AMERICAN LAWN APPLICATOR

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index done!

Greenbugs laying eggs on Kentucky bluegrass

Dr. Alexander Radko
U.S.G.A. Golf House
Far Hills N. J. 07931

webworms

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The Sod Webworm, Turfgrass Pest

by Scott Sargent, The Northrup King Company

Sod Webworms get their name from the silken tunnels in which they burrow at the base of grass plants.

Scott Sargent has been an entomologist for the Northrup King Co., Minneapolis, MN for eleven years. Sargent, who works at the company's Eden Prairie Research Station, holds a B.S. in entomology from the University of Minnesota. He is involved in researching resistance to insects in turfgrass, and in a wide variety of crops. Sargent also specializes in pollination research.

Sod webworms can be a severe problem in many turfgrass varieties. The Northrup King Co., Minneapolis, is performing ongoing research which is helping to develop grasses combining sod webworm tolerance with other desirable characteristics. Eventually, this will help minimize the problems caused by these insects. However, since most of the common turfgrass varieties used at the present time are susceptible to sod webworms, control with chemical insecticides is still essential in the lawn care industry.

Sod webworms are a turfgrass problem in the midwestern, eastern, and southeastern parts of the United States, Ohio, Illinois, Indiana, Kentucky, and Tennessee, in particular, are states in which damaging sod webworm infestations are routinely found. In Minnesota sod webworms cause major problems every four to five years. Over the years, generally, the sod webworm is one of the turf insects that has gotten the most attention, mainly because it is a problem over a wide geographic area; it quickly disperses itself within an area because of its flight ability, and its effects are quickly expressed during periods of stress in the hot part of the summer.

Our company has spent almost a decade studying sod webworms and their effects on different grasses. From this research, we are gathering information which will enable us to offer new

One the right, the tolerant Scaldis Hard Fescue withstands sod webworm infestation well. On the left, Cascade Fine Fescue shows the characteristic brown patches which indicate sod webworm presence.

Black lights were used to attract sod webworm moths to turfgrass plots at the Research Station. The black lights helped to increase the numbers of sod webworm eggs deposited in the plots.

turfgrass varieties which will combine sod webworm tolerance with other desirable traits. At present, the research has already helped determine the sod webworm tolerance of current turfgrass varieties. "Tolerance" in this sense does not mean that the sod webworms will not attack the grasses, but that the grass stands up well to the effects of infestation.

Fine fescues most susceptible

The most susceptible of the turfgrass varieties in the tests have been the fine fescues. However, two fine fescues, Scaldis Hard Fescue and Dawson Red Fescue, have shown excellent tolerance to sod web worms. Kentucky bluegrasses are also particularly susceptible to sod webworms, showing little tolerance as a whole. Merion, Windsor, and Park, however, have shown at least some tolerance to sod webworms.

Although severe infestations have been noted in perennial ryegrasses, the varieties appear to be somewhat more tolerant than the bluegrasses and fine fescues. In particular, Northrup King's Delray Perennial Ryegrass has performed well when tested for sod webworm tolerance.

Though Northrup King had already been rating the varieties of turfgrass in their field plots which withstood sod webworm infestation well, it was in 1972 that researchers first initiated greenhouse testing of the grass plants. To date, we are apparently the only commercial seed company doing greenhouse testing of turfgrasses for sod webworm tolerance. The moths to be used in the studies were collected in blacklight traps, and the eggs which they deposited were gathered and hatched. Larvae were then placed on individual grass plants in the greenhouse. Five weeks later, the results of the sod webworm damage were evaluated.

Sod Webworm

DEVELOPMENT OF SOD WEBWORM RESISTANT GRASS

One of the most significant findings resulting from the testing was that sod webworm resistance in grass plants is an inherited trait. In testing done with fine fescues, a resistant plant crossed with a resistant plant resulted in highly resistant progeny. When a resistant plant was crossed with a susceptible plant, the progeny had intermediate resistance qualities. A susceptible plant crossed with a like susceptible plant yielded a highly susceptible progeny.

Turf resistance is inherited

We are presently working with this data in an attempt to combine sod webworm resistance with other desirable features to develop new fine fescue grass varieties. Though this research is promising, it may be another five to eight years before any resulting varieties would be available. Nonetheless, new varieties would eventually lessen the effects of sod webworm infestation.

