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straight years at the rates of 80 and 120 lbs. per acre. The Kentucky Bluegrass turf core at the left was taken from an adjoining plot that was not treated. Note that there is no difference between the treated and untreated cores. Similar results were obtained in plots of fescue and certain strains of bentgrass.

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will ultimately be suitable for insects that feed on phloem tissue, since these are inaccessible to broadcast spray treatments. Considering the importance of sapsucking and bark feeding insects on shade trees and in forests, systemics almost certainly will be used widely as soon as the technological picture is complete.

Chemical Management From Seed to Maturity

To summarize the picture, it is obvious from the few examples cited that a great many problems of tree culture may be solved with chemicals. Nurserymen, foresters, and shade tree specialists have, until now, been growing trees partly or entirely by hand or machine. The discoveries of the past few years have made many hand methods archaic because of their cost and the quality of results.

Safe, effective herbicides are now in use in many nurseries, bringing great savings in weeding labor. Fumigants have been used to solve nursery soil problems that had all but eliminated production of high-quality trees. Site preparation and sustained weed control in outplanting areas have improved survival immensely and have contributed to uniformly vigorous growth and fine appearance of saplings at considerable savings in cost per unit of growth or return. The excellent condition of trees grown under sustained weed control renders them much more resistant to disease and insects, reduces opportunities for animal damage, and lessens the risk that has been such a factor in production of trees.

Cost of removing undesirable trees has dropped to a few cents per tree, or less, for chemicals, and equipment is available that permits application to large numbers of trees at minimum labor cost and with negligible toxic hazard. The same equipment is useful for systemic insecticides, permitting low-cost control of insects that have been previously inaccessible.

There has been, without question, a chemical revolution in the woods. There are few prob-

lems of a biological nature that cannot be solved more economically, and in many cases more safely, with chemicals than with existing nonchemical methods. Opportunities for application of this technology are almost limitless, and the values enormous. Jobs will be created, rather than lost, because many jobs can now be done economically that have been left undone in the past.

Chemical industries can and should enter into research and development with an understanding of the objectives of tree growers. Once the liaison is established, the industries can do for tree growers as much or more than has been done in agriculture. On this scale, cooperation (or perhaps it should be called symbiosis) will make the growing of trees a far more attractive enterprise than has ever before been possible.

Use Right Chemical Tool For Weed Control (from page 15)

Many herbicides require an actively growing plant to absorb and translocate the chemical to a remote site of action. Underground stems, or rhizomes, of certain plants cannot receive direct treatment with herbicides. Summers are usually dry and hot; winters usually wet and cold. Under these conditions, vegetative growth is reduced and the situation is not ideal for application of herbicides.

A high degree of selectivity in a herbicide may, in some situations, be a mixed blessing. Despite its remarkable potency against certain weeds and its favorable margin of safety in lawn grasses, a particular herbicide simply may not be effective against all weed species in a mixed infestation.

In such situations, a combination of two or more herbicides, applied either sequentially during the season or mixed for application, may be indicated. In areas infested with crabgrass and mixed broad-leaved weeds, for example, crabgrass may be best controlled with a preemergence herbicide, but early post-

(Continued on page 46)



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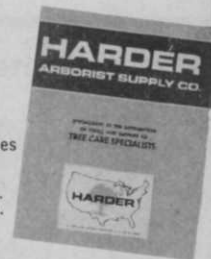
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Survey '67:

Turfgrass Management Training, Part 2

From "brushup" short courses to two-year technical programs, from four-year undergraduate courses leading to B.S. degrees to research-oriented postgraduate studies, colleges around the country are stepping up their turfgrass management training programs in the face of heavy demand for graduates. On the following pages, and in coming issues, WTT surveys turfgrass programs and the specialists behind them. Next installment will appear in June.

The Pennsylvania State University, University Park, Pennsylvania



Dr. J. M. Duich: Opportunities have never been greater but do co-exist under both a craft and professional philosophy. Future is attractive if both student and industry each plot a course.

Turf training at The Pennsylvania State University is the responsibility of the Agronomy Department, with Dr. J. M. Duich as Turfgrass Project Leader.

Programs offered include four-year undergraduate work leading to B.S. degree, graduate study towards M.S. and Ph.D. degrees, and a Winter Course (four 8-week terms over a two-year period). Studies leading to a B.S. degree, agronomy major with turf option) allow students to be practically oriented. Major areas of activity within the Agronomy Department are crops, soils, and turfgrass. Subject area of more academic graduate work is primarily dictated by students' area of research, which is being conducted in breeding, nutrition, soil physics, and weed control.

