to get grass seeds to lodge long enough to become established is becoming an increasingly important use of these implements. It is easy to see in the Kodachrome slide depicting an Aerifier hole through the compacted zone showing water entering the hole and spreading beneath. It also shows that seeds sown in this way can get their roots quickly into the looser, more friable soil below the compacted zone.

There are various methods of preparing grass for planting, especially where these grasses must be planted vegetatively because there is no seed. One of the methods shown was the use of the Rototiller in tearing the sprigs loose after which the sprigs were broadcast on a prepared seedbed and firmed in with a caterpillar-type tractor. This did not work too well because the seedbed was not sufficiently moist. The sprigs were wiry and jumped back out of the soil and no water could be applied after planting. A very small percentage of the sprigs survived. This is not a satisfactory way of planting.

One of the really new methods of harvesting sprigs for planting was accomplished last summer on the Army-Navy Country Club fairways. Admiral Phillips and Jim Thomas permitted me to come in with a power-driven, side delivery rake roughening the excellent bermudagrass turf on the fairways. This was then followed by the fairway mowers and the clippings were picked up with a big fairway sweeper. These clippings were excellent planting material and within an hour were introduced into a prepared seedbed, harrowed in, and firmed down. This, I believe, is really a new method of preparing and planting sprig material.

The Verti-cut mower is being used for preparing sprig material by feeding sod through the whirling knives.

This use was not in the design of the machine, but represents another use for this implement.

Mal McLaren in Cleveland made excellent use of the Aerifier with one-inch spoons in converting an unsatisfactory putting green to a new type of bent by planting sprigs in the holes. This green is very satisfactory today. Various methods of planting were then shown, including strip sodding such as was done with St. Augustine grass at the Union Building at the Texas A & M College. Spot sodding is a common method with St. Augustine in the cemeteries in Houston, Texas. Then followed four priceless slides showing the first planting of Meyer Z-52 Zoysia even before it was named Meyer. The author and his associates grew this first Meyer in the green-house during the winter of 1947-48 and planted it in a large plot back of the south building of the Plant Industry Station in May of 1948. The solid sod, grown in flats, was cut into small squares only slightly bigger than one-inch square, molded into sort of a cone, and inserted into Aerifier holes. These small bits of sod were pressed down with the heel and allowed to develop quite naturally without any further assistance. They successfully met all competition without irrigation and today it is a solid block of Meyer Zoysia sod.

Pictures of the mole drain were shown to depict how useful this implement can be in opening the difficult soil and weedy sod for insertion of sprigs, chunks of sod or plugs of sod for converting an unsatisfactory turf to an improved grass. This has been done at many places including the Philadelphia Country Club, and Merion Golf Club. Following this, several pictures of other devices were shown: cutting slits into the sod, inserting sprigs. Last summer, one of the notable examples was on the #6 fairway at Woodmont, where better than an acre of poor fairway turf was planted to U-3 bermuda in rows approximately 18 inches apart with sprigs approximately that same distance in the row. In spite of a very dry summer and poor rocky soil, the catch was excellent. Other devices have been utilized for planting including a subsoiler mounted on a Ford Ferguson tractor. One of the principles of any machine is that on the return trip after planting plugs or sprigs in a slit, one wheel of the tractor presses the slit closed to firm the soil about the new pieces of material. This is extremely important. Hand planting is still the best method of planting where there is a limited amount of material, being sure to firmly press down the soil around the new planting with a tractor, truck, or heavy car.

Water is quite essential in order to get the most out of a new planting. Without it, a new planting can easily fail. Zoysia seedlings were shown, planted in both nursery beds and also in existing fairways under continuous play.

One of the best examples was Operation Zoysia, designed by the author and his associates and carried out on #3 fairway at Fairfax Country Club, Fairfax, Virginia. The plugs and seedlings of various zoysias were planted in holes prepared with one-inch spoons on the West Point Aerifier. Also shown were zoysia seedlings in a nursery in Johannesburg, South Africa.. Tifton 57 bermuda at Tifton, Georgia, has been sprigged successfully in Aerifier holes. Various methods of stripping sod were shown, but this has not proved too successful because of the wash-boarding effect and uneven growth.

Solid sodding is becoming much more important. With the advent of the power-driven sod cutters, it is much less costly than ever before. This method of establishing a new tee or fairway area or lawns will become increasingly popular as low cost planting material becomes available. It becomes incumbent upon the superintendent to provide a sod nursery of these improved grasses for the continued improvement of the course with which he is charged.

