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Adult Japanese Beetles

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The Japanese Beetle: A Major Pest of Turfgrass

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The Japanese beetle, *Popillia japonica* Newman, was first discovered in the United States in a New Jersey nursery in 1916. Since then it has become well established in all states east of the Mississippi River, except Florida, Louisiana, Minnesota, and Wisconsin. Of all known insect pests of turfgrass, the larvae of the Japanese beetle commonly called "grubs" are by far the most destructive pests of cool season turfgrasses, often requiring extensive control measures and frequent reseeding of heavily damaged lawns.

HOST PLANTS

The adult beetle feeds on the foliage, flowers, and fruits of about 300 species of plants in 139 families, and can cause extensive damage to a variety of trees, ornamentals and cultivated crops (*Figure 1*). The beetle's most frequent and extensive feeding, however, is restricted to 47 plant species in 22 plant families, particularly, among Rosaceae, Malvaceae, Vitaceae, Polygnoceae, Aceraceae, Ulmaceae, and Salicaceae. Recent work shows that beetles not only locate host plants by olfaction (detection of volatile chemicals given off by the plants), but most likely use olfaction in discriminating more preferred plants from those with less appeal [Ahmad 1982]. Moreover, the remarkable ability of the beetle to exploit highly diverse and often unrelated plants has been attributed to the presence of a general-purpose enzyme system (called the mixed-function oxidase (MFO) system) in the gut [Ahmad 1983]. The MFO system affords the beetle with detoxification ability to effectively deal with toxic secondary plant chemicals associated with its host plants.

Like the adults, the larval stage also feeds on the roots of many diverse plants including grasses. Thus, the larvae thrive on the abundant roots of turfgrasses cultivated in home lawns, golf courses, commercial sod farms, industrial state grounds, grassy tracts along the highways, recreational parks and grounds and cemeteries.

BIOLOGY OF THE BEETLE

In New Jersey, beetle adults begin to emerge from the soil in June, reaching peak populations in July (*Figure 2*). After mating, adults burrow into the soil where single eggs are laid in clusters at a depth of 2-4 inches. In her average lifetime of 30 to 45 dyas [Fleming 1972], a female may lay 40-60 eggs.

A conspicuous feature of the

Figure 1: Adult Japanese beetle feeding and in copulation. The female is usually larger than the male. The body is colored a brilliant metallic green. The abdomen is partially covered with coppery brown wings (elytra).

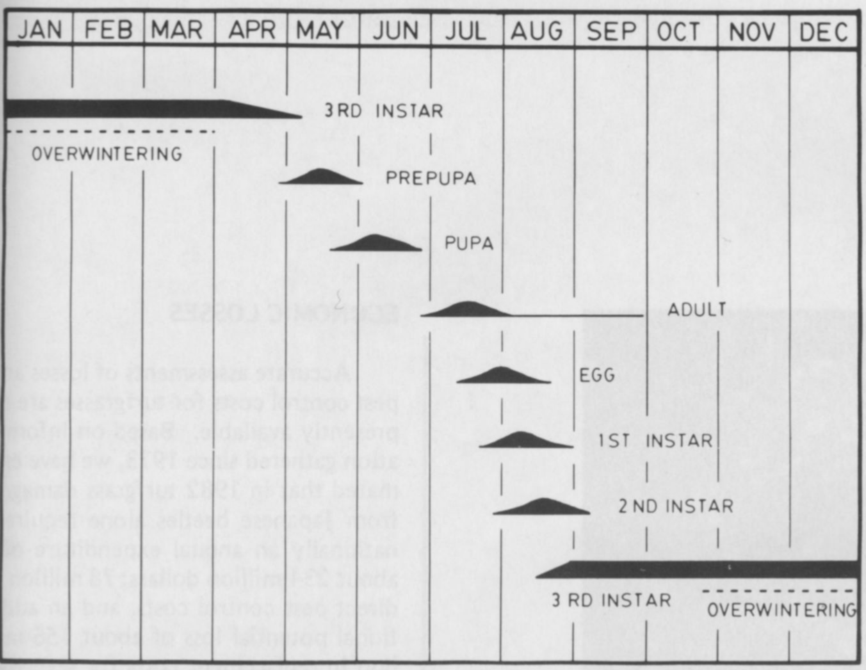

Figure 2: Life cycle of the Japanese beetle in New Jersey. The beetle has one generation in a year. It overwinters as 3rd-instar larvae (grubs), 6-12 inches deep in the soil. The larvae pupate after having fed on grass roots in the spring. Transition from 3rd instar to pupa involves an intermediate stage known as prepupa. The prepupal stage is pale compared to the 3rd instar, its skin is shrunken and abdomen clear because of ejection of excreta and soil. The adults begin to emerge in June reaching peak populations in July. Eggs are laid through July and early August. The eggs hatch into small 1st-instar larvae and most are transformed to 2nd instars by mid-August. Third instars first appear in late August and feed for nearly two months before moving to deeper soil for overwintering. Third instars represent the fully grown larvae and are characterized by the C-shape position they usually assume in the soil. All three stages of the larvae look alike at casual observation except for conspicuous size differences. The relative sizes of the stages are given in Table 2, and a fully grown 3rd instar shown in Figure 5.

Table 1: Development changes in body dimensions and mass from egg to adult stage of the Japanese beetle[1]

Beetle stage	Size (mm)	Mass (mg)
Adult		
Male	ND[2]	80-150[3]
Female	ND	110-180[3]
Egg	0.2-2.0[4]	0.8-2.5[4]
1st instar	1.5-10.5[4]	2.0-20[4]
2nd instar	11.0-18.5[4]	20-90[4]
3rd instar	18.5-32[4]	90-270[4]
Prepupa	ND	190-270[3]
Pupa	7x14[5]	145-260[3]

[1] Data based on field-collected specimens over a 3-year period (1978-81), from 3 locations in New Jersey; Rivervale (northern N.J.), East Millstone (central N.J.), and Trenton (southern N.J.). Some values reported here are slightly different from those of Fleming (1972), and most are in fair agreement. Measurements for dimension or mass determinations were made on 100 unsexed individuals of each development stage.
[2] Not determined.
[3] Ranges indicated individual variations.
[4] Ranges represent growth factor.
[5] Average dimension, maximal width vs. length.

beetle's growth and development is the phenomenal increase in larval size and mass. For example, the mass difference between the tiny newly hatched first instar and the fully grown 3rd-instar larva is 130 fold (*Table 1*). Therefore, the 3rd instars require and consume a far greater amount of food than the relatively smaller younger stages, and, consequently, are the most devastating to turfgrasses. It is therefore desirable to control the larval population before it enters 3rd instar, or larval stage.

Since both grasses and grubs thrive in a moist soil, wet summers favor the development of extensive damage to turfgrass. As a result, higher than normal populations build up. Golf courses and well-managed grounds of industrial estates where turfgrasses are frequently irrigated provide favorable moisture at all times and, thereby, are subject to regular and often severe damage from larval feeding.

Drought has an adverse effect on larval survival; it significantly reduces infestation levels in occasionally irrigated or nonirrigated areas such as parks and roadsides. Unusually early drops in fall temperature also affects larval survival and considerably reduces the population level the following year. This is because the larvae are forced to cease feeding earlier and to move to deeper soil (6 to 12 inches) for overwintering; many larvae thus overwintering prematurely, are less well prepared for winter survival and ultimately perish.

Studies at Rutgers University of the larval populations of 2nd and 3rd instars of the beetle at three locations in New Jersey (Rivervale, northern N.J.; East Millstone, central N.J.; and Trenton, southern N.J.) revealed a highly aggregated pattern in their spatial distribution (*Figure 3*). The degree of aggregation decreases from early 3rd instars (summer/fall) to late 3rd instars (April/May). Presumably a combination of two factors are responsible for this change: (a) overwintering mortality; and (b) dispersal during redistribution in the spring when the larvae move up to near soil surface to feed and complete development to adult beetles (Ng *et al.* 1983).

Japanese Beetle

Figure 3: A cluster of 68 larvae of the Japanese beetle in a 1 sq. ft. area. Such clusters clearly depict the highly aggregated spatial pattern of larval distribution.

ECONOMIC LOSSES

Accurate assessments of losses and pest control costs for turfgrasses are not presently available. Based on information gathered since 1973, we have estimated that in 1982 turfgrass damage from Japanese beetles alone required nationally an annual expenditure of about 234 million dollars; 78 million as direct pest control costs, and an additional potential loss of about 156 million in replacement costs for severely damaged areas, (*Table 2*). These figures represent nearly one-third of total maintenance costs for turfgrass damage by all known insect pests. Therefore, losses related to damage caused by the Japanese beetles to turfgrass figures

Table 2: Estimates of turfgrass acreage and replacement costs, by all insect pests and Japanese beetles alone, and by geographic area.