THE SOD WEBWORM LIFE CYCLE

Sod webworms are the light brown to grayish larvae of lawn moths. The larvae are one-fourth to three-fourths inches long, have coarse hairs and generally have dark spots. There are many species of sod webworms. The three most common appear to be *Pediasia trisecta, Crambus mutabilis,* and

Sod webworms are grayish, white or light brown, with coarse hairs and dark spots. Full grown, they reach up to three-quarters inches in length.

Crambus teterellus. Different areas generally have one or two predominant species, which may or may not be among the three major species. Lawn infestations could conceivably be caused by several sod webworm species. The major species have similar life cycles, however, and can apparently be controlled through the same methods.

The sod webworm eventually becomes a three-quarter inch long, whitish, gray, or buff-colored lawn moth. When at rest, the lawn moth holds its wings backward, close to the body, giving it a cigar shape. When lawn moths are aroused from their hiding places in the grass, they fly in a characteristic jerky, zig-zag pattern before quickly alighting in the grass again. The lawn moths are attracted to household lights at night.

In the spring, adult moths which have spent the winter as larvae tightly coiled in a closely woven "silken" case covered with small pieces of grass, emerge as lawn moths. In June, after spending a few days in the pupal stage, the adult moths emerge, mate, and deposit eggs. The female sod webworm moth drops its eggs into the turfgrass while flying over the turf in the evening

Damage occurs at larval stage

hours. Eggs hatch in about one week, and the young webworm larvae then begin feeding on the grass.

It is only in the larval stage that the sod webworm actually damages the grass. The sod webworms feed during the night and early morning hours, chewing off grass blades at their base. During the next five weeks or so, the sod webworm passes through four molting stages, to finally grow to its full, three-quarters inch size. The lawn moths which emerge from the sod webworm pupal stage begin the egg-laying process, and the cycle renews. In Minnesota this second generation of larva overwinters in its silken tunnel, but there may be three or more generations per year in areas with a longer summer.

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Baseball-sized brown patches in lawn are good indicators of sod webworm infestation. Sometimes the patches are punctuated by pencil-sized holes which indicate that birds have been feeding on the worms.

HOW TO DETECT THE SOD WEBWORM

The presence of the sod webworm in turf is most easily detectable after the larvae has already begun to damage the grasses. The appearance of brown patches in the lawn, up to the size of a baseball, may indicate the presence of sod webworms. Often, these patches are punctured by pencil-size holes, which are produced by birds digging webworms out of their silk burrows of the soil surface. Much of the bird-feeding activity can be noted in the early morning.

Potential problems with the sod webworm may be surmised if there is a high population of adult moths above or in the turf at dusk, or hiding in the shrubbery during the day. Usually, it takes 10 to 12 days from the time the moths are sighted until their first progeny begins to feed on the grass.

Webworms may be detected through examination of the damaged sod. Breaking apart the grass thatch may uncover the webworm, or the silken tunnel in which it lives. In addition, the presence of frass (green excrement) and small bits of clipped grass blades in the thatchy tunnel is also evidence of the presence of sod webworms.

Larvae may also be "flushed out" of the soil for detection through use of a chemical irritant which causes larvae to rise to the surface. This helps to gauge whether the numbers of sod webworms present are sufficient to warrant chemical treatment of the problem. A mixture of one tablespoon of pyerethrin insecticide per gallon of water may be applied per each square yard of lawn. A frequency of one to five sod webworms in each square yard of turfgrass may warrant treatment with an insecticide, but this "economic threshold" is, of course, flexible, depending on how much unsightliness the turf manager is willing to tolerate.

TREATMENT FOR CONTROL OF SOD WEBWORM

Diazinon and carbaryl (Sevin) are the insecticides most commonly used for sod webworm control. Timing is quite important in applying insecticides for sod webworms. Insecticides are effective when applied while the larvae are actively feeding but before the baseball-sized dead spots appear.

Probably the best method for timing treatment is to note the time of peak moth abundance, and treat the lawn one to two weeks later. Proper maintenance of the lawn will help considerably in lessening the effects of the sod webworm. Maintaining proper fertility and giving the turf adequate water during drought periods will allow the grass to tolerate more sod webworm feeding.