Many times sod is cut far too thick. It takes weeks for it to knit to the soil and for the nursery from which it was taken to heal. Pictures taken at the Turfgrass Field Day at Boys Town, Omaha, Nebraska, show common bluegrass sod stripped two inches thick as is normally done in that area. At the author's insistence, the power sod cutter was adjusted to cut sod one-half inch thick. A ten-foot roll cut two inches thick could barely be lifted by a strong man with both hands. A ten-foot roll of sod cut one-half inch thick easily could be lifted with one hand. Not only will the thin-cut sod knit more quickly where it is laid, but the nursery from which it is taken will also recover far more rapidly because more rhizomes and planting material have been left in the soil to reestablish the stand.

Sod plugging is coming into its own particularly on lawns, athletic fields and playgrounds. This is not a new idea. It has been borrowed from the golf course superintendent who has been practicing this for many years, but new improved sod pluggers have been developed with magazine-type chambers making it quicker and easier for fool-proof plantings to be made. Many

putting greens are being converted to improved strains of bentgrasses without ever taking the putting green out of play. This is an achievement for which we have long sought.

A picture was shown depicting the planting of an improved shade grass in shady areas where it is next to impossible to get grass seed ever to establish a permanent turf. Plugs of sod of adapted grasses set into these areas are almost sure to grow. In the author's experience with this new improved shade grass developed on his lawn, the survival of these two-inch plugs in heavily shaded areas has been nearly 100%. A picture was shown of Michie Stadium at West Point, New York. (Please do not confuse this with West Point, Pennsylvania, where the West Point Products Corporation is located.) These pictures of Michie Stadium and Beaver Field at Pennsylvania State University showed where sod plugs of improved grasses have successfully repaired injuries to the field immediately following games. This has been far more successful than the attempts at seeding that have been made in the past. Then followed pictures showing the planting of sod plugs into lawns.

The work of Dr. Zaki Mahdi at the University of California, Los Angeles, was described by O. J. Noer and Tom Mascaro. Mr. O. J. Noer is with Milwaukee Sewerage Commission. Mr. Mascaro is President of the West Point Products Corporation. They discussed the experiments run by Dr. Mahdi with the two-inch and four-inch pluggers, using no fertilizer, Milorganite, maleic hydrazide in various combinations. The effects showed strongly that U-3 bermuda spread much more rapidly when the surrounding grass first was sprayed with maleic hydrazide to slow the growth. Then a plug of U-3 bermuda was planted with plenty of Milorganite under it. This combination caused the U-3 to spread most rapidly against the surrounding competition.

In summary, it appears that considerably more study needs to be made on the methods of planting grasses, both from seed and with vegetative material. It is rather unlikely that any firm will go into the business of making many grass planters simply because the market is too limited and once an improved grass is established, proper management creates a permanent turf with little or no need for any replanting. The satisfactory rapid low-cost establishment of improved grasses into existing turf areas without taking the areas out of use is one of the most challenging problems facing the agronomist and the engineer today.

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DRAINAGE - Panel Discussion

Admiral Phillips, Leader

Panel Members: Bob Scott, Sr.
Reuben Hines
Paul Weiss
Marshall Farnham
Frank Murray
Alton Rabbit

John S. Phillips

To summarize the salient features of drainage, first let us consider air with relation to a green.

A green should be so located that air will flow freely over its surface. It should not be hedged in by shrubbery, land formations, trees or structures of any description. It should be cut in the open to receive plenty of sunlight, and placed in the path of any prevailing breezes that might pass over its surface. The soil itself should be porous enough to allow air to circulate through its structure and provide the necessary oxygen to support the life of the grass plant.

Greens with poor air drainage are highly susceptible to disease such as brownpatch.

With regard to water drainage, it may be said that in general any low pocketed areas existing on the course should be contoured with a sloping surface such that water will not pond, but will drain clear of playing areas. If this is not possible, then we must resort to tilling the area in order to carry water off. This method is successful in taking care of excess rain water or seepage from springs.

With regard to greens, we might say that they are better off over-drained than under-drained for we can supply water through irrigation, whereas, when a green becomes saturated we must wait for that drainage inherent in the green, plus evaporation to get rid of the damaging excess water.

Greens may be drained in several ways: by surface contouring, by tilling,by a combination of the two,and by percolation thru the sub-soil. (It would appear that the latter three methods offer greater insurance against the ravages of super-saturated soil resulting from abnormal rain--conditions.) Tilling is costly

($250.00 - $500.00 per green) however, the cost is minor when we balance it against the possible loss of a green or at least the green's unavailability for play over extended periods because of wetness. Insofar as possible, surface drainage should not be led to the front apron of a green for most of the trafficking is over this area and walking on wet soggy turf is ruinous to the latter, because of compaction. At least two directions of surface drainage should be provided.