Parameter	New Jersey[1]	5 N.E. States[2]	All U.S.[3]
Total acreage	750,000	4,127,000	12,381,000
Replacement value (millions of dollars)	655	3,606	8,100
INSECT DAMAGE AND REPLACEMENT COSTS (millions of dollars)[4]			
Damage due to all insects			
Control costs	19	79	236
Replacement costs	38	157	471
Total costs	57	236	707
Damage due to Japanese beetles			
Control costs	6	26	78
Replacement costs	13	52	156
Total costs	19	78	234

[1] New Jersey estimates based on an unpublished report by S. R. Race (Dept. of Entomology and Economic Zoology, Cook College, Rutgers University, 1973). Cost projections from 1973 to December 1982, were based on Prices Paid Index for items used in agricultural production and maintenance (Courtesy of A. R. Koch, Dept. of Agricultural Economics and Marketing, Cook College): dollar increases between 1973-82 were: seed, 71%; fertilizer, 91%; chemicals (pesticides), 42%; energy (only maintenance and fuel costs for lawn machinery), 139%; and wages, 92%. Total production items, 90%, measured against based year 1977 (=100).

Area estimates include, established homelands in the states, number of housing starts, golf courses (231), commercial sod farms, parks, playgrounds, industrial estates, school grounds, turf tracts along highways, airports, and cemeteries.

[2] Total turfgrass acreage and replacement values for New York, New Jersey, Maryland, Virginia, and Pennsylvania (H. T. Streu, unpublished).

[3] All U.S. states (estimated by H. T. Streu, to be somewhere between 8 and 12 billions of dollars, for replacement value).

[4] Damage for the 5 N.E. states and for the entire U.S., were proportionally estimated from the more detailed estimates of New Jersey.

prominently in the staggering national maintenance cost of about 700 million dollars annually.

DAMAGE AND ITS DIAGNOSIS

In New Jersey, the most serious damage to turfgrass is caused by the 3rd-instar larvae of the beetle, which occur from mid-August to September, and sometime well into October. Damage is manifested as patches of wilted, dead or dying turfgrass (*Figure 4*). Severe to moderate damage also occurs during spring (late April to May), when the 3rd-instar larvae move up from their winter cells, 6 to 12 inches deep in soil, to resume feeding.

Presence of 3rd instars is also indicated by the feeding activity of skunks, racoons, other small mammals, and blackbirds, crows, and starlings, which tear up the turfgrass in search of larvae. According to Niemczyk (1981), another good indicator of larval infestation is ground mole activity.

Because economic damage standards vary from state to state, economic threshold levels (larval density per sq. ft.) also vary considerably; in New Jersey, for example, control measures are recommended when the larval count is 3 or more per sq. ft., in Ohio as high as 8 or more, and in New York 1 or more per sq. ft., signal application of control measures.

Figure 4: Dead and dying patches of turfgrass caused from severe damage to the roots by the larvae of the Japanese beetle.

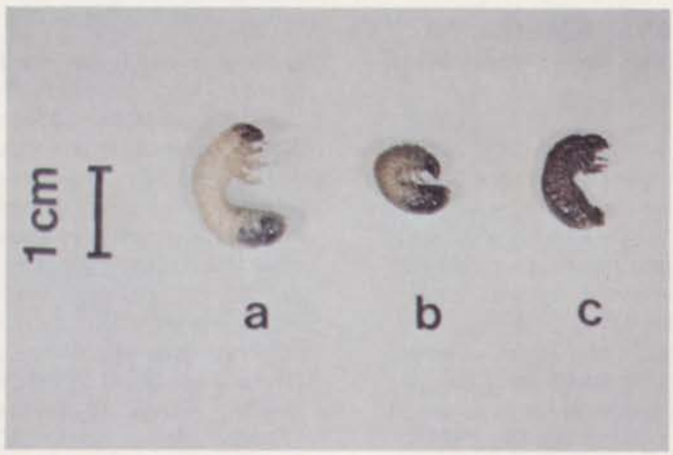

Figure 5: (a) body-size and color of a normal 3rd-instar larva, (b) a chlorpyrifos-poisoned SYM stage of 3rd instar, and (c) a chlorpyrifos-treated deceased larva. SYM = shrinkage of body (S, Body reduced to about ½), yellow-brown coloration of the body (Y), and moribundity or paralysis (M). Once the insecticide-treated larvae exhibit these features, they are destined to die within 24 hours.

SAMPLING PROCEDURE AND PROPER TIMING OF INSECTICIDE APPLICATION

In New Jersey, the recommended economic threshold level is 3 larvae per sq. ft. for 2nd instars. Threshold levels for the 3rd-instar larvae are presently unknown. In any case, the 3rd instars being 5-6 times larger than the 2nds are difficult to control because their insecticide tolerance is proportionally very much higher; this problem increases in relationship to materials with short persistence in the soil. Therefore, for all insecticides except isofenphos (Oftanol), managers are advised to direct control measures during early August when the bulk of the larval population is in 2nd stage [Vasvary and Davis 1979]. This requires proper timing of insecticide application for best results. A sampling method is needed which is both rapid and statistically sound for estimating population density accurately, and classifying populations requiring control vs. those not requiring control. A

Japanese Beetle

sampling method that meets the above criteria calls for ten one-sq. ft. samples per 1000 sq. ft. area. The sampling involves cutting into the turfgrass, laying back the sod and examining the root zone in the first 3-4 inches of the soil for quantification of the larval density.

The sampling described above is ideal for accurately estimating field populations and essential for experimental work. However, in high priority areas, e.g., golf course greens, tees and fairways, sampling and decision for control often is based on fewer (2-4) observations. This is especially the case when discoloration and animal damage is severe and usually the sampling reveals high infestation levels; substantially more than 3 larvae per sq. ft.

Table 3: Change in chlorpyrifos tolerance of Japanese beetles from Rivervale, New Jersey; 1978-1982.

Year	Beetle stage	Mean LD_{95}[1] Adelphia	Mean LD_{95}[1] Rivervale	Tolerance[2] factor
1978[3]	Adult	1.4	6.0	4.3
1979[4]	3rd instar	9.2	62.5	6.8
1980	3rd instar	9.1	73.9	8.1
1981	3rd instar	9.6	96.1	10.0
1982	3rd instar	9.3	110.2	11.8

[1] Results of topical tests in the laboratory on field collected insects. For detail on this method, see Ahmad and Das (1978). LD_{95} = dose lethal to 95% of the population.
[2] LD_{95} ratio; Rivervale vs. Adelphia insects.
[3] Data are from Ng and Ahmad (1979), and rounded to one decimal.
[4] Data are from Ahmad and Ng (1981), and rounded to one decimal. All other data (1980-82) are being reported here for the first time.

TOXICOLOGY— DURATION OF TOXIC ACTION AND SYMPTOMS OF POISONING

For monitoring the efficacy of insecticides applied to an area of turfgrass, it is imperative that we know how long an insecticide exerts its toxic action, what the symptoms of poisoning are, and what symptoms signal an irreversible process leading to death. The length of acute toxic action of both organophosphorus and carbamate insecticides in Japanese beetle larvae is seven days [Ahmad and Das 1978]. Dying larvae in advanced stages of poisoning exhibit three distinct symptoms 24 hours prior to death (see *SYM* larvae in *Figure 5*). The symptoms are: (a) shrinkage in size and reduction of body mass by about 50%; (b) yellow-brown coloration of the body instead of the normal whitish appearance; and (c) paralysis. Dead larvae are usually very dark and, also, within a few hours, bloat in size by the decomposition of the body (*Figure 5*).

INSECTICIDAL CONTROL— SUCCESS AND FAILURE

Chlordane, an organochlorine cyclodiene insecticide, was first introduced for larval control in 1947 [Fleming 1950]. Thereafter, and for nearly two decades, chlordane and other cyclodienes, e.g., aldrin, dieldrin, and heptachlor, afforded good protection against the Japanese beetles. Resistance to these insecticides developed, however, and was first reported in 1973. This cyclodiene resistance is wide-spread and has been documented in Connecticut [Dunbar and Beard 1975], New Jersey [Ng and Ahmad 1979], New York [Tashiro and Neuhauser 1973], Ohio [Niemczyk and Lawrence 1973], and Pennsylvania [Anon. 1973]. Cyclodiene insecticides thus became ineffective and, moreover, their use was restricted by the EPA due to their very long persistence in the soil and, hence, the potential of environmental hazards. As a result, nonpersistent organophosphorus (mainly) and carbamate insecticides have since replaced cyclodienes for the control of Japanese beetle larvae.