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Controlling Weeds in Turf

by Milton E. Kageyama

Dr. Kageyama received his Bachelor of Science Degree from the University of Hawaii. His Ph.D in entomology was received from Cornell University. Dr. Kageyama is presently employed as program manager of research and development for O. M. Scott & Sons.

What is the first step or two toward controlling weeds in turf? Most effective weed control can be attained if first of all the weed problems are correctly identified. Knowing the specific problems allows the turfgrass manager to define the nature of growth for each weed species during the year, whether it is an annual grass, perennial grass, or a broadleaf species. With this information, the proper chemical control can be selected.

Good control is very important; however, it is also important to reduce the potential of phytotoxicity to the desirable grasses and to avoid any adverse side effects to neighboring vegetation. Understanding the nature of the problem and the treatment options also enables the turfgrass manager to properly time the application.

Weed problems are commonly encountered where thin turf is found. Therefore, a successful weed control program also needs to assure correction of those conditions which enabled the weed to establish and compete successfully with the grass initially. This may mean implementing improved management practices to create a dense, more vigorous turfgrass stand to reduce the potential for weed reestablishment.

Figure 1: A vigorous, dense stand of well managed turf can help avoid many weed problems.

Crabgrass can be controlled

What herbicides can be used to control crabgrass? Crabgrass can be controlled by the use of a number of selective preemergence or postemergence treatments. Examples of these are listed in Table 1.

When selecting the herbicide, care should be taken to consider the tolerance of the turfgrass species to the herbicide. For example, atrazine should definitely not be used on bluegrass turf since bluegrass is very sensitive to it. However, it can be used for St. Augustine grass in some areas.

How do they work? The preemergence herbicides are applied directly to the turf and act by creating a chemical barrier at the soil surface. This barrier prevents crabgrass seedlings from emerging and developing normally. Because of this effect, it is important that

Table 1. Registered herbicide for crabgrass control

Preemergence Chemicals
Atrazine
Benefin
Bensulide
DCPA
Oxadiazon
Siduron
Postemergence Chemicals
MSMA
DSMA

physical disruption of the barrier be avoided to keep from breaking the herbicide layer in the soil and allowing weed establishment. For example, areas treated with a preemergence herbicide should not be aerified after an application is made during the time crabgrass is germinating.

The postemergence herbicides DSMA and MSMA are absorbed through the foliage of the crabgrass plant and accumulate primarily in the meristematic areas of the plant where new growth is occurring. Through the disruption of cellular metabolism in the plant, these chemicals effectively control a number of species of grass weeds.

Timing is important

When is the best time to apply a herbicide for crabgrass control? Preemergence herbicides need to be applied before crabgrass germinates in the spring. Because the germination of crabgrass is related to temperature, application dates will vary from one part of the country to another. In general, preemergence crabgrass treatments should be made before dandelions are in full bloom or before soil surface temperatures are consistently over 65°F. The map indicates approximate crabgrass germination dates. An application of preemergence herbicides should be made prior to the date given for a particular location. Treatments made too late will not control early germinating weeds.

Will these treatments control other grass weeds also? Depending on the herbicide used and the rate applied, other grass weeds may also be controlled by preemergence treatments. As Table 2 indicates, foxtail, barnyardgrass, goosegrass, and annual bluegrass *(Poa annua)*