Greens built on hard surfaces such as an impervious clay soil should have their subgrades carefully sloped and free of pockets or low areas. The subgrade might readily be contoured generally to conform to the surface of the green.

Greens built on the side of a hill should be safeguarded from seepage by the installation of an interception tile line above the green.

A very appropriate and terse statement may be made with regard to drainage of turf soils, namely "Perfect Turf cannot exist without perfect drainage".

Bob Scott, Sr.

I don't know why they picked me to be on this panel. Maybe they thought the Admiral could get something out of me from the past that will help those in trouble in the future. So I'm going to be using the adverb "why" a good deal through my fifteen minutes.

Why do horticulturists produce such beautiful plants and flowers in a green-house? Because he has control of the water, air, heat and shade required by the plants under his care. A golf course superintendent does not have that kind of control.

Why don't we have as much trouble on our greens during a dry summer as a wet one? Because we can usually give the required amount of water during a dry one but can't always get it away fast enough during a wet one - mostly for lack of good drainage.

Why do some greens respond quicker to fertilizing than others? Because the root system is deeper and healthier in some than in others. Mostly because of a better balance of air and water due to good drainage.

Why did a new green in low land go wrong even though tile drains and cinders were laid underneath? Because

the open ditch to which the main drains were led was allowed to get higher, blocking a free get-away of excess water under the green. This was corrected, the roots went down and the grass lived happily ever after.

Why did a green on top of a high hill go wrong in wet weather? Because the green was too flat - partly in the shade. No sand in the heavy soil, no drainage and compaction took place.

Why have some greens under my care help up, even though one or two are flat, for the past 33 Years? Because they have either a tile or stone and gravel drainage system and their roots are always deep and healthy.

During unfavorable weather or perhaps careless watering a good foundation could be the roots salvation. A poor foundation could be their ruination.

There is an old Scotch saying "A penny saved is a penny earned". A good drainage system will soon earn the cost of its installation and save the superintendent many headaches.

Speaking of headaches, I have seen the time during a wet-hot summer when it was not raining violets, as the old song goes. Nothing but headaches for myself and other superintendents who had heavy soil and the drainage was none too good.

Modern aerifying equipment is excellent - tools for getting air, water or fertilizer into the soil. But you can't always use them to advantage during excessively wet weather or during tournaments, but with good drainage underneath and their use you would be more than half safe.

Reuben P. Hines, Sr.

I was raised a dirt farmer and learned the hard way, many years ago. As a boy, we would tile our drains with wooden poles. They would last three to ten years depending upon the kind of wood used. We then would have to do the job over.

When replacing the wooden poles, we used stone collected from the farm, placing a stone on each side of the trench, capping with larger stones, filling with more stones to about ten inches to the ground level and dill in the balance with soil. Size of these drains averaged about 14 inches in width and 30

inches in depth, and if properly installed are still doing service. The cost of labor was 75 cents per day, sun up to sun down and the work was done mostly by hand.

The modern way of drainage is by using power trench machines which dig a 14 inch by 30 inch trench 1000 feet in eight hours, using improved drain tile covered with gravel, cinders or sand. This type drain will do the job.

Good drainage of soils is indispensable to healthy growth of grass and all crops. Surface drainage is necessary, but the removal of excess water within the soil is most important. Grass roots will go down deep in soils which have good sub-drainage but will be limited in soils which are waterlogged.

If you have proper drainage and good top soil, grass and all crops will endure drought and heat. Under drains should be used in all greens built with soil which contains heavy amounts of clay. Some golf course architects are not in favor of drain tile under greens and consider them just an extra expense. They say, surface drainage is all that is necessary. They are making a costly mistake and unnecessary expense to the golf club. Tile installed in construction costs in labor and material, $300.00 per green of 5000 square feet. If installed at time of construction, thousands of dollars would be saved.

The Golf Course Superintendent has many headaches with poor construction. I have been correcting some for the past 28 years. Tile drains should be a must in all new green construction in the Mid-Atlantic area, and contracts in all construction should specify the necessity of tile drainage. Greens with poor sub-drainage would be cheaper and more satisfactory if rebuilt correctly than to nurse them along in their present poor condition.