The organophosphorus insecticides have not proven to be as effective in controlling Japanese beetles as the cyclodienes, however. In part this is due to the short residual action of these materials, and in some cases, as shown for chlorpyrifos (Dursban), because of binding to the thatch [Niemczyk and Kruger 1982]. A disturbing recent finding is that the potential exists for the ultimate development of resistance to these insecticides in the Japanese beetle. Work at Rutgers University conducted during 1978 showed that a population from Rivervale, N.J., varied considerably in susceptibility to chlorpyrifos, and an experimental promising carbamate insecticide, bendiocarb. Greater tolerances of 4.3X to chlorpyrifos and 2.1X to bendiocarb were reported for this population, compared to susceptible beetles from Adelphia, N.J. [Ng and Ahmad, 1979]. Subsequently, the tolerance of the Rivervale insects to chlorpyrifos has increased to 11.8 fold (*Table 3*). A more resistant beetle population (42.2-fold resistance) was recently discovered at a golf course in Fairfield, CT [Ahmad and Ng 1981].

Selection of a population against an organophosphorus insecticide often confers resistance to other compounds in this class [Perry and Agosin 1974]. The premise of a broader resistance is supported by field observations that both trichlofon (Dylox or Proxol) and diazinon were as ineffective as chlorpyrifos during 1979 trials against the larvae of the Fairfield population [A.m. Radko, pers. commun., 1979]. Rivervale larvae which have not attained as high tolerance as the Fairfield larvae remained susceptible to trichlorfon, which provided good control [W. Gaydosh, pers. commun., 1979].

The above data and observations taken together raise the possibility, that with time, Japanese beetle populations will become resistant to organophosphorus compounds. Moreover, cross-resistance is also likely to extend to carbamate insecticides, as the mode of action and detoxification mechanisms associated with tolerance and resistance are common to both types of insecticides [Perry and Agosin 1974, Plapp 1976].

The gut MFO enzymes mentioned earlier, and whose natural function is to detoxify toxic plant substances, also detoxify synthetic insecticides having a wide variety of chemical structures. It is interesting to note here that the MFO level in the Rivervale population is two-fold higher than in the susceptible Adelphia population. Although a similar study of the Fairfield larvae has not been conducted yet, it is likely that the selection process involves increases in the insecticide-detoxifying MFO system in resistant individuals.

Despite the spectre of resistance, newer materials with altered structures to enhance toxicity (for example, the new entry, isofenphos) may for sometime continue to provide satisfactory performance. Better formulations of existing and/or new entries may further boost efficacy to provide good control of even those populations that have already attained low-level tolerance. However, the threat of a broad-spectrum and high level resistance (100 fold or more) looms, and it is not unrealistic to predict that this may occur within a decade or so. Therefore, we must earnestly and immediately begin the search for other control alternatives.

CURRENTLY AVAILABLE CONTROL AGENTS AND THEIR EFFICACY

In New Jersey during the past decade, high Japanese beetle larval populations provided an ample opportunity to evaluate larval control materials. The success of these materials depends upon several factors, one being that the susceptibility levels of larval populations vary according to the history of insecticide use. Superimposed upon varying susceptibility levels are environmental characteristics such as the presence of thatch, rainfall and pH.

The threat of a broad-spectrum and high level resistance looms

Fortunately, suitable larval control insecticides are available to turfgrass maintenance personnel. Isofenphos (Oftanol or Pro-Turf Insecticide 4) has emerged as one of the most dependable and long lasting material. It is available in granular formulations and is applied at the two pounds of active ingredient per acre rate. During the past five years, isofenphos has provided over 95% control in all our test plots.

Bendiocarb (Ficam W or Turcam) has provided over 90% control at the two pounds active ingredient rate per acre. Bendiocarb is available as a 76% wettable powder.

Trichlorfon (Dylox or Proxol) as a 80% soluble powder applied at a rate of ten pounds (of active material) per acre has been a standard larval control material for several years. Some mild phytotoxicity has been reported at this rate; however, it is not universal nor of a long duration.

Milky spore disease powder (Doom or Japidemic) is the primary biological control material for Japanese beetle larvae. It has provided satisfactory control in New Jersey and thus far there have been no reports of tolerance.

OTHER CONTROL MEASURES—NEW HORIZONS FOR RESEARCH AND DEVELOPMENT

Recently, research emphasis is being placed on studies of the intricate relationship that exists between an in-insect species and its host plants. The knowledge of biochemical and physiological mechanisms that govern an insects location of host plants, selection of preferred hosts, and an insect's defense mechanisms to overcome the plant-defensive toxins to permit safe exploitation of its hosts, offers the hope that in the near future, insect pest management will include careful manipulations of these phenomena.

The observation many years ago, that the Japanese beetle is attracted by odors emanating from its host plants, is the basis for trapping of beetles using geraniol or a mixture of phenethyl propionate (PEP) and eugenol [Ladd *et al.* 1975, 1976]. Currently there are three commercially available mass-trapping systems. Two use lures composed of PEP: eugenol mixed with bran. The third lure contains the female sex-attractant, Japonilure, in combination with PEP and eugenol. The efficacy of these traps remains to be evaluated critically. Despite the popular belief that beetles are drawn into areas with traps, it has been noticed that presence or absence of favored host plants is more important in concentrating beetles [Klein 1981]. This observation is consistent with the recent demonstration that olfaction plays a key role in both host location and host preference of the Japanese beetle [Ahmad 1982]. Clearly, there is the need for isolation and characterization of attractive plant volatiles to serve as powerful lures effective in field situations.

Despite being highly polyphagous, Japanese beetles do not feed on all plants, and several, in fact, deter feeding. Azadirachtin, a compound isolated from

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the Indian neem tree *(Azadirachta indica)* is a powerful feeding deterrent to the Japanese beetle. This compound and other neem terpenoids (structure unknown) are of particular interest in that they show systemic action, and possess hormone-like growth disruptive properties in addition to anti-feeding activity [Jacobson *et al.* 1978]. We need to know about the identity of these and other feeding deterrents, their potency, and practical ways for dispensing them in the field as well as utilizing them in insect-pest management practices.

From time to time many plants have been reported to be toxic to the beetle. For example, the geranium *(Polargonium domesticum)* is toxic to the beetle, the flower being more so than the foliage [Fleming 1972]. The toxic effect is greater if feeding occurs while exposed to light. The toxic factor in geranium has not been identified but we suspect that it is a photosensitizer such as furanocoumarins and polyacetylenes. These compounds, when exposed to light, react with oxygen in its ground state (triplet) to product singlet oxygen and triplet (deexcited) compounds. Singlet oxygen is highly reactive and literally burns up insect tissues.

The above examples serve to illustrate some of the possibilities for using naturally-occurring phytochemicals for control of Japanese beetles. They may be used as potent lures for mass-trapping, as feeding deterrents, growth inhibitors, or even as quickly-acting insecticides. These alternatives could be on hand by the time resistance to conventional insecticides renders them totally ineffective.

SUMMARY

The larva of the Japanese beetle *(Polillia japonica* Newman) is one of the most destructive pests of turfgrasses in the United States. It is responsible for a national expenditure of about 234 million dollars annually. Direct pest control costs are 78 million dollars with an additional 156 million as potential replacement costs for severely damaged areas. Two organophosphorus insecticides, isofenphos (Oftanol or Pro-Turf Insecticide 4) and trichlorfon (Dylox or Proxol), and a carbamate insecticide, bendiocarb (Ficam W or Turcam), provide suitable larval control at the present time. Milky spore disease powder (Doom or Japidemic) is the primary biological control material for the larvae. There is some evidence suggesting, that with continued use, resistance will ultimately develop against the currently used chemical insecticides. However, research is now underway for alternative methods of control. Beetle traps have been developed using attractive substances such as geraniol, phenethyl propionate, and a sex-attractant, japonilure, in various combinations. Host-plant/insect interaction studies have begun in search for more powerful lures, feeding deterrents, growth inhibiting compounds, and quick-acting plant-origin insecticides.

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Agrotec Introduces New Durotec Hose

A new high pressure Durotec hose, manufactured from a never-before used material, is being introduced this winter by Agrotec, Inc., Pendleton, North Carolina.