Begun in 1929 as a research program, Penn State offered its first undergraduate turf course in 1932, with formal recognition of a "turf major" for graduate and undergraduate study in 1949 and 1950, respectively. Currently, there are 13 undergraduates, with four M.S. candidates and two Ph.D. candidates. Winter Course has a current enrollment of 52 students working toward a Certificate in Turfgrass Management. Turf teaching is conducted by Dr.

Duich, Dr. D. V. Waddington, and A. T. Perkins, with Dr. H. Cole teaching turf pathology courses.

Requirement for entering B.S. program is a basic high school background plus college entrance exams. Grad students must have a favorable undergraduate average. Winter Course students are selected on basis of high school performance, experience, and recommendations by turf industry supervisors (practical turf experience is almost a necessity). Resident tuition for B.S. studies is \$130 per term; nonresidents pay \$260. Winter Course tuition per 8-week term is \$131.25 for residents and \$262.50 for nonresidents. Regular students enter the fall term, starting in mid-September; applications should be in by January or earlier. Winter Course starts mid-October; applications deadline is Aug. 1, or earlier for best consideration. Address inquiries to Pennsylvania State University, University Park, Pa. 16802, as follows: for Winter Course, Dr. F. C. Snyder, Director of Short Courses, Room 212 Armsby Building; for B.S. studies, Dean of Admissions; for graduate studies, Dean of Graduate School, 101 Willard Building.

Colorado State University, Fort Collins, Colorado



Dr. R. L. Foskett: Graduates are employed at world-renowned golf courses and turf operations.

Turf training at Colorado State University comes under the Department of Horticulture, and is directed by Dr. R. L. Foskett.

Programs offered include four-year undergraduate and graduate work, with a complete renovation of curricula now in progress. Studies will be designed to include specialized course work in soils, irrigation, plant pathology, plant physiology, and landscape horticulture. Turfgrass management students work towards B.S. or M.S. degrees in horticulture, with a turf option. On-the-job training, encouraged now, will soon be made a requirement of the program.

Begun in 1950, Colorado's program has a present enrollment of 10 turf students.

Turf instruction is conducted by W. G. Macksam, Jess L. Fults, and Jack Altman.

Requirement for entering the program is admission to the University, which calls for favorable class rank in high school and college entrance exams. Colorado residents pay tuition of \$112 per quarter, or \$336 per academic year. Nonresident tuition is \$337 per quarter, or \$1,011 per year. Admission is normally to the fall quarter, which starts on Sept. 17 in 1967. Prospective students, however, are encouraged to submit applications six months in advance of registration. Requests for additional information should be directed to Dr. R. L. Foskett, Head, Department of Horticulture, Colorado State University, Fort Collins, Colo. 80521.

University of California, Riverside, California

Turf training at the University of California, Riverside, comes under the Department of Agronomy, and is directed by Dr. Victor B. Youngner, Associate Professor of Agronomy.

Programs offered include four-year undergraduate, graduate, and evening courses conducted by the University Extension Service. Curricula in Riverside's School of Agriculture are currently being revised. "Students interested in turf management will take the Plant Science major (formerly Agricultural Science major), selecting electives which will be especially useful in this field of work," Youngner reports. "In addition, he must meet requirements in the Humanities, Social Sciences, Life Sciences, Physical Sciences, and Agriculture. While we have no vocational-type courses in the University of California, a conscientious

student can obtain excellent preparation for turf management as well as any agricultural occupation," Youngner says.

Begun in 1950 with graduate training only offered, undergraduate studies were added in 1958. Formerly at UCLA, this program was transferred to Riverside in 1965. Instructors in all fields important to understanding of turf management contribute to the program.

Requirement for entering this program is a high school "B" average or transfer in good standing after two years at a junior college. Currently, about the top 12% of high school graduates are being accepted. There is no tuition for California residents. Nonresident tuition is \$267 per quarter. Requests for information can be sent to Dr. V. B. Youngner, Department of Agronomy, University of California, Riverside, Calif. 92502.



Dr. Victor B. Youngner: Opportunities excellent for well-trained man with basic courses in plant sciences, fewer for short course graduates.