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Crabgrass Control by Chemical Methods

H. B. Musser

Crabgrass can be eliminated from established turf and can be kept out successfully. The attack must be double-barrelled, giving consideration to both cultural practices and chemical treatments. Cultural practices consist largely of those standard operations of cutting, fertilizing, watering, aerating, and general maintenance, that are necessary for the production of good quality turf. They are so familiar to every professional turf maintenance man that it is hardly necessary to do more than call attention to their role in weed control. Their bearing on the extent of weed infestation is so important and so obvious that they must be given a prominent place in any control program. There is little to be gained by going into what is often an expensive and time consuming program of chemical eradication, if cultural practices at the same time are not adjusted to produce and maintain a good quality turf that will successfully resist re-invasions.

The control of crabgrass by treatment of the turf with various herbicidal materials has been the subject of investigation for a number of years. Many materials have been evaluated from the standpoint of their selective efficiency under different rates, methods, time and frequency of application. Until quite recently most of the materials studied were essentially of the contact-kill type. The effectiveness of these depends mainly upon their effect upon the plant tissue with which they come into direct contact.

Among such materials, three have shown sufficient differences in their effect on the good turf grasses and crabgrass to make them useful tools for a crabgrass control program. These are phenyl mercury acetate (PMA), potassium cyanate, and sodium arsenite. As might be expected, all of them will produce a better kill of young immature crabgrass than when applied to older tougher plants. Their effectiveness also varies with the rates, frequencies and number of applications, and the soil moisture, temperature and other environmental conditions under which crabgrass is growing. Where so many factors are involved it is to be expected that variable results will be obtained

from treatment to treatment and season to season. This can be illustrated by the following tabulation showing annual crabgrass survival in experiments conducted by the Pennsylvania Agricultural Experiment Station through the 5-year period 1949-1953.

Table 1. Crabgrass Control. Average percent survival of crabgrass treated with various herbicides during the 5-year period 1949-1953.

Year	NO. of Treatments	Period Between Treatments	Date of Last Appl.	Pot Cyan. Rate Per A	Pot Cyan. Crabgr. Survival %	PMA Rate Per A	PMA Crabgr. Survival %	Sod Arsenite Rate Per A	Sod Arsenite Crabgr. Survival %
1949	3	1-month	July 26	16 lbs.	15	10 pts.	11	5 lbs.	19
1950	5	20-days	Aug. 30	8 lbs.	15	5 pts.	33	1½ lbs.	18
1951	3	7-days	Aug. 23	8 lbs.	24	8 pts.	35	1 lb.	35
1952	4	14-days	Aug. 13	8 lbs.	3	8 pts.	2	1½ lbs.	8
1953	5	10-days	July 31	8 lbs.	5	7 pts.	1	1½ lbs.	1

The above summary shows that when each material was used at its most effective ratio, number of applications, and period between treatments there was no significant difference between the results obtained. It also emphasizes that wide differences can be secured by varying any one of these items.

The overall results of these studies indicate strongly that the following methods of use of each material will provide the most satisfactory degree of control.

Material	Rate of Treatment (per acre)	NO. of Treatments	Interval Between Treatments (Days)
PMA (10%)	7 Pts.	4 to 5	10 to 14
Potassium Cyanate	8 lbs.	"	"
Sodium Arsenite	1½ lbs.	"	"

The principal cautions to be observed in following the above recommendations are:

1. Sufficient water must be used to insure uniform coverage (50 to 200 gallons per acre depending upon spray equipment.)

2. Treatments should not be made when soil moisture is low and temperatures are high (above 80-85°F).

3. Treatments should be started as soon as crabgrass emerges.

At the above rates and frequencies of treatments the permanent turf grasses will be temporarily discolored. Normally they recover within a period of two or three weeks. The records show that the turf coverage following the treatments is significantly better than an untreated plots due to reduced competition from the crabgrass.

Effect of Herbicides on Seed Head Development and Seed Viability.

A somewhat different approach to the problem of crabgrass control consists in applications of the above herbicidal materials during the period of seed head emergence and development. In this case the primary objective is reduction in seed production rather than a kill of the crabgrass plants. Studies of this type have been conducted by the Pennsylvania Agricultural Experiment Station during the past 3 years 1951-1953. The results indicate that this method may be an effective tool for crabgrass control in cases where early treatments have not been made or have been ineffective.

The following summary shows the results of treating crabgrass infested turf periodically during the period of seed head emergence through the 3 year period 1951-1953.