The new thermoplastic hose is covered with a high abrasion-resistant urethane, bonded to a braid of synthetic fiber, and provides 1,000 PSI working pressure. An extremely flexible and kink-resistant hose, size ranges are from ¼ inch I.D. through 3/4 inch I.D. with a four-to-one safety factor.

This hose tube is made of a new thermoplastic rubber to provide resistance to a wide range of chemicals, herbicides, insecticides and hot water. It has a four-to-one safety factor, meaning the hose withstood a burst pressure of 4000 pounds in tests.

Agrotec President Roger Cohil said, "It has required a lot to time and effort to find a hose that was more durable to abrasions and more resistant to chemical and solvent attacks. Vibration causes the hose to wear very rapidly, particularly when in contact with environments such as concrete, asphalt or metal objects over which the hose has to be pulled. This new material and new process allows us to make a 90-day limited no failure warranty on Durotec hose."

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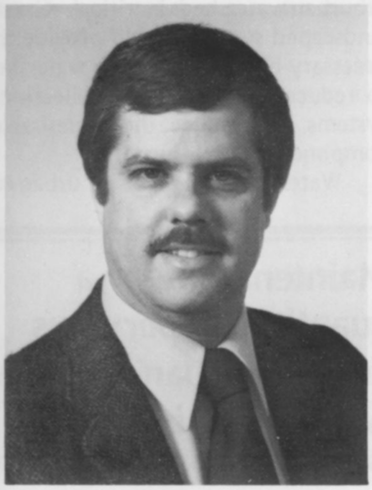
Penn State to Study the Effects of Runoff Water

by T. L. Watschke, Pennsylvania State University



T. L. Watschke is a Professor of Turfgrass Science and project leader for turfgrass weed control and growth regulation at The Pennsylvania State University, University Park, Pennsylvania. He received his B.S. from Iowa State University, Ames, Iowa and M.S. and Ph.D. degrees from Virginia Polytechnic Institute and State University. Since joining the faculty at Penn State in October of 1970, Dr. Watschke has been involved with several aspects of turfgrass weed control, growth regulation, microclimate, and physiology research. Dr. Watschke is a member of the American Society of Agronomy, Crop Science Society of America, The International Turfgrass Society, Weed Science Society of America, and is currently President of the Northeastern Weed Science Society. Dr. Watschke is also a member of Sigma Xi, Phi Sigma, and Gamma Sigma Delta (The Pennsylvania State University Chapter recently awarded Dr. Watschke the 1982 Teaching Award of Merit).

In the March/April 1982 edition of **American Lawn Applicator**, Dr. Robert W. Schery, then the Director of the Lawn Institute, wrote an article entitled "Managing Urban Habitat." In his article, he asked the question, "Why aren't the benefits of lawns and ornamental plantings in the urban environment emphasized to the public sector?" Instead, most media attention is focused on the alleged degradation of water quality as a result of fertilizer nutrients and pesticides applied to the landscape.

Part of the problem relates to how different people perceive risk. In a recent survey, three groups of people (League of Women Voters, College Students, and Business and Professional Club Members) were asked to rank 30 sources of risk according to their actual annual contribution to the number of deaths in the United States as they have been determined by actuarial estimates (Scientific American, February 1982). The sources of risk included smoking (150,000 deaths), alcohol (100,000 deaths), motor vehicles (50,000 deaths) and handguns (17,000 deaths), as the four highest ranked by actual number, and food preservatives, pesticides, prescription drugs, and spray cans the lowest ranked with none of them responsible for a death. However, when the risks were ranked by the three groups, pesticides were rated as having the ninth highest risk by the League of Women Voters, fourth highest by College Students, and fifteenth highest by Business and Professional Club Members. None of the groups had an accurate perception of the risk from pesticides. Conversely, food coloring, which was actually ranked as having higher risk than pesticides, was ranked twenty-sixth by the League of Women Voters, twentieth by College Students, and thirtieth by Business and Professional Club Members. A much more accurate perception.

In addition to misperceiving pesticide risks and being bombarded with negative media treatment, more and more people are being exposed first-hand to application of fertilizers and pesticides in their own neighborhoods.

In the past 15 years, the Lawn Service Industry has undergone a phenomenal increase in growth. This increase has primarily occurred in areas of high population density (i.e., the northeastern United States). According to a 1966 survey the total turfgrass

Fertilizers and pesticides are being applied in areas where water run-off is high

maintenance expenditures for the United States exceeded 4.3 billion dollars. At that time, nearly 3 billion dollars was being spent on home lawns (by individuals or through the hiring of professional lawn care companies). By 1977, the Professional Lawn Applicators Association of America estimated that 1.2 billion dollars was spent on professional lawn care alone. This figure has been updated for 1982 to approximately 2 billion dollars, or nearly half the expenditures for all turf in the United States as recently as 1966. It has also been estimated that only 8 percent of the potential lawn care market has been realized.

These surveys and estimates indicate how significant the lawn care business has become. The managerial

Runoff Water

inputs to the urban-suburban landscape have dramatically increased as a result. Fertilizers and pesticides are being applied in liquid and granular form to many more acres of landscape than they were 15 years ago. These materials are being applied in areas where water runoff is high due to streets, walks, driveways, etc. In many areas stormwater runoff can eventually be a major source of water utilized by municipalities.

All receiving bodies of water have water quality standards specified for them based on natural quality plus the use for which it is intended (drinking, recreation, or propagation of aquatic life) (Kibler, 1982).

Water quality of several stormwater systems has been assessed over the past 15 years in different parts of the United States. It has been concluded that a significant pollution potential exists for untreated stormwater. The sources of pollutants have been categorized as occurring from three sources: 1) land surfaces, 2) catch basins, and 3) combined sanitary and storm sewer systems. Of the three, the land surface has been

Sediment is the most important pollutant in runoff water

identified as the primary source of pollutants, particularly the streets, gutter, and other impervious areas connected to the streets or storm sewers. A long list of potential pollutants can accumulate on these surfaces (including movement of materials from landscaped surfaces). Studies at the University of Florida by Huber *et al.* (1979) and those by the U.S. Environmental Protection Agency (1978) are being conducted to increase the knowledge of the sources and magnitude of pollutants in urban runoff.

Studies on agricultural lands have shown that sediment is the most important pollutant in runoff water. Only in areas where landscapes are being established do management inputs made to the site significantly influence the amount and quality of the sediment. In most urban-suburban watersheds, sediment in runoff water is minor compared to total runoff. Therefore, even though pesticide concentrations may be 2 to 3 times higher in sediment than in the aqueous phase, the amounts are a small portion of the total runoff.

The amount of runoff, and therefore the pollution load contributed by pervious surfaces in urban areas, is smaller than that coming from impervious areas (L. A. Roesner, 1982). As an example, converting a watershed from a park (90% pervious) to a multiple residential area (20% pervious) would result in significant differences in runoff and pollution load from the area. At peak flow, the watershed outflow would increase approximately 8 times due to the conversion.

It has been estimated that when population changes from 100 to 13,000 persons per square mile the peak rate of surface runoff for a given surface area becomes about 10 times greater. Concurrently, the time elapsed before runoff occurs decreases to about one tenth that for rural areas (Brater and Sherill, 1975). It is projected by the year 2000 that 80% of the population will reside on less than 10% of the land (Vlachos and Flack, 1974).

Obviously, the need to maintain a quantity of pervious areas in urban-suburban watersheds is critical. Grassed, landscaped surfaces could provide the necessary buffer within the watershed to reduce the burden on collection systems and reduce the undesirable components of the runoff.

Water quality aspects of urban run-

Maintenance of a quantity of pervious areas in urban-suburban watersheds is critical

off are very complex and poorly understood. A work group discussing the water quality aspect of urban runoff at the Urban Runoff Quantity and Quality Research Conference at Franklin Pierce College, Rindge, NH, in 1974, identified eight specific areas where information was needed. One of the areas listed was "surface non-street material including animal wastes, garbage, fertilizers, chemicals, pesticides, household and commercial refuse awaiting collection".

The possible deleterious water quality effects of non-point pollution sources in general, and urban runoff in particular, were recognized by the Water Pollution Control Act (Public Law 92-500) of 1972. Because of uncertainties about the true significance of urban runoff as a contributor to receiving water quality problems, Congress made treatment of separate stormwater discharges ineligible for Federal funding when it enacted the Clean Water Act (Public Law 95-217) in 1977. In addition, Congress decided to fund Section 208 of the Law to study the problem of non-point source (i.e., storm water runoff) pollution from urban areas on receiving waters. To obtain information that could help resolve the uncertainties, the Environmental Protection Agency established the Nationwide Urban Runoff Program in 1978. This five-year program is intended to answer questions like: 1) to what extent does urban runoff contribute to water quality problems, 2) what is the effectiveness of control short of treatment in areas where reduced water quality exist, and 3) within cost constraints, what are the best management practices for control of urban runoff.

The findings of the Nationwide Urban Runoff Program are not known as yet, but information accumulated to date from a variety of sources provides some insight. Urban-suburban watersheds that have a realistic percentage of pervious surfaces have a lower potential for having water quality problems with their runoff. What is not known is the extent to which management inputs to pervious surfaces affects the quality of the runoff. With the increased interest in reclaiming surface runoff to make more efficient use of available water resources, it is imperative that the quality of such water be determined.

At The Pennsylvania State University, the College of Agriculture has initiated the development of a research area to study the effects of landscape management on the quality of runoff water. This area represents an expansion of the existing Valentine Turfgrass Research Center. In addition to water quality studies, future research at the expansion site will relate to turfgrass problems in the home lawn, sod, landscape, and athletic field areas. As an inter-disciplinary project, it is being supported by the departments of Agronomy, Entomology, Plant Pathology, Agricultural Engineering, and Horticulture. At present, an inactive soil runoff testing facility is being renovated to accommodate this new research project. Additional funding to develop the facility has been granted to the University by the Pennsylvania Turfgrass Council. Installation of different landscape schemes and imposition of management treatments are scheduled for the summer of 1983. Landscapes of varied composition and density will be fertilized and receive pest control consistent with current recommendations and practices.

Another question raised by Dr. Schery in his article early last year was, "Why shouldn't lawns and ornamental plantings be a required part of community planning?" Why shouldn't they indeed! We are hopeful that our research will clearly document the degree to which landscape management inputs affect the quality of runoff water from such sites. Thus, one of the goals of this study will be to define management practices that improve the quality of life for urban-suburban society without deleterious effects on water supplies. Another goal is to determine the role of landscaped surfaces in maintaining the quality of runoff in urban-suburban watersheds. As a result of research of this type, it may become a standardized recommendation of community planning commissions that specific amounts of land intended for development must be designed as pervious landscaped areas.

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Mole Control– A Problem for Lawn Applicators

by Glenn R. Dudderar, Michigan State University

Glenn R. Dudderar is an extension wildlife specialist with the Department of Fisheries and Wildlife at Michigan State University. He received his B.S. in 1965 from West Virginia University, and an M.S. in 1967 from Virginia Polytechnic Institute and State University. Glenn's professional experience includes: research technician, U.S. Forest Service, Upper Darby, Pa., 1964-65; Extension specialist, wildlife, Extension division, Virginia Polytechnic Institute and State University, Blacksburg, Va., 1967-73; Extension specialist, (temporary), wildlife, Department of Fisheries and Wildlife, MSU, 1973-75; Extension specialist, 1975 to date.

One lawn problem that lawn applicators have difficulty solving is the damage caused by moles. This difficulty is caused by the following factors.

1. A need to know more about moles and their habits.
2. A need to know more about the nature of the mole damage and mole damage control.
3. The need for more appropriate control tools.

The 3 species of moles occurring in the Great Lakes region are the eastern mole *(Scalopus aquaticus)*, the hairy tailed mole *(Parascalops bereweri)* and the star-nosed mole *(Condylura cristata)*. Both the star-nosed mole and the eastern mole occur in Michigan while the hairy-tailed mole occurs to the east and south of Michigan.

Damage done to lawns by the eastern mole and the star-nosed mole are usually distinctive. Damage by the eastern mole is recognized by the fact that many of the eastern mole's tunnels are just an inch or two below the surface thus creating a long, winding ridge. Although mounds of earth are occasionally associated with the raised ridges, they are few and infrequent. On the other hand, the star-nosed mole digs many of its tunnels at a depth of 4 to 6 inches and thus the surface of the lawn is not raised. However, the soil excavated from these tunnels is pushed to the surface through a vertical shaft thus creating numerous and frequent large mounds of raw earth.

Normally these patterns of damage are distinctive, but occasionally during cool, moist weather in the summer when much of the mole's food is near the surface, star-nosed moles will tunnel close enough to the surface to also produce ridges similar to the eastern mole.

Star-nosed mole damage

Occasionally both species will occur in a lawn, especially lawns that are not well drained or which are adjacent to a body of water. Star-nosed moles prefer poorly drained soils, whereas eastern moles prefer well drained soils.

Moles eat the organisms that live in the soil especially insect larvae and earthworms and will occasionally take succulent vegetable matter such as newly sprouting seeds or bulbs. More frequently, however, damage to plants is caused not by moles, but by meadow mice and ground squirrels that frequently invade and make use of mole tunnels. As moles feed they follow their food supply and thus burrow at a depth where they are most likely to encounter their preferred food. Obviously then, they are closest to the surface during cool, moist weather and are deepest (where they cause no harm and leave no indication of their presence) during cool weather or extremely hot, dry weather. Hence, mole damage is most frequent and extensive in the spring and fall and during cool moist periods in the summer.

Obviously the mole's system of tunnels is extensive, consisting of tunnels at many different levels which receive varying amounts of usage by the mole.

Both the lawn applicator and the client will have difficulty in determining whether a mole control operation has been successful for the simple reason that no mole control technique will prevent damage from new moles digging exploratory tunnels in a treated area.

Although it is a popular belief that the chlorinated hydrocarbons such as Dieldrin and Chlordane are single-shot long term solutions to mole problems it simply is not true. Golf course greenskeepers would be the first to testify that, although greens were kept insect and earthworm free through the use of chemicals, this would not deter new moles from making exploratory tunnels onto the greens. Consequently, today it is possible for lawn applicators to completely eliminate moles in a lawn by one of several techniques only to have that technique judged a failure because of moles from adjacent properties digging new tunnels on the property from which the resident moles had been successfully eliminated. Further, none of the insecticidal techniques whether the old Chlordane or the new Diazinon and Oftanol provide immediate solutions to mole problems. All of these insecticides work by eliminating the moles food supply. However, it may be more than a week before the moles realize that they are not finding sufficient food before they move to another location or starve. Thus in many cases, insecticidal control techniques are judged to be failures prematurely.

Mole damage most evident in the spring and fall and during cool moist periods in summer.

Eastern mole damage

Reliably, mole control techniques available to the lawn applicator who works for a single client include direct killing, trapping, insecticide application and burrow fumigation.

Direct killing is accomplished by smashing them with an object as they burrow. Although moles burrow at night and are most active at night, they are still active until just after dawn. It is relatively easy at this time to see the long winding ridges being pushed up by eastern moles tunneling just below the

Mole Control

surface of the ground. With practice a person can quickly and quietly approach the tunneling mole and kill it by smashing the earth down with a shovel or similar instrument just behind where the earth is being lifted up. Repeated application of this method can rapidly remove eastern moles from an area. This method does not work for the star-nosed mole because it burrows too deeply.

Trapping is accomplished by using either harpoon or choker mole traps. Eastern moles are easy to trap provided that the trap is placed on a tunnel that is actively being used every day and that problems with function of the trap are noted and resolved. Locate active tunnels of eastern moles and gently flatten a short section of every ridge that you can find with your foot; marking it in some way. Any ridge that has been pushed back up within 12 to 24 hours is over an active tunnel. Traps placed on these ridges should catch a mole every 24 to 48 hours. If a trap hasn't caught a mole in 3 days, it is in the wrong location, or it has caught all the moles using that particular tunnel and should be moved to a new location.

In heavy clay soils, the trap will sometimes rise up out of the ground rather than impale or crush the moles. If this is the case, use coat hangers and small pieces of wood or metal to stake the trap to the ground. Work the harpoons or jaws of the trap back and forth or up and down through the soil to insure smooth penetration of the soil. If the trap is sprung prematurely, remove a small piece of sod from under the trigger pan so as to delay the action of the trap. If moles burrow around the traps, then either the soil has been flattened too tightly, or part of the trap, usually the harpoons, are projecting into the tunnel and alarming the mole.

Locate active tunnels of star-nosed moles by gently flattening each mound. Mounds that are pushed back up in 24-48 hours are over active tunnels. To trap star-nosed moles, it is necessary to dig a hole beneath one of the mounds of earth. The hole should extend to the bottom of the mole's tunnel, usually 4 to 6 inches below the surface of the ground. Refill the hole with enough earth to cover the top of the mole's tunnel with approximately 2 inches of earth. Set the trap in the hole.

Trapping is accomplished by using either harpoon or choker mole traps.

Insecticidal application is accomplished by applying various insecticides which reduce the moles food supply. Moles feed on insect larvae, earthworms and other invertebrates. The use of insecticides to reduce insect larvae can eliminate enough of the mole's food supply so that it either starves to death or moves elsewhere providing certain conditions are met. The following insecticides are registered for insect larvae control in lawns:

Diazinon— liquid- 2 oz./1000 sq. ft.
— 5% granular- 2½ lbs./1000 sq. ft.

Dursban— liquid- 0.6-1.2 oz./ 1000 sq. ft.

Milky spore disease— liquid - 7½ oz./ 100 sq. ft.
— dust- 20 lbs./acre or per label

Of the insecticides available to homeowners, I find the 5% granular diazinon to be the most effective. However, all of these insecticides are effective only if: 1) any thatch is completely broken up prior to application; 2) applications are made in late May and August; 3) 250-500 gals. of water are applied to the lawn after insecticide application; 4) evaluation of effectiveness is made no less than 2 weeks after application. Occasionally, a second application may be successful.

CAUTION: diazinon may kill lawn feeding birds— robins, ducks and geese. Keep pets and children off lawn while damp.

All of these insecticide applications seem to be most effective in sandy to sandy-loam and loam soils and seem to be less effective in clay-loam and clay soils. This may be because earthworms are more abundant in the latter soils and insecticide penetration is most reduced in these kinds of soils. A new insecticide, Oftanol, promises one application white grub control. So far, I have tested it only once with unsatisfactory results, but further tests are needed.

Finally, burrow fumigation is accomplished by fumigating with cyanide gas or phosphene gas. To use calcium cyanide, locate active tunnels and use a duster to blow calcium cyanide into the tunnels in both directions every 5-10 yards. Seal openings. Two or three pumps on the duster is sufficient.

Calcium cyanide may kill the roots of plants in the tunnels. To use aluminum phosphide locate active tunnels and place a tablet into the tunnels every 10 yards. Use no more than 4 tablets per mole system.

Direct kill and the trapping are the least costly methods assuming the applicator develops reasonable competency with either method. For applicators who have several customers with mole problems, only the insecticide application and burrow fumigation are feasible because the other methods require daily application. Even fumigation and insecticides, however, require an understanding of mole biology and the advantages and disadvantages of these methods if they are to be used successfully. The routine use of these methods responding to the presence of mole damage without regard to mole biology, soil type, thatch, the appearance of thatch and the response time of treatment will ensure low rates of success. Whereas consideration of these factors should result in success rates closely approaching 100%.

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Circle No. 10 on Reader Reply Card

Dominos and Other Slick Tricks

by John Kenney, Turf Doctor, Framingham, MA

Recently, I attended a pesticide board meeting at the state office building in my state's capitol. Although these meetings are open to the public, I did not know that, nor had I ever been notified when or where the meetings were to be held. In my state, the pesticide board is the arm of and enforcement authority on all matters regarding pesticides. At this particular meeting, a group of self-appointed environmental protectionists were requesting the board to allow public hearings throughout the state to gather public testimony regarding their beautifully written proposals to change the regulations (not the laws, the regulations) regarding the use of pesticides. The meat of their proposed changes would include:

1. Eliminate the aerial application of all pesticides for anything except agricultural purposes.
2. Require the pre-notification of all abutters to any area that is to have any pesticide applied.

This proposal would eliminate all gypsy moth and mosquito control programs (since they are non-agricultural) and, in spite of the obvious intent of the proposal to stop aerial applications, the wording also includes the lawn care applicator and his treatment of turf areas.

The meeting was attended by about 60 people, which, I came to find out later, was about 5 times the normal attendance. Apparently the word had gotten out and the owners of farms, structural pest control companies, tree care companies, right-of-way maintenance companies and lawn care companies were packed into the small room. There were also about 6 people from this newly-formed environmental group; an attorney, a doctor, a suburban housewife, a bee-keeper, an "interested party" (I came to realize that she was the organizer from one of the national groups) plus your basic hairy-legged and bra-less, former anti-war activist type, straight out of the Kent State era, who sat there and knitted a sweater during the whole meeting.

Before the thing started, the men who knew the members of the board indicated to a small group of new-comers that the board was not going to allow this thing to go to the public hearing stage. "The board is dead-set against this proposal."

Once the 'environmentalists' began their plea, I thought I was seeing another of Ray Fosse's magnificently choreographed routines. The public hearings will be held on March 14th and 15th. (slick trick: they just changed the public hearing dates to the 10th & 14th.)

The pesticide board was swayed for a number of reasons, but the only ones which were not rebutted by the users, the items which seemed to have the most impact on the board were:

1. Similar regulations already exist in New Jersey, specifically in Stafford and Roxbury. The townships of Maplewood, Ringwood and Bloomingdale are considering them also.
2. Similar laws exist in many of the Canadian provinces.
3. Manchester, Connecticut has recently enacted similar regulations.

It was very clear to me that the behavior of the town fathers in places that I have never even heard of, is threatening to put all of my people (and me) on the unemployment line. The domino theory is not a theory.

There can be no debate about the intentions of the 'environmentalists' and how they plan on eliminating the use of pesticides. They are going after the non-agricultural states, township by township, regulation by regulation, until the domino effect sweeps into all states, even those which are almost exclusively agricultural. For the most part, they have abandoned any efforts to push any bills through congress, they have stopped trying to get new regualtions adopted and enforced by the E.P.A., they have instead, focused their attentions on the regulations, not the laws, but the regulations of the non-ag states and on the regulations within the communities that appear the most vulnerable. Sure, there are still some bills being proposed for legislative changes, but equally dangerous efforts are occurring on the local level, and all these fires are being fanned by the national media in their swashbuckling attempts to 'right the wrongs' that are convenient for them to presume are being committed.

Here are some of the state bills that are being considered:

Connecticut: No. 414
Would require written consent by 85% of the residents of an area before a biological insecticide could be used.

Connecticut: No. 5779
Would require pre-notification.

Connecticut: No. 5984
Would prohibit a pesticide application within 200 ft. of a water supply.

Connecticut: No. 6000
Would give the local commissioner of the E.P.A. the full authority to decide how close to buildings any pesticide can be applied.

New Jersey: No. 1670
Would require (in effect) an environmental impact study for each community, on each chemical that is used in the workplace.

Oregon: No. HB 2414
Would require employers to keep and maintain records, which are to be open to the public, for a period of not less than 30 years, on any "toxic substance". The list of the items which must be included in these records is too long to publish in this article but the real 'kicker' to this bill is their definition of a 'toxic substance': "any substance which is capable of causing injury, disease or death." It seems that this definition would include such pernicious and dangerous substances as water.

If you do not belong to your trade associations, in particular to the PLCAA, do it now! The only real hope for an effective counter to these self-appointed vigilantes, these holier that thou guardians of the common prosperity, is to join together in a unified way against them.

If there are any local efforts in your area to ban or restrict the use of environmental chemicals (pesticides), please let me know. Thanks!

John Kenney can be reach at the Turf Doctor, 82 Herbert Street, Framingham, Mass. 01701. (617) 879-4510.

If you would like to receive information about joining the PLCAA, circle the following number on our reader reply card.

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New Electric Sprayer

The new Dobbins CS-25 and CS-25S electric power sprayers bring new versatility and mobility to power spraying, according to Master Manufacturing of Sioux City, Iowa. The sprayers draw power from the 12-volt battery of a garden tractor or pickup truck. The CS-25 is a trailer model for towing behind a garden tractor, while the CS-25S is on a skid for easy transfer. Both Models allow easy application of chemicals without the added weight, noise and fuel cost of a gasoline engine. A hand-held spray gun and boom assembly gives the sprayer flexibility.

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The O.M. Scott & Sons Company announces the publication of its new "Guide to the Identification of Turfgrass Diseases and Insects." The 100 page book describes 25 common turfgrass diseases and 35 common turfgrass insects with more than 120 full-color photographs and illustrations.

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The insect portion identifies insects as either turf-damaging or nuisance-type pests. The former is broken down further by area of activity: in the soil, in thatch, or on leaves and stems. A separate section on nematodes is also included. Each insect is described by its physical appearance, life cycle, type of turf damage (or physical discomfort), and regional adaptation and preferred host grasses, if any.

For further information about Scott's "Guide to the Identification of Turfgrass Diseases and Insects," and other technical information publications, write to the O.M. Scott & Sons Company, Marysville, Ohio 43041. Attention: Customer Training Department, or use the reply card.

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New Aerator by Dedoes

Dedoes Industries, Inc., Walled Lake, Michigan introduces a new, well designed aerator, with the following features: aerates 1000 square feet per minute; pulled behind most tractors and carts; turns while aerating; can give 2½" on center spacing; collects the cores as you aerate in one pass; has almost no major maintenance to worry about; reasonably priced.

For more information contact Dedoes Industries, Inc., 1060 W. Maple Road, P.O. Box 575, Walled Lake, MI 48088, or use the reply card.

Circle No. 19 on Reader Reply Card

800 Attend Michigan Turfgrass Conference

The largest turnout in the history of the Michigan Turfgrass Conference was on hand recently in Lansing. A positive response was received from everyone who took part in the two day program. Speakers were enthusiastic about the "standing room only" attendance at the seminars and exhibitors who set up tables for an "Evening with the Industry", were also grateful that they had taken part in the program.

The conference will return to Long's Convention Center next year. However, the sponsors, The Michigan Turfgrass Foundation and Michigan State University, are looking ahead to the day when a larger center will be needed to accommodate the crowd.

Michigan State's annual field day, held at the John Hancock Research Center, will offer something new this year. There will be a "hands-on" equipment display in conjuction with the turf plot visits at the university. The scheduled date for this year's field day is September 1st.

It is quite evident, as these conferences and organizational memberships continue to grow, that our industry is comprised of successful businessmen who are truly concerned about their future as well as the future of our environment that they can and must protect.

TREAT TWICE AS MANY LAWNS AND DOUBLE YOUR PROFITS?

Save Time With Formolene™ 30-0-2 Liquid Lawn Fertilizer

Add Formolene to your liquid program and you'll have more time to treat more lawns — up to twice as many! Because of Formolene's high concentration of nitrogen and its low-burn potential, it can be applied with less water. One fill of your truck could treat more than twice as many average sized lawns as urea, urea blends or UAN solution. So you can increase your customer base—and your profits!

Formolene's Advantages are Outstanding:

- Low-burn potential
- Quick green-up and lasting color
- Uniform, moderate turf growth
- Blends with other nutrients, chemicals
- Requires no agitation

A "Do-it-yourself" Source for Water Insoluble Nitrogen

You can convert 25% of Formolene nitrogen into a low-cost water insoluble nitrogen suspension — right in your truck tank.

Get the Whole Story

For more information on Formolene Liquid Fertilizer, contact your nearest Formolene Dealer. He can supply you with complete chemical and pricing information.

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LIQUID FERTILIZERS

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PLCAA

Circle No. 24 on Reader Reply Card

Classified Ads

SPRAY TRUCK– 1979 Chevy one ton truck– 750 gallon tank– mechanical agitation– excellent spraying condition– low mileage– must sell–$9200. Call (502) 456-6777, ask for Pat McConnell.

1979 Louisville FORD TRUCK with custom designed storage compartments. 1979 FINN LAWN FEEDER with power take off. Both like new, will sell separately or together. (313) 468-5285.

1968 DODGE SPRAY TRUCK, 6 cyl., 5 ton, 1800 gal. 5 compartment tank. PTO, 300' hose and electric reel. $2500, call after 3:30. (313) 278-0440.

SPYDER FORKLIFT/TRAILER, 200 hours, exc. cond., Zionsville, IN $12,400. Call George (317) 873-5231 or 873-5937.

SPRAYING EQUIPMENT– pump, hose and reel. Price: $300 negotiable. Call Northville MI, (313) 348-6251. Ask for Bob.

1982 SKID SPRAY UNIT– 600 gal., SS compartmentalized tanks, chemical inductor, Myers 2C95 pump, 18 h.p. Briggs engine W/LP gas conversion, electric hose reel with 300 ft. hose. $7250. Call Elkhart, IN (219) 294-3039.

QUALIFIED INDIVIDUAL needed to work my turf spraying business in the N.Y., N.J. area. He or she must be licensed appropriately and be willing to work long hours March - October. Contact Tony Cioffari, Creative Landscaping, 398 Garibaldi Ave., Lodi NJ 07644 (914) 356-2074.

WANTED TO BUY: Lawn spray/tree spray company or accounts. S.E. Penn., central and southern NJ. Residential, commercial and industrial accounts any size including sterilization. Contact Steve after 6 pm. (215) 357-8875, or write to Spray Associates, Box 445, Warrington, PA 18976.

ACCOUNTS WANTED– national chemical lawn care company seeks accounts to acquire. Selling price open for negotiation. If interested, send name, address, phone number and number of accounts available to Dept. B, American Lawn Applicator, 31505 Grand River Ave., Suite One, Farmington, MI 48024.

WANTED TO BUY: Lawn care company in Midwest (Mich., Ill., Ind., Wisc.) area Small to med. size. Chemical turf applications only– no mowing or tree care. Send information to Lawn Care, P.O. Box 361, Grosse Isle, Mich. 48138.

TRACTOR-LAWN COMBINE UNITS (2) No. 179 IH Hydrostatic tractors w/10 gal. tank on tractor. Combines are stainless steel with aerators, 4 granular bins, and 20 gal spray tank. $3,500 per unit. Call (315) 637-6001 or (315) 492-3217

WANTED: Used four wheel self-propelled Hahn or Cushman 120 - 175 gallon sprayer for greens. P.O. Box 191, Brentwood, TN 37027. (615) 794-6646.

WANTED: Dealers/Distributors for Ag Spray Hose. Hose is of finest quality and fully guaranteed. Receive distributor discounts and supplement your winter income. Call Dick Charles, Green Thumb Spray, (516) 485-1919.

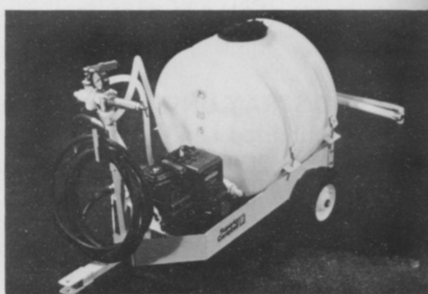
Classified ads in AMERICAN LAWN APPLICATOR are a "FREE" service to our subscribers. ALA will run one free ad per subscription in each issue. Our classified column is restricted to used equipment and employment. We reserve the right to reject any ad submitted.

L.S.A.M. Elects New Officers

The Lawn Sprayers Association of Michigan, established in January of 1974, recently elected new officers: (L to R) are Secretary, Blane Rickel, Green Valley Lawnspraying; Treasurer, Pat St. Germain, Liqui-Lizer; Managing Director, Tom Brune, Atwood Lawn Spray; President, Bill Olsen, Green World Lawn Spray; and Vice President, John Morell, Quick Green Inc.

The 45 member organization holds three or four meetings annually to discuss ways and means of upgrading the proficiency of various member companies through the use of chemical applicator equipment and general business practices. Many members of the L.S.A.M. are also members of the PLCAA.

New Sprayer from Superior



The new Superior Campbell lawn and garden sprayer from Superior Equipment Manufacturing Co., Inc. was designed to be towed behind a riding lawn mower. With 7' coverage spray booms at 150 psi and a handgun that sprays approximately 32' vertically at 100 psi, the lawn and garden sprayer provides a versatile, economical and dependable means of applying liquid fertilizers, pesticides and other lawn and tree care chemicals. The sprayer is equipped with a 4101C roller pump, a 2 hp. Briggs & Stratton engine, and 25 gal. capacity polyethylene tank. The lawn and garden sprayer is also available in an Econo model that utilizes a 12 volt electric demand pumping system that delivers up to 45 psi. For more information, contact, Superior Equip. Mfg. Co., Inc., P.O. Box 768, Mattoon, IL 61938, or use reply card.

Circle No. 28 on Reader Reply Card

Japanese Beetle

con't from page 10

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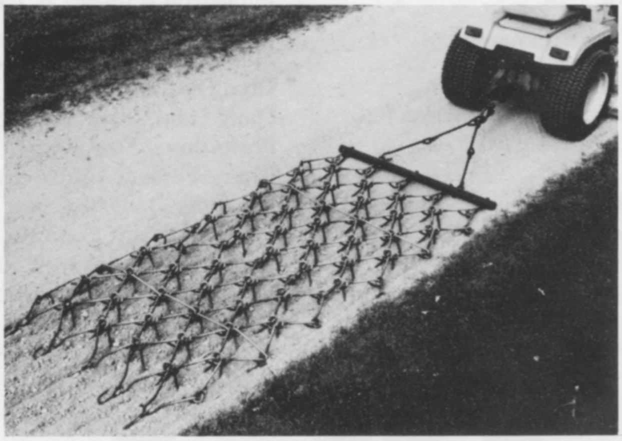
Tine Harrow by Fuerst



The Fuerst Flexible Tine Harrow does a lot of jobs mechanically you now do by hand or let go because of lack of labor. Loosens and brings thatch to the surface on turf areas making it easily picked up by sweeper or mowed off. The Harrow's weight and flexibility also make it ideal for breaking up soil cores after aerification. Prepares seedbed while smoothing out rough, uneven ground on new construction areas. Reduces hand raking to absolute minimum. Works in seed and fertilizer when overseeding and fertilizing. Eliminates nearly all snow mold problems in one simple pass. Claimed by leading grounds superintendents.

Complete information is available from Fuerst Brothers, Inc., P.O. Box 356, Oregon, IL 61061, or use reply card.

Circle No. 30 on Reader Reply Card

Stephen Brown Joins C.P. Chemical

C. P. Industries in White Plains, NY announced that Stephen S. Brown has joined their firm as Vice President and General Manager of the Agricultural Products Division. C. P. Industries' products line includes liquid slow release fertilizers and blended base mix materials for lawn care companies and horticultural crops. Mr. Brown was previously employed by the Tru Green Corporation in East Lansing, Michigan as Director of Support Services and Corporate Agronomist.

Steve was also the former editor of American Lawn Applicator and was quite instrumental in getting the publication started. We have fond memories of working with Steve and wish him the best of luck in his future with C.P. Chemical.

Circle No. 31 on Reader Reply Card

Circle No. 32 on Reader Reply Card

PROXOL® KILLS GRUBS AND SURFACE FEEDERS. *FAST!*

There's no need to wait over a month for a grub control to work. Economical Proxol 80SP insecticide readily penetrates thatch to work fast for an effective broad spectrum kill, including grubs and surface feeding sod webworms, armyworms, and cutworms.

You apply Proxol with the liquid application equipment you already have. So there's no need to haul spreaders and bulky packages on your rig, put up with package breakage and waste, or carry them in inventory. Proxol's convenient 2- and 5-lb. packages make measurement easy. Eliminates waste. You can even mix Proxol with other non-alkaline chemicals.

And you can rest easy with Proxol. Customer's children and pets are not exposed to a granular residue left on the turf. Proxol is easy on the environment, too. No unpleasant odor to offend customers. No long-term residual buildup in the soil.

Proxol kills grubs and surface feeders. Fast! Over 150 U.S. distributors and 8 regional TUCO Distribution Centers assure convenient product availability. These same sources also have Acti-dione,® a TUCO broad spectrum fungicide, long used by golf course superintendents, to stop turf disease problems before they start.

For more information, call toll-free:
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616-385-6613

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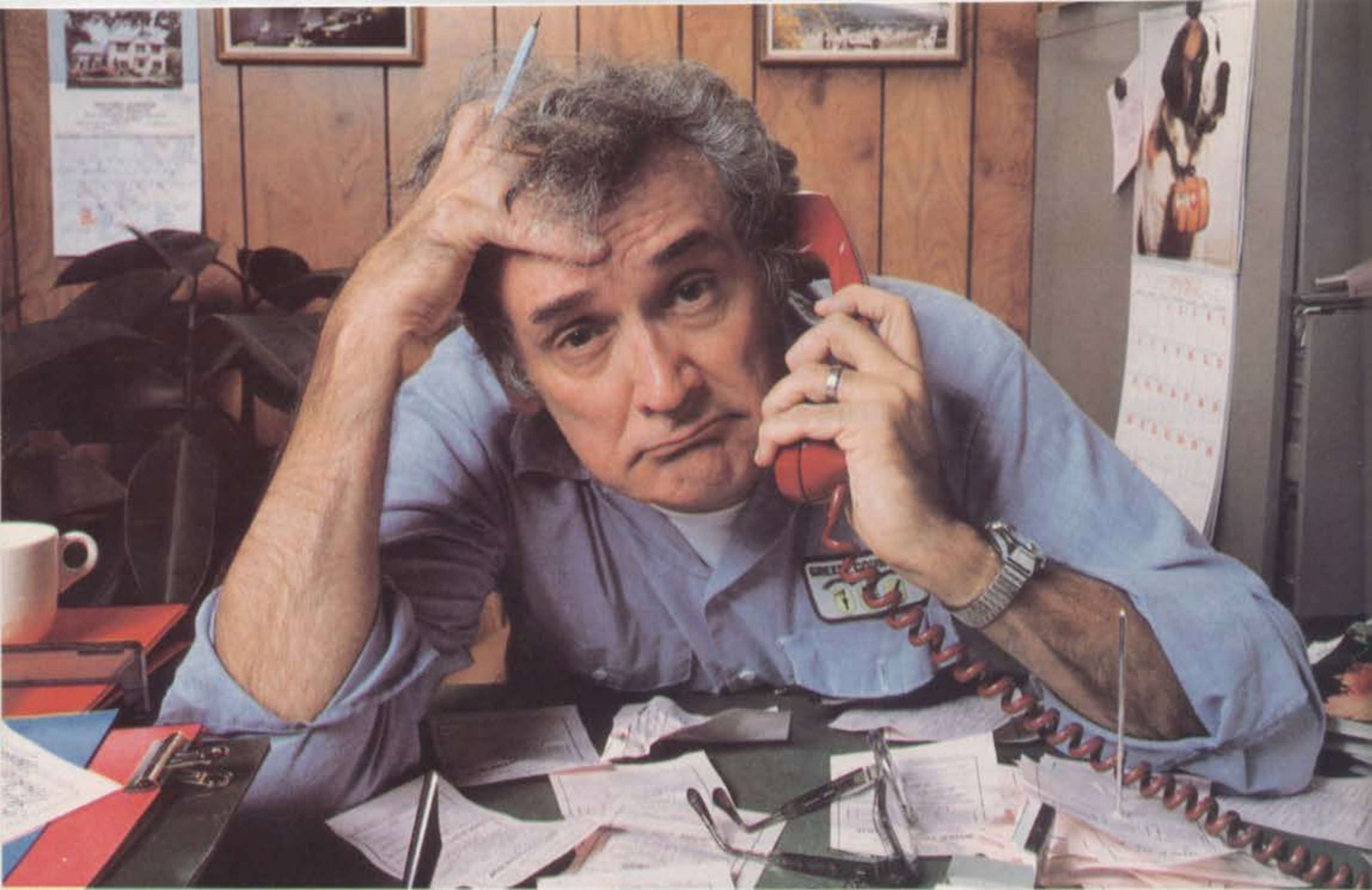


FUNGICIDE

WITH CHIPCO® 26019, THE DISEASES WON'T COME BACK BEFORE YOU DO.

It's only logical to include disease prevention in your lawn care program.

Now, thanks to CHIPCO® 26019, it's also practical.

And profitable, too.

THE FUNGICIDE THAT LASTS LONG ENOUGH TO FIT INTO YOUR EXISTING SCHEDULE.

With CHIPCO 26019, you get effective, season-long disease control that fits into your program.

Just add 26019 to your existing spray schedule and the disease problem's solved. No need for you to make extra service calls just to apply fungicide.

And because of its long-lasting control, no disease-related call-backs from dissatisfied customers either.

CHIPCO® 26019 IS HIGHLY EFFECTIVE ON LEAF SPOT, BROWN PATCH, FUSARIUM BLIGHT, AND MORE.

The performance you get is outstanding not only on the two biggest lawn disease problems—Helminthosporium Leaf Spot and Brown Patch—but also on Dollar Spot, Fusarium Blight and Helminthosporium Melting Out.

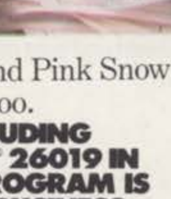
CHIPCO 26019 will control winter diseases like Grey and Pink Snow Mold, too.

INCLUDING CHIPCO® 26019 IN YOUR PROGRAM IS GOOD BUSINESS.

CHIPCO 26019 is easy to use wherever lawn diseases crop up. It will improve your reputation with customers and help you generate more profit.

For details on CHIPCO 26019...and on "The Right Approach" incentives program...contact the dealer who carries the CHIPCO line of turf care products or call us at (201) 297-0100.

Rhône-Poulenc Inc., Agrochemical Division, Monmouth Junction, NJ 08852.



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CHIPCO® 26019
TAKING CARE OF BUSINESS.

Please read the label and use only as directed.