Kansas State University, Manhattan, Kansas



Dr. Ray A. Keen: Demand for graduates exceeds supply by factor of four or five.

Turf training at Kansas State University comes under the Department of Horticulture in the College of Agriculture, and is directed by Dr. Ray A. Keen, Professor of Horticulture.

Programs offered include four-year undergraduate and graduate work, plus a summer workshop course. Students work towards B.S., M.S., or Ph.D. degrees in agriculture. "There is no curriculum, as such, for turfgrass majors," according to Dr. Keen. "The curriculum is in the College of Agriculture, with majors in the various departments; turfgrass training is part of the ornamental horticulture section of the Department of Horticulture."

Begun in 1954, Kansas State's turf pro-

gram has a current enrollment of 17 students; there were four in the last graduating class. Turf management courses are taught by Dr. Keen, with supporting courses in the departments of Agronomy, Plant Pathology, Entomology, Botany, etc.

Requirement for entering the program is high school graduation. There is no tuition charge. Students are normally admitted to the fall session, which begins in September. KSU's next summer workshop in turf is tentatively scheduled for July 1968. Further information on the Kansas turfgrass management program can be obtained from Dr. Ray A. Keen, Professor of Horticulture, Kansas State University, Manhattan, Kans. 66502.

University of Massachusetts, Amherst, Massachusetts

Turf training at the University of Massachusetts comes under the Department of Plant and Soil Sciences, and is directed by Dr. Joseph Troll, Associate Professor of Turf Management.

Programs offered include two-year training, four-year undergraduate studies, graduate programs leading to M.S. and Ph.D. degrees, and an eight-week Winter School for Turf Managers. Two-year program is administered by the University of Massachusetts' Stockbridge School of Agriculture and leads to an Associate degree in Plant and Soil Sciences, major in turf management. This course is designed to qualify students for openings in the field. Four-year course leads to a B.S. in Plant and Soil Sciences with a turf option. Emphasis is on basic sciences which will prepare students for positions in research, teaching, industry, etc. Winter School offers a certificate upon completion; courses cover plant science, agricultural engineering, entomology, and landscape operations.

Begun in 1926 with the Winter School, described as the first course of its kind and the beginning of turf teaching in this country, Massachusetts added the four-year program in the early 1930's and the two-year program in 1946. Two year enrollment (which is limited by facilities) currently stands at 100. Winter School enrollment (also limited) is presently 30. Turf management courses are taught by Dr. Troll.

Requirement for entering these programs includes sound high school preparation and college entrance exams. Two- and four-year courses carry tuition of \$200 per year for residents, and \$600 for nonresidents. Winter School tuition is \$80, and this course will next convene in Jan. 1968, with Nov. 1, 1967, the application deadline. Regular students enter programs in September, with Mar. 1 the application deadline. Information requests can be directed to Dr. Joseph Troll, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, Mass. 01002.



Dr. Joseph Troll: Opportunity is unlimited for graduates, especially for golf course and landscape work.

New Mexico University, University Park, New Mexico



Clarence E. Watson: Field has become a profession of its own.

Turf training at New Mexico State University comes under the Department of Agronomy in the College of Agriculture and Home Economics, and is directed by Clarence E. Watson, Associate Professor of Agronomy.

Program at NMSU is a four-year study course which leads to a B.S. in agronomy as part of the Recreational Areas Management curriculum. This curriculum is designed to train students as golf course superintendents, park and grounds supervisors, researchers in plant and soil sciences, educators, etc. Courses provide background in agronomy, horticulture, biology, agricultural engineering, mathematics, chemistry, and communications.

Begun in 1964, there are currently seven

majors in the Recreational Areas Management curriculum, with the first student due to graduate this spring. A graduate program is also being started.

Requirement for admission to the program is normally a high school diploma from an accredited school, though an acceptable ACT test score may be used in lieu of diploma. Tuition per semester is \$168 for New Mexico residents and \$393 for nonresidents. Next starting date for courses is Sept. 15, 1967. Application should be made several weeks in advance. Further details can be obtained from Mr. Clarence E. Watson, or from Dr. A. A. Baltensperger, Head, Department of Agronomy, New Mexico State University, Las Cruces, N. Mex. 88001.

The Ohio State University, Columbus, Ohio



Dr. Robert W. Miller: Many opportunities. Unable to supply needs of industry, private and public organizations, and others.

Turf training at The Ohio State University comes under the Department of Agronomy, and is directed by Dr. Robert W. Miller, Assistant Professor.

Programs offered include four-year undergraduate studies and advance work leading to M.S. and Ph.D. degrees. Degrees are in agronomy, specializing in turfgrass management. Students have a choice of programs in Agricultural Industries, Agriculture, or Agricultural Science. Intensive training in turf, soils, weed control, and other related agronomic fields, as well as in entomology, plant pathology, horticulture, and other sciences, is provided. Students must also complete work in such areas as English, humanities, social science, and communications. Dr. Miller says, of job training: "We have insisted that students in turfgrass management work on a golf course or some other turfgrass area. No college credit is earned, but the valuable experience is appreciated."

Begun in 1961, the Ohio program has a current enrollment of 17, and has produced 10 graduates with B.S. degrees and three with M.S. degrees. Courses in turf management are conducted by Dr. Miller, with other staff members.

Requirement for entering this program is high school graduation. Ohio residents pay \$150 per quarter for tuition; nonresidents pay an additional fee of \$186 per quarter. Students may enter at the start of any quarter. Undergrad applications are required by Aug. 1 for autumn quarter, Nov. 15 for winter quarter, Feb. 15 for spring quarter, and May 1 for summer quarter. Early applications are encouraged. Specific turf inquiries should be directed to Dr. Robert W. Miller, The Ohio State University, Department of Agronomy, 1827 Neil Ave., Columbus, Ohio 43210. General admissions information can be obtained from Admissions Office, The Ohio State University.

University of California, Riverside, California



Dr. John H. Madison: Best opportunities are in park administration and planning. Many not willing to pay for top calibre student.

Turf training at the University of California, Davis, comes under the Department of Landscape Horticulture, and is directed by Assistant Professor John H. Madison.

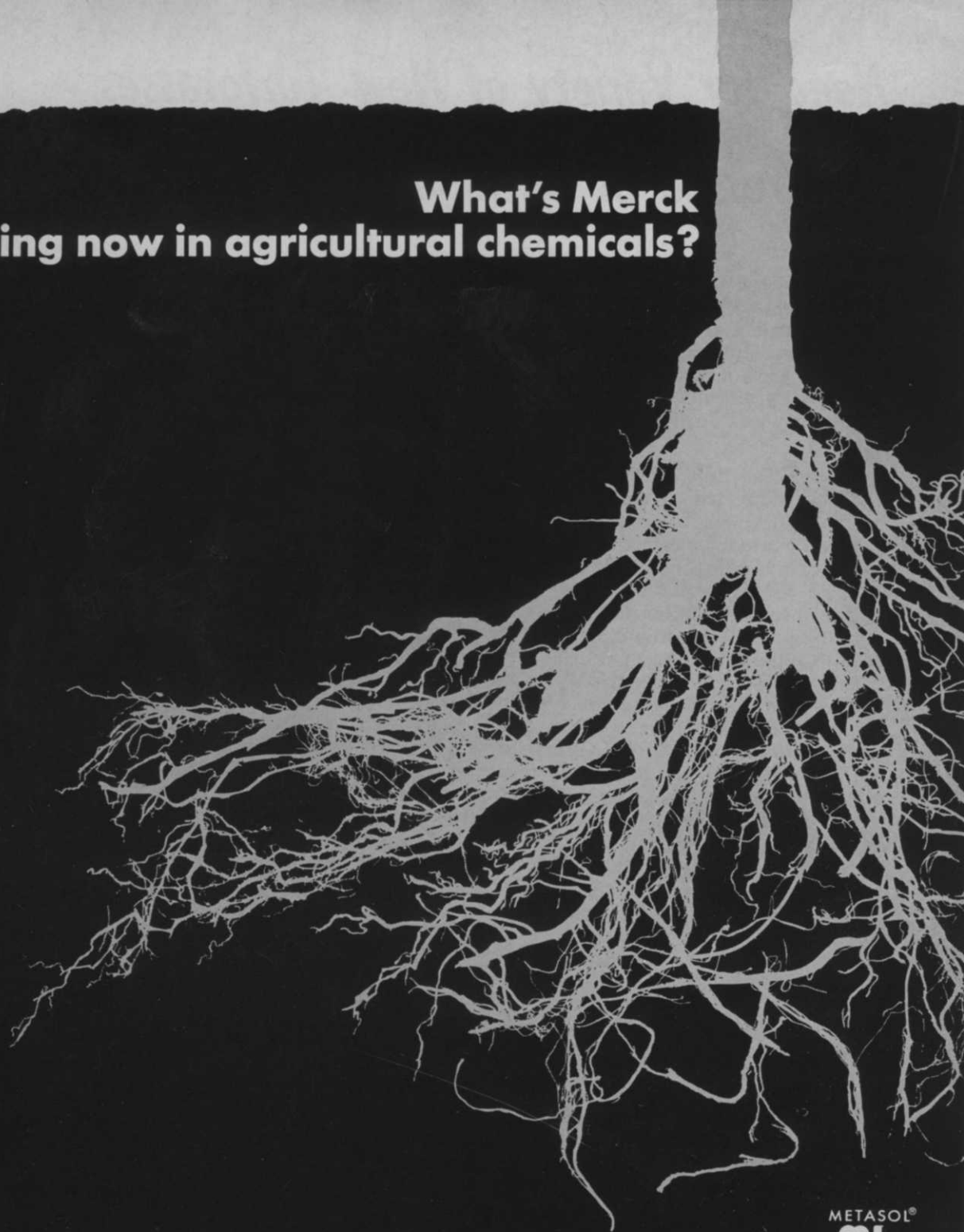
Programs offered include four-year undergraduate and graduate studies. Students may obtain a B.S. degree in plant science with a major in landscape horticulture, floriculture, or park administration; M.S. in horticulture; or Ph.D. in botany, plant physiology, soil science, or genetics. "Majors emphasize sound preparation in plant science," according to Madison. "In the senior year, a student's entire background is brought to focus intensively on problems of turf culture. This may be supplemented with summer work in the field. We expect all of our graduates to have a good background in turf, and sooner or later most of them use it. Students especially inter-

ested in turf can be given individual consideration—for example, by working on the turf research program."

Begun in 1953, the Davis program has a current undergraduate enrollment of 18, with 13 M.S. candidates and two Ph.D. candidates. Courses in turf culture are taught by Dr. Madison, with numerous staff members teaching allied subjects.

Requirement for entering this program is the equivalent to graduation in top 12% of accredited high school class. Nonresident tuition plus fees comes to \$348.50 per quarter, while California residents pay \$81.50 in fees. Starting date for '67 is Sept. 25, with application deadline past; '68 starting date is Sept. 23. Program inquiries should be directed to Chairman, Department of Landscape Horticulture, University of California, Davis, Calif. 95616.

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Need for Variety of New Turfgrasses

Stressed at Michigan's 37th Annual Conference

Turf is the fastest growing agricultural crop in Michigan today. Some 174 growers handled 20,000 acres this past year. Evidence of growth is seen by comparing progress with 1960 when production was only about 5,000 acres.

Though the full 20,000 acres was not harvested in one year, gross cash returns to growers in 1966 amounted to \$27 million. These are data presented by the staff of Michigan State University to members of the industry attending the 37th Annual Turfgrass Conference March 15-16. Overall, returns to the industry last year were estimated to be \$222 million. Of this grand total, maintenance accounted for \$149 million with production, shipping and laying of sod adding up to \$72 million. Maintenance of home lawns is the major source of income to the industry, estimated to be a \$90 million operation in the state. Golf courses were next with expenditures of \$18.5 million, followed closely by industrial areas at \$18 million. The Michigan staff stresses that many of these figures are estimates, but careful study leads

them to believe they are conservative.

Even so, the industry for Michigan is a major one and one which is growing. This rapid rate of progress is demanding answers to many new problems, a situation to be expected. For example, sod producers need more and better equipment to take the place of almost nonexistent hand labor. No longer can the grower depend on seasonal help to harvest the crop. Growers are also concerned about the need for new varieties and mixtures which will stand up on the home lawn despite the varied management he is in the habit of practicing. Industry needs a variety of types of turf also, to meet the demand for quality and utility. And practically everyone in the industry is concerned with the threat of disease to existing varieties, especially to Merion bluegrass and especially in Michigan.

New Research Aimed Specifically For Sod Grower

Like a number of leading research institutions, Michigan State is pushing for answers. Dr. James B. Beard of the depart-



John King, researcher, MSU Crop Science Department, discussed rooting characteristics of organic and mineral-based sods.

ment of Crop Science at MSU discussed many of the practical phases of the industry about which much of the new research is centered. Flooding, a perennial problem in many areas, causes varying amounts of damage depending on the type of grass and temperatures. At 50° Fahrenheit, few varieties of grass are hurt. Bluegrass, for example, showed little or no damage for the first 30 days under water, some damage at 45 days. Bentgrass showed no damage during the first 40 days of exposure to flood-type conditions and no serious damage for 60 days. *Poa annua* (annual bluegrass) showed the first injury at 25 days, red fescue at 15 days.

But when temperatures are higher, all grasses suffer heavy damage. At 86° F. red fescue showed kill at one day, bluegrass after 3 days, others accordingly.

Optimum temperatures for growth of turfgrass are in the 65° to 70° range. Growth slows appreciably when temperatures climb to 86° and kill is evident at 105° to 108° and above in annual bluegrass. Dr. Beard said



Principals at Turf Conference: Dr. Paul Rieke, Department of Soil Science at MSU, left; President Frank Farier of Michigan Turfgrass Foundation, center; and Dr. James B. Beard, Department of Crop Science, MSU.

What is there to weed control besides just killing weeds?

Maybe the area to be treated is already weed-free. Or maybe it's infested with established weeds. Perhaps the weeds are annuals. Or deep-rooted perennials that ordinarily are more difficult to control.

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kill at such temperatures had proved to be a surprising phase of the research. In this particular study, air movement was found to be a major factor in cooling the growth area of turf. As little as 4 mph of air movement cooled the growing area by 14 F. at mid-afternoon.

Mulches continue to be tested for erosion control and their value in establishing a good microclimate for new grass establishment. Straw with asphalt tie-down still proves superior in Michigan studies. Some new types do give erosion control, but fail to deliver adequate establishment conditions. Excelsior material shows promise according to Dr. Beard.

Three primary factors attribute to winter kill. Besides desiccation, snow mold and low temperatures are prime problems. Snowfall on unfrozen ground sets up ideal conditions for snow mold. High temperatures followed by sudden drops below 20° F. create conditions for kill.

Oxygen suffocation from sheet ice cover is not a common problem. Research shows that there is little damage during the first 75 days and ice cover for this long a period is uncommon. Bentgrass showed no injury in the first 75 days of ice cover, and Kentucky bluegrass and annual bluegrass very little.

Fusarium Blight is Spreading To North Central Area

Fusarium blight, a relatively new disease problem in the east is spreading and has been found in Michigan. This fact is causing concern at the moment in this upper north central producing area of the nation.

Dr. Paul Rieke, department of Soil Science at MSU, brought the 500 turf industry members at the conference up to date on current fertilizer studies at the institution. Regarding use of urea nitrogen on turf, he reported that 1, 2 or 3 applications gave results superior to 6 applications yearly, providing that irrigation was sufficient.

And in establishing new turf from seed, all elements of fertilizer do as well with surface application as when placed 2 to



Turf panel fields questions from floor: Top, left to right, Pat Biondi, Melvindale-Northern Allen Park Schools; Herbert Taylor, Herbert Taylor and Son Landscape Contractors, Detroit; and Bill W. Milne, Superintendent, Grosse Pointe Country Club. Below, left to right, Arthur T. Durfee, General Motors Technical Center, Warren; James Smith, Huron-Clinton Metropolitan Authority, Milford; and David Heiss, Cascade Country Club, Grand Rapids.



4 inches deep except phosphorus. Phosphorus alone did a significantly better job when worked into the soil. He also reported more winter hardiness where the nutrient level is high—among all types of grasses except bentgrass.

John King, researcher in the MSU Crop Science department, discussed studies with organic and mineral-based sods. Sod grown on organic soil, he said, had a greater rooting capability than sod grown on mineral soil. Rooting proved to be much slower on a clay soil compared to a sandy loam.

Watering properly may be more important in most cases than normally realized. Soaking

heavily when sod is first laid is considered the optimum practice. Afterward, best results are obtained by watering only 1/8 inch daily. This has proved superior to watering a full quarter inch daily.

Directors elected by the group were: James Standish, executive secretary, Michigan Golf Course Association, Detroit; James Smith, Field Landscape Architect, Huron-Clinton Metropolitan Authority, Milford; and Roy Peck, Superintendent Country Club Golf Course, Kalamazoo. President Frank Forier and Vice-President Bill W. Milne were re-elected to their respective positions.