Year	No. of Treatments	Treatment Interval (Days)	Date of last Treatment	Pot. Cyanate Rate per Acre	S'd H'ds per Sq. ft.	PMA Rate per Acre	S'd H'ds per Sq. ft.	Sod. Arsenite Rate per Acre	S'd H'ds per Sq. ft.	Pot. Cyan. &2,4-D. Rate per Acre	S'd H'ds per Sq. Ft.
1951	3	7-8	9/4	8 lbs.	1	8 pts.	8	1 lb.	5	---	---
	(Control)			0	89	0	105	0	112	---	---
1952	3	8-14	8/14	8 lbs	16	8 pts.	8	1 lb.	62	8 lbs KOCN 1 lb. 2,4-D	0.3
	(Control)			0	215	0	215	0	215	0	215
1953	5	10	8/12	6 lbs.	6	6 pts.	72	---	---	---	---
	"	"	"	101 lbs.	0	8 pts.	55	---	---	---	---
	(Control)			0	375	0	375	---	---	---	---

The date in table 2 represents an average reduction for all materials of better than 90%. In addition, germination tests have shown a reduction in seed viability on the treated plots of approximately 60%. Although further tests will be needed on materials that have received only limited study, the above date seems to clearly indicate that this method of crabgrass control has definite possibilities and deserves further study. Some of the things that need investigation are methods of application designed to secure maximum coverage of seed heads and intervals between applications.

Crabgrass Control by Pre-emergence Treatments

A third method of crabgrass control that is showing interesting possibilities is treatment with herbicidal materials that affect the germinating seeds. Only one year of results of this study are available and more tests will be necessary before conclusions can be reached. The data in table 3 are presented with the definite reservation that they do not constitute recommendations of any of the materials studied.

Table 3. Effects of pre-emergence treatments of established turf on crabgrass populations.

Material	Rate per Acre (pound)	Treatment Inverval (Weeks)	No. of Treatments	Percent Crabgrass Survival
2,4-D	1.5	1	4	7.1
Napthyl phthalamic acid	6.0	4	5	13.9
EH Sesin	8.0	7	3	15.5
Nothing	--	-	-	70.9

Note: Survival based on average number of living plants per square foot at peak infestation on control plots.

In this series of tests the first treatments were applied approximately 2 weeks prior to first crabgrass emergence on the control plots. It is believed that the percentage of crabgrass following treatment with these materials can be reduced materially by better adjustment of rates and treatment intervals.

The turf on the test area was composed of a mixture of Kentucky bluegrass and bentgrass. There was no evidence of injury or discoloration of the permanent grasses, except that in a few areas the bentgrass appeared to be checked to some extent by the 2,4-D treatment.

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Fungus Diseases and Their Control in Cool Season Grasses

William Klomparens
Michigan State College

The diseases affecting fine turf as well as other green plants are caused mainly by the fungi. The fungi as a group are not strange, mysterious things. They can be seen by the aid of magnifying instruments. They can be identified, grown, killed, allowed to reproduce, prevented from reproducing, and utilized to quite an extent in industry. They are extremely valuable in decomposing the organic matter present on most of the earth's surface. Probably their most important function is that of breaking down these plant reminas so that the nutrients can be utilized by other plants.

They are, of course, microscopic in size and magnification is needed in order to study them carefully. If a part of a filament of a fungus were magnified on a screen so that it appeared to be about three inches wide, this would be an approximate magnification of two thousand times. If an average man were to be magnified two thousand times, he would stand about two and one-quarter miles tall and have a footprint of approximately a quarter of a mile long. Such is the size of the microscopic organisms under discussion.

These microorganisms do not live only on the dead remains of living plants. They may also be found on living plants and, in some instances, both on living and dead plants. When they are found on live plants in large numbers, they are apt to be causing disease. Disease may be defined as any effect on a host plant which would interfere with its normal development or economic value. Diseases, of course, are not necessarily caused by fungi or other parasitic microorganisms. There are the so-called non-parasitic diseases which are caused by mineral or nutrient deficiencies or by excesses or deficiencies in water and even by deposits of smoke and other toxic substances.

We, however, are primarily interested in the diseases caused by particular parasitic action of the fungi. Many complex factors are involved in the development of a fungal disease, and all of these factors must be working together in proper sequence. We must have a proper temperature, proper moisture which would include relative humidity, a susceptible host, and an active parasite (fungus).

Each and every common turf disease is affected by the principles just mentioned. Very often, the control of these environmental conditions is so difficult that it is nearly impossible to reproduce these diseases at will. If the necessary temperature and humidity are not present at the same time and for a proper length of time, we cannot have a plant disease condition. There must also be present the parasitic organism and its susceptible host plant (turf) in order to cause any symptoms such as we know.