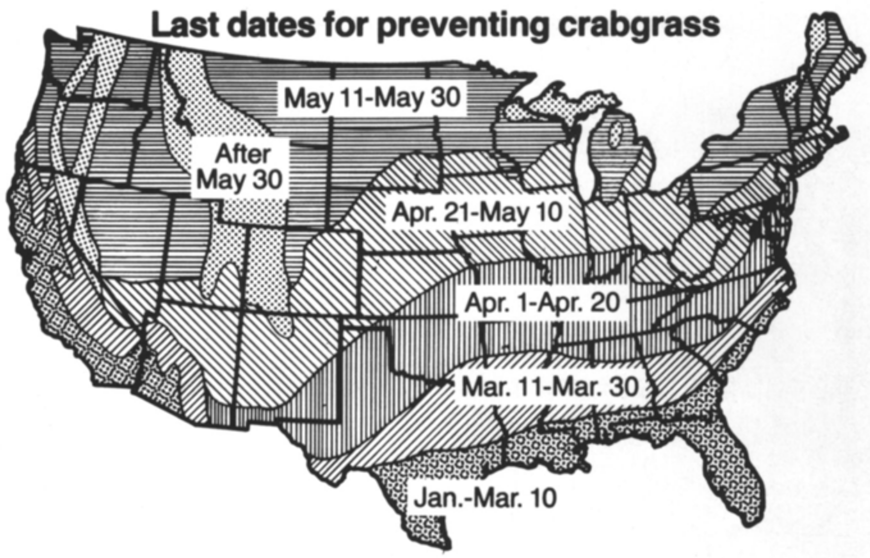


Figure 2: This map indicates periods during which crabgrass seeds begin germination in different parts of the country. To control crabgrass, the herbicides should be applied before these dates.

Table 2: Registered herbicides for annual grass control in turf.

	Foxtial	Barnyardgrass	Goosegrass	Annual bluegrass
Bensulide	X	X	X*	X
Oxadiazon	X	X	X	X
DCPA	X	X	X*	X*
Benefin	X	X	X*	X*
Siduron	X	X		

*Suppression

are examples of weeds that a number of preemergence chemicals are effective in suppressing or controlling.

DSMA and MSMA applied as postemergence treatments are labeled for the control of foxtail, barnyardgrass, and goosegrass in addition to crabgrass.

What are some of the undesirable perennial grass weeds? Some of the problem perennial grass weeds in turf include tall fescue, quackgrass, nimblewill, dallisgrass, and in certain lawns, bentgrass and bermudagrass. Although not true grasses, sedges are narrow leaved perennial monocots which are also often a problem in lawns. These species can be introduced into a fine turf area by contaminated seed mixtures or by transporting plant parts on equipment or in topsoil. Once established, perennial grass weeds are

Weed Control

How Dandelions Grow: *1. Cut-away shows clearly the long root typical of the dandelion.*

2. Cutting a dandelion off, even below the ground, is only a temporary measure, as next photo shows.

3. Less than a month later, the dandelion has already begun to grow back from the portion of the root that was left in the ground.

difficult to control. This is because of the presence of underground plant structures (rhizomes, tubers or bulbs) which, if not effectively killed, can regrow and result in a reinfested lawn.

How can perennial grass weeds be controlled? At this time there is no selective perennial grass weed herbicide registered for use in fine turf. Chemical control of the perennial grass weeds such as tall fescue and quackgrass requires the use of non-selective materials such as those listed in Table 3.

Except for cacodylic acid, these chemicals are systemic compounds and applications made to plant foliage are translocated downward to the underground rhizomes. The efficacy of these herbicides depends on their control of existing above-ground vegetation and their effect in preventing regrowth from rhizome buds. In cases where regrowth is not completely stopped, repeat applications are necessary.

A number of factors can influence the performance of these non-selective products, including growth stage of the plant being treated, climatic conditions, time of year, and rate of application.

Table 3: Registerd herbicides for perennial grass control.
Amitrole
Cacodylic acid
Dalapon
Glyphosate

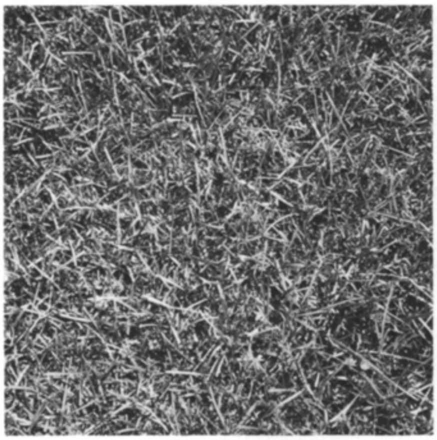
For example, fall applications are often more effective since conditions are conducive at this time of year for increased translocation of the herbicide through the plant and down to the rhizomes.

Depending on the size of the area treated, turf sites may need to be reseeded following treatment. With amitrole and dalapon, overseeding must be delayed for 4 to 6 weeks to allow for dissipation of the chemical residue. Glyphosate and cacodylic acid at recommended rates have no significant residual activity in the soil and replanting of treated areas can proceed soon after treated weeds are controlled.

Sedges can be controlled with some of the same non-selective herbicides used for perennial grass weeds as well as with the organic arsenicals (e.g. DSMA and MSMA) or bentazon.

What are the major broadleaf weeds in turf? Geographic location and conditions of the growing site have a major impact on the species of broadleaf weeds encountered in a particular area. While numerous broadleaf weed species can present problems in turf in various sections of the country, the following are some of the more common weeds encountered in established turf: dandelions, plantains, clovers, black medic, speedwells, spurge, oxalis, ground ivy, red sorrel, chickweed, knotweed, henbit, thistles, cudweeds, lespedeza, lippia, healall, buttonweed, and violets. A number of weeds are special problems in a newly-seeded area. These include purslane, shepherdspurse, yellow rocket, and ragweed.

How can the broadleaf weeds be controlled? First of all, weed pressure in established turf can be minimized by utilizing proper management practices and optimizing the envionment to encourage good turfgrass growth. Vigorous, dense stands of turf are less prone to severe broadleaf weed problems since seedling weeds are at a competitive disadvantage under these conditions. Regular fertilization at recommended



How Weed Control Works: *1. Here is a dandelion that has just been treated with a granular weed control.*

2. Five days later the stems and leaves have begun to wither and fade.

3. One month later, the leaves and stalks have disappeared, and the root has been absorbed into the soil.

rates and proper irrigation will reduce the amount of broadleaf weed infestation in fine turf areas. Once these weeds become established, however, cultural practices are less effective and the use of herbicides is usually necessary.

A number of good selective postemergence herbicides are available for control of broadleaf weeds in turf. The three most commonly used herbicides are 2,4-D, mecoprop (MCPP), and dicamba. These herbicides are all systemic, hormonal type compounds which are usually formulated in combinations to broaden the spectrum of weeds controlled. For example, the strong activity of 2,4-D on rosette type weeds such as dandelion and plantain, and the good activity of mecoprop on species such as clover, makes a product containing these two active ingredients much more useful than either herbicide formulated alone. Dicamba is sometimes added to 2,4-D and mecoprop to provide an even more effective product. Wild garlic, red sorrel, Canada thistle, yarrow, knotweed, and purslane are some of the weeds controlled well by dicamba, but not as easily controlled with 2,4-D or mecoprop.

On certain warm season grasses such as St. Augustine, zoysia and centipede, atrazine can be used for control of many broadleaf weeds. In a new seeding situation, bromoxynil is effective for the control of a number of annual broadleaf weeds if applied when plants are still young. The other postemergence herbicides should not be used on a new lawn until after three or four mowings since they can be phytotoxic to turfgrass seedlings.

Effective control depends on foliage uptake

Herbicides for control of broadleaf weeds in turf are available as either granular formulations or liquid sprays. Since effective control is dependent on good herbicide uptake through the plant's foliage, it is generally important to achieve maximum leaf contact with these products.

Best performance of these herbicides is obtained when applied to actively growing weeds and turf. This optimizes the uptake and translocation of chemical throughout the weed. Ideally, this also parallels the time when turf displays good lateral growth activity and can readily fill in the voids left by the dying weeds. It is equally important to time these postemergence applications properly to avoid making treatments when temperatures are high since this can increase potential for injury to the desirable turfgrass.

What precautions are necessary with use of herbicides? Proper use of herbicides will reduce the potential for adverse effects to the turfgrass plant community, the surrounding environment, and the user. Proper identification of a weed problem and use of the correct herbicide at the recommended rate as specified on the product's label help in achieving maximum utility from an application.

Non-target effects of herbicides can be minimized by taking the proper precautions in application. Herbicide drift can create problems to surrounding

Weed Control

vegetation if applications are made when wind speeds are too high. Morning or late afternoon treatments are usually preferred.

In addition to drift, lateral movement or leaching of certain herbicides can lead to problems if improper applications are made. Amitrole and dicamba are examples of two mobile chemicals that can injure non-turf plantings if label directions are not followed carefully.

Finally, from the user safety viewpoint, it is important that herbicides be treated like any other pesticide. Practicing proper handling, application, and storage procedures to avoid applicator contact with the herbicide is necessary to assure the safe use of these products.

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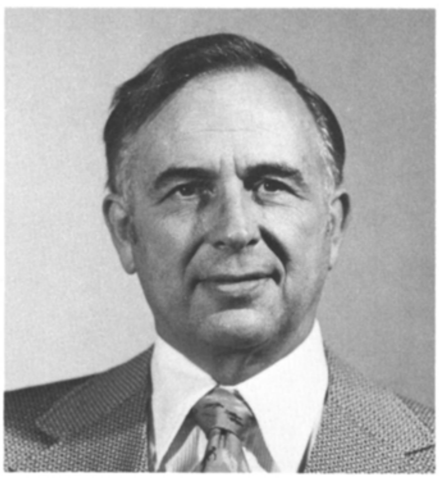
Managing Urban Habitat

by Dr. Robert W. Schery, Director, The Lawn Institute



Dr. Robert W. Schery, Director of the Lawn Institute, is a nationally recognized turf authority, lecturer and consultant. In his post as Institute Director, he prepares educational and technical materials on the proper seeding and maintenance of turf, and serves as liaison between the Institute and research and technical staffs of the college experimental stations.

Dr. Schery is a native of Missouri, having been reared in the St. Louis area. He was educated at Washington University, completed graduate work at the University and the Missouri Botanical Garden.

He has traveled throughout the United States and the world, is co-editor of 'The Flora of Panama" appearing in the annals of the Missouri Botanical Garden; and the author or co-author of such books as Plants for Man, Plant Science, Plant Agriculture, The Lawn Book, A Perfect Lawn, The Householder's Guide to Outdoor Beauty, Lawn Keeping, and others. Major research projects include tropical floristics, economic botany, and popular horticulture subjects. Several hundred magazine and journal articles have appeared under his signature.

Dr. Schery has been a member of the teaching and research staff of Washington University, senior technician for the Rubber Development Corporation, lecturer at the University of Wisconsin, and botanist for the Monsanto Chemical Company and the O.M Scott Company. As a consultant he has served the Garden Institute of Research & Development and several leading commercial houses. In 1973 he was awarded "Recognition of Professional Excellence" by the Ohio Turfgrass Foundation.

He is a member of the American Association for the Advancement of Science, American Society of Horticultural Science, American Society of Agronomy, American Horticultural Society, Ecological Society of America, Garden Writers Association of America, The Society for Economic Botany, Weed Science Society of America, and other professional organizations. He has been an officer and on the Board of Governors of The Nature Conservancy, and Treasurer and Life Trustee of the Ohio Chapter. Dr. Schery has served as Chairman of the Lawn & Turfgrass Division of the American Seed Trade Association, on its Board of Directors, and on various committees. He is contributor to Encyclopedia Brittanica, Encyclopedia Americana, and World Book, and author of sections in various gardening books including Agricultural Yearbooks and gardening encyclopedias. For further information, contact The Lawn Institute, 991 West Fifth Street, Marysville, Ohio 43040.

Do turfgrass custodians fail to "put their best foot forward" by not emphasizing the benefits that lawns and ornamental plantings lend the urban environment? Do they instead get caught up in a tangle of details, focusing upon costs, worrying about trivia, while the grand sweep of ecological happenings centers elsewhere? What shapes the urban environment today impinges not upon an unimportant minority, but upon most of humanity. It's a great audience, and a cause whose time has come. Those dealing in esthetic and environmental services should encourage greater appreciation of the importance of their fields. They are caught up in a fast-moving tide these days.

GRIM REALITY—

In a world where the overdraft on resources becomes increasingly ominous, almost everyone has been made aware of inflation, energy crises, threats to peace and stability. It's a somber backdrop. In America we have air quality problems (smog and acid rain, for example), while water depletion and pollution considerations mount. Desertification even threatens in certain areas, where the demands of urbanization exceed the capacity of the environment to provide.

In some places impoundments become choked because of sedimentation, soil is lost through erosion as vegetative cover dwindles, noxious weeds invade, dust storms swirl, and extinction slowly envelopes once unique habitat. Blackouts may be precipitated during heat waves, livestock perish for want of succor; salinization and eutrophication of water sources occur frequently.

One can empathize readily with

Why shouldn't lawns and ornamental plantings be a required part of community planning?

gloomy expectations, so apparent are they. No wonder that the public becomes apprehensive! Why not, then, attempt to counter this vague uneasiness with positive understanding about urban habitat?

THE HUNGER FOR GREENERY—

Although functionally essential, blacktop and pavement are inherently ugly. Witness the appreciation that even scrawny street trees, mere bits and snatches of parkland in the city, elicit. These are amenities that not only break with man-made monotony, but touch almost instinctively upon a fundamental

Managing Urban Habitat

chord of plant-mankind relationships. That attractive grounds contribute more than to esthetics alone may be somewhat less well understood; people might need reminding that lawns and ornamental plantings are life-supporting systems, helping to link humankind with the garnering of the sun's energy through greenery.

Lawns and ornamental plantings are life-supporting systems

Environmental benefits from managed habitat are quite evident. Urban lawns, for example, literally keep us out of the mud and hold the dust down. They ameliorate temperature extremes, insulating the ground in winter, cooling the environs in summer (largely through transpiration, a natural way of "air-conditioning"). Living plants release gaseous oxygen, which we breathe as "fresh air", and in exchange carbon dioxide and toxicant traces are removed. Cities, islands of heat and pollution, fortunately are buffered by their lawns and gardens, making such population centers reasonably habitable.

AN ECOSYSTEM APPROACH?—

It does not take technical training to appreciate thriving vegetation; observe the public's general aversion to more blacktopping. And why shouldn't lawns and ornamental plantings be a required part of community planning? I wonder, though, why the ecosystem approach has not been more widely utilized in arguing for a balance between structures and plantings in urban areas? Perhaps it's because people customarily deal only with their own small niche.

Yet, NEPA law calls for environmental impact assessments for almost any perturbation, from the building of a power plant to the laying of a pipeline. We'll never be able to foresee all of the consequences from disturbance, but it does make sense to weigh its consequences on the entire system so far as such consequences can be ascertained. This would seem particularly true in urbanizing areas where little natural diversity remains, and the ecosystem has therefore turned quite fragile.

Where people live, land disturbance is inevitable. Because of deep-seated impact vacated space can almost never be returned to pristine natural conditions. Succession, to use an ecological term, must go through a cycle starting with aggressive, sun-loving weeds (introductions from the far corners of the world, first annual, then perennial), which quickly gobble up ground left untended. Things get worse quickly thereafter. The point is that land on which the basic ecosystem has been upset (by urbanization) cannot then be simply healed by nature without a lot of undesirable successional stages.

In humid climate east of the Great Plains, open space freed from management (i.e. not provided with intelligent lawn tending) would first turn into coarse, unkempt swards. Bramble patches replete with vines and poison ivy would evolve soon after. Then might come volunteer honeysuckle, multiflora roses and other "brush", springing up especially under bird roosts. Eventually the tangle would likely revert to a thicket overstocked with short-lived saplings. A mess such as this is esthetically and environmentally intolerable by today's standards.

IN MANAGEMENT'S FAVOR—

How much better it is to maintain control of vegetation on disturbed habitat. This can be accomplished fairly economically these days by taking advantage of modern technology. There are nowadays many specially-bred lawngrass cultivars and ornamental plants, suited to most uses and almost all environments. Certainly very capable equipment is readily available for necessary mowing, and for the spreading of fertilizers and pesticides quite precisely if and when these are needed. All of this bestows benefits upon lived-in surroundings rather than brutalizing the environment further.

Where people live, land disturbance is inevitable

This is not to suggest that public relations should become subservient to know-how. Just as with the hazards from radiation, things unseen and of potentially long-term consequence become scary. People are afraid of the unknown, and in a vague sort of way fear chemical toxicity. It should be made clear that there is no such thing as perfect chemical purity, and that toxicity results not from traces but from imbalances. "Toxicity" is an everyday occurrence in nature, too, as with selenium-rock weathering, alkali ponding, and plant allelopathy.

Proper precautions must be taken, of course, so that safety tolerances are ample. Care must be undertaken that ground water not be contaminated with labile chemicals, nor air infused with noxious fumes. Fear can be muted by explaining about the usually quick and efficient breakdown of strange molecules by the environment, through oxidation, under ultraviolet radiation, with biological activity in the soil, and so on. Ordinarily, any build-up of toxic material is precluded: Dr. Jagschitz reported to the 1981 symposium on weeds held in Columbus, Ohio, how, after seventeen years of consistent application of a wide range of herbicides on his test grounds in Rhode Island, there was not one case of cumulative build-up.

Where exceptions might occur, as with use of long-lasting DDT or similar chlorinated hydrocarbons, biodegradables can be substituted. In short, as part of a PR effort, everything possible should be done to calm fears concerning environmental degradation. Responsible custodians do take great pains to insure against unnecessary disruption of the ecosystem.

MIDST CONFUSION, CONFIDENCE—

Fortunately, there are many positive occurrences that breed confidence. The public can be reminded, for example, that exciting new cultivars have been bred for particular purposes. Thus, fine new lawngrasses adapted to a wide range of climates and various preferences are to be had. Even for the transition zone, once a "no man's land" for lawns, attractive new cultivars of tall fescue are now available. And certainly, the array of new polycross perennial ryegrasses make then a thing of beauty as well as utility, over a climatic range exceeding their basic maritime suitability. A heady assortment of bluegrasses run the gamut from a panache of highly bred beauties as Adelphi, America, Eclipse, and Bonnieblue that strut their stuff in the best-kept lawns, to self-reliant sorts like Arboretum proved out by natural selection.

Professional lawn service has many favorable assumptions going for it. One is presumed expertise; know-how of a pleasant, helpful sort is assumed, as in an awareness of the latest labelings and legalities. But ecosystem evaluation requires such pervasive wisdom that no one can be expected to have mastered it completely. An honest admission of "I don't know, but I'll try to find out" is certainly superior strategy to faking expertise!

The professional should make clear his concern for the environment

The best brains disagree about many events: the influence of carbon dioxide levels in the atmosphere, for example. Yet this very matter touches upon the home grounds as well as the world at large, and is of human interest. Lawngrasses, like other plants, utilize carbon dioxide to build food as part of the equation that releases oxygen for respiration. The popular appeal of the system is obvious, for it is this that sustains life. But at what level does carbon dioxide become a hazard, encouraging a "greenhouse effect" (that would raise average temperatures with worldwide climatic consequences), and how helpful are lawns and gardens in countering this trend? One can only guess whether home plantings will respond to more carbon dioxide with greater growth.

A homeowner can reasonably expect monitoring of his small environment if he has engaged grounds care. Thus someone familiar with home ecosystems should periodically inspect the property and integrate the findings. Here's where common-sense expertise can ward off potential problems. The professional should make clear his concern for the environment, such as sparing the nesting sites of birds, taking care not to spray or damage wildlife enclosures, thoughtful trimming rather than butchering of trees and shrubs, help create a favorable image.

Generally, a grounds care specialist has the advantage of first rate equipment lacking to a homeowner. It should be possible to spray, spread and trim with care, lending an air of confidence and professionalism. Some treatments, such as lawn scarification and aerification, may be fruitless so far as ecosystem response is concerned; but nevertheless they can be impressive from a public relations standpoint if they are something the property owner is intent upon. People are also part of the urban ecology.

Although lending advice for complementary endeavors can build goodwill and forge loyalities, the response must be honest and not deliberately sugarcoated. There are problems still to be faced squarely. The latest information about restricted pesticides might be worthy of discussion, for example. And lawn watering touches far-reaching concerns these days. Fortunately, water is still reasonably abundant and available.

Demand for potable water increases as populations build in areas with limited surface supplies, and watering restrictions ensue. Even though the household water which can be saved by such restraints as reduced showering and

Managing Urban Habitat

minimal toilet flushing is inconsequential (over three-fourths of the nation's water consumption goes for agricultural irrigation, and much of the remainder for manufacturing and processing, not for home use), when restrictions are imposed it hurts. Sound irrigation advice should be welcomed. As a matter of fact lawngrasses don't generally need the quantity of water lavished upon them by most homeowners, and east of the Great Plains, at least, they will probably survive on natural rainfall alone (even though they would look more lush during dry periods if watered).

Lawngrasses don't generally need the quantity of water lavished upon them by most homeowners

It should be recognized that stringencies are likely to become greater—not only with water but with energy supplies and other raw materials as well. One publication has already noted that having a green lawn in northern California during a water shortage marked one with an "unpatriotic" stigma. Joseph Rossