

pleasant to play and to get full value for each dollar spent. Metropolitan clubs can afford to schedule fungicide treatments to prevent disease, and can provide the niceties their members want. A small town club may be compelled to take more chances with disease and provide the bare necessities only. By good management they can keep their members happy.

Agricultural Chemicals in Efficient Turf Management

Dr. William H. Daniel

Purdue University, Lafayette, Ind.

YOUR first question is: What can agricultural chemicals do for me? In reply you must answer the questions: What are my problems and my needs? What equipment, labor, experience and technology are available for the utilization of agricultural chemicals?

Agricultural chemicals is a term which encompasses a broad field. It includes fertilizers, insecticides, fungicides, and many other special items. Let us consider fertilizers first.

Fertilizers include organic materials, such as cottonseed meal, sewerage sludge (either activated or processed) and waste by-products. There are also four types of manufactured or synthetic nitrogen; ammonium salts, nitrate salts, urea and urea-formaldehyde. Besides these there are two major forms each of phosphates and potash. One is concerned then with the desired combination of three major nutrients which are available in twelve major forms.

Recent studies of plant tissue content and compilations of soil test results confirm earlier observations which indicated that when phosphorus is present in the soil at an adequate (medium) level, growth response to further additions of phosphorus should not be expected. Therefore phosphorus incorporation should be a part of seedbed preparation. Phosphorus should be incorporated as completely into the root zone as possible. Dr. Alderfer, in New Jersey, reports that roots will grow only where phosphorus is above minimum levels.

Phosphorus use has been emphasized in the growing of field crops, and its use in seedbed preparation has been stressed.

Although the session is designed for the superintendent, it would seem fitting to stress the wisdom of keeping abreast with new developments. By the same token it is important for the club to have a competent man at the helm. Besides being well versed in the technical problems of turf management, he should have labor management know-how.

These facts may cause one mistakenly to apply unnecessary amounts of phosphorus. The fact that phosphorus has been used in more than adequate amounts is evidenced by the findings of recent studies which disclosed that 98 per cent of the established golf greens in the Midwest have excess phosphorus accumulated in the upper 2" of the soil. The fertilizer industry is rendering a valuable service in the current trend to produce fertilizers of a 4-1-2, 3-1-2, or 2-1-1 ratio. These permit you the convenience of using a complete fertilizer without the necessity of over-using phosphorus.

Potash is a different matter. Its repeated application on irrigated turf should be mandatory. For many golf greens I would like to see some potash applied monthly. This applies to those fertilizers which give a peak availability, then a dearth of supply. These must be used more frequently and at lighter rates per application to achieve satisfactory results.

You are well acquainted with the organic nitrogen materials whose excellent performance is particularly noticeable in the late summer and fall periods. Under comparative testing the new class of urea-forms has been brought to the attention of many of you. These materials, which are chemical compounds produced industrially by the combining of urea and formaldehyde, can give a rather uniform release of nitrogen so that two applications per year may perform very satisfactorily. Continued use of these materials will contribute to successful understanding of their performance.

As with organics, you may use the urea-

forms as the background fertilization. Then, for special occasions, for cool weather or other conditions when you wish added vigor, light applications of soluble nitrogens may be applied to augment the background supply.

As a final point on fertilizers, it should be pointed out that if you are feeding turf heavily in experimental plots or under actual growing conditions, the first noticeable decline is in the yield of clippings. This will be followed shortly by a lightening in color, but it may be a considerable time before the density of the leaves of turf below the cutting height are actually reduced so that playability is modified. For this reason, all turf fertilizers may give satisfactory performing turf as long as we look at the performance of the grass remaining after clipping, while if we watch only clippings or greenness we see predictions and warning signs which may not yet be important in the golf playability of the turf itself.

Fungicides are Good

When we observe or learn of the tremendous variation in the fungi and algae that may affect turf plants, by producing disease symptoms, we marvel at their complexity and their variation. I never think of disease without thinking of Cohansey (C-7) creeping bentgrass. It does very well but only when protected from disease. We do have available from reliable producers a comparatively satisfactory array of fungicides. There is, as always, the problem of proper timing to have the chemical protection on the leaf blade as the fungus mycelium attempts to grow and cause damage.

The USGA has, in its past years, done a marvelous job of supporting and encouraging the research and the exchange of knowledge which has brought about the understanding of management principles and the capable performance of turf today. Currently in the Midwest we appear to lose more turf due to wilting than to all disease combinations. With good fungicide preventive maintenance, spraying schedules is your key to continued quality turf ready for play. As we progress, the use of broad spectrum fungicides, for example, Acti-

dione RZ and Kromad, will continue to offer more potential to both turf superintendents and the novice homeowner.

Herbicides Improve Rapidly

Perhaps the group of agricultural chemicals most important to you is herbicides. Weed problems in turf may be caused by chickweed, crabgrass, goosegrass, knotweed, henbit, dandelion, buckhorn, etc. With herbicides many of these can be controlled. Nevertheless, the potential of the chemical to control seeds is only one part of a three fold problem. The other two parts are proper use of the material and subsequent improvement of the turf in the area involved. Dr. J. A. DeFrance, reporting to the Northeast Weed Control group, mentioned that seven grasses needed additional study—annual bluegrass, goosegrass, chickweed, knotweed, nimblewill, pearlwort and spotted spurge. Certainly in the Midwest nimblewill presents a major problem.

On golf greens *Poa annua* continues to be a major pest. Although many chemicals have been tried—all so far, even partially selective—have to be used very painstakingly and only in favorable selective seasons or stages of growth. Endothal offers some promise. Neburon, although it will kill *Poa annua* and chickweed, lacks sufficient safety to desired grasses.

We at Purdue have done extensive work on applications of arsenic in toxic quantities for the control of *Poa annua*. Calcium arsenate at the rate of 12 pounds per 1000 square feet or lead arsenate at the rate of 24 pounds per 1000 square feet, are suggested with follow-up half rates twice a year until vigor and survival of the *Poa annua* is inhibited. Soils high in pH, organic matter, clay or phosphorus require more arsenic for adequate inhibition. Although several companies are considering pelleted arsenics (for convenience in application) none will be on the market before fall of 1958 or later. Since arsenics also inhibit crabgrass establishment the homeowner market is very attractive for this item.

Crabgrass Control is Practical Now

In 1955 disodium methyl arsonate was first sold. Today it predominates the post-

emergence crabgrass control market, succeeding potassium cyanate and supplementing phenyl mercuric acetate. Research in 1957 has led to the production of a faster acting material, amine methyl arsonate, which will be available in 1958 through several formulators.

Soil Sterilization Needs More Attention

Dr. Gene Nutter of Florida reports on tests of 12 chemicals—four of which (Vapam, methyl bromide, Mylone, and calcium cyanamid) have been used to

some extent by turf superintendents. It does require extensive planning and some added work before satisfactory performance can be expected from these materials. Nevertheless, the potential service of sterilization of special soil is generally not being utilized.

Insecticides require some finesse in use but many types are available and the user may usually expect satisfactory performance. Generally, recognizing the problems is the key to satisfactory results.

Adequate Equipment Contributes to Efficiency

David M. Lilly and J. R. Watson, Jr.,

President and Chief Agronomist, Toro Manufacturing Corp., Minneapolis, Minn.

EFFICIENCY in golf course operation implies the development and maintenance of the highest possible degree of turfgrass quality and player acceptance commensurate with a given expenditure of time, energy and money. Efficiency in golf course operations is attainable through organization, planning and supervision. Adequate equipment contributes to efficient golf course operations. In fact, adequate equipment is essential for efficient golf course operations. The selection, procurement and use of adequate equipment should be approached on the same basis as the overall golf course operation; i.e., a planned and organized approach with proper supervision.

Need

Labor costs have been and still are rising. Further, there seems little reason not to expect this trend to continue. Likewise, player demands for higher quality playing conditions are increasing. Budgets are not, and probably will not, increase proportionately.

Labor is most likely the biggest expense item in a yearly budget. This means, primarily, that hand operations are too expensive and must be eliminated. If the demands for ever improving maintenance standards are to be met economically, operations must be keyed to the use of not only more mechanized equipment, but also to equipment which will produce a great number of work units per man hour of operation. Great strides have been made in this respect during the past two decades,

but still greater strides must be made if player demands are to be met.

Planning

The direction for increased efficiency through adequate equipment does not necessarily lie in the development of new equipment, non-existent today. Rather, increased efficiency may (and probably does) lie in the development and execution of programs built around equipment presently available, or in the later stages of development. Certainly the greatest immediate potential for increasing efficiency calls for such an approach in our thinking. This means planning.

RESPONSIBILITY—The club membership is responsible for overall programming of operational standards. It must decide the type of course and level of maintenance required for its particular needs. These expressions are made through their appointed representatives — the Green Committee. Based on the authorized expenditures (budget for golf course operation) the committee, in cooperation with the golf course superintendent, prepares and submits a long range and immediate plan of operation. If approved, the superintendent executes the program under the general supervision of the Green Chairman.

Planning for adequate equipment then, is indirectly the responsibility of the membership but, in actuality, the direct responsibility of the superintendent—acting within the confines of an operational program, planned and developed in coopera-