Melting-out with its characteristic symptom--that of progressing from powdery blue color to a definite yellow to a dead, blackish brown matted area--is very dependent upon all the environmental conditions just mentioned. Melting-out cannot occur unless the humidity is extremely high. It cannot occur if the temperature does not reach the proper level. It also needs the presence of the Helminthosporium in large numbers and a susceptible grass.

Large brownpatch with its characteristic thinning within the smoke-colored ring is also governed by all these factors. Large brownpatch will not occur unless all of them are present.

Dollarspot, which produces the commonly recognized bleached areas,also needs a specific set of conditions. In this case, however,we find that cooler temperatures will favor the disease. True dollarspot does not occur in extremely hot, humid weather. The fungus is able to attack grass blades only during the cooler weather. This organism lies dormant during the hot, humid weather and during the winter months.

Fading-out, which is caused by Curvularia sp., attacks the common grasses during hot, humid weather. This organism, like the Helminthosporium and the brownpatch organism, is favored by warm, humid weather and it is only at these times that it can cause the reddish-brown, angular spots or snaky-patterned spots that we commonly recognize as fading-out.

The copperspot symptoms which are not often seen are also caused by a parasitic fungus which requires very definite environmental conditions in order to damage fine turf grasses. This organism, like others mentioned,cannot and does not cause damage during the cold months of the year as the commonly known snowmold organism does. Each fungus requires specific conditions in order to damage turf.

Although all of the diseases discussed produce different symptoms and are favored by different environmental conditions,they all will respond to the general principles of control. The principles of plant disease control are: EXCLUSION, ERADICATION, PROTECTION, and RESISTANCE.

Exclusion is the principle that utilizes plant quarantine laws which, in effect, govern the entry into our country of any parasitic or detrimental organism, plant or insect. This principle would have little effect on the control that is practiced at present, since the diseases we are combatting are already here and occur commonly. It will, however, serve to minimize the number of new diseases which may occur in the future.

As a principle, eradication involves elimination of the parasitic organism,whether it be fungus or insect. Complete destruction of wild host plants and weeds would also come under this type of control. Partial eradication is practiced by all golf course superintendents.

The third principle of plant disease control--that of protection--is the one which golf course superintendents would be the most apt to use. This is primarily the erection of a chemical barrier between the parasitic organism and the host plant.

Almost all sprays are applied to fine turf areas for protective purposes. The fungicides do not completely eliminate the fungus. The herbicides do not completely eliminate the weeds,nor do the insecticides completely eliminate the insects. In actual practice, the only result is severe reduction in numbers of the fungi, weeds and insects. This principle of protection also involves many other recommended practices. Good coverage and spray application techniques are necessary and should be followed. Sanitation, which is the removal of any refuse or trash where insects and fungi might be produced, is important only for control of turf diseases but for all plant diseases. Good sanitary practices will also aid pest control.

The last general principle, that of resistance, is probably quite well recognized. The breeding and selection of strains of grass which are resistant to diseases and insects have been practiced for many years. We find, however, that at present we have no one single strain of grass that shows high resistance to all pests which may destroy turf. It is also well known in the biological field that in many cases when

a resistant strain of plant is developed, the fungus is able to change itself so that it may then attack the newly found resistant plant. We also find that new, unpredicted pests may attack these new varieties.

Culture and maintenance practices which could have been discussed earlier are considered to be of such importance as to deserve discussion by themselves. Observation of nearly a thousand individual plugs of diseased grass has led to the finding of very definite correlation between severe disease and thatch or mat. Adequate coverage and penetration by fungicides will probably be one of the most beneficial results derived from removing excess thatch or mat. Maintenance practices could also include improvement of air drainage by trimming trees and removing heavy underbrush. This would be of considerable aid in allowing air movement across a green. If excess soil moisture is a problem, improved conditions of drainage may also lessen the severity of the disease problem. Any maintenance or culture practice that will prevent the relative humidity or temperature from becoming excessive will materially contribute to disease control.

Disease will, however, occur in the most favorable locations on a golf course when the environmental conditions are proper and the parasitic organism and susceptible turf are present. Turf disease control may best be obtained by understanding the principles involved in disease and disease control and in applying these principles when and where it is possible. Any practice which will keep the relative humidity low, the temperature under partial control and allow the fungicide to come into contact with the fungus will be economical in the long run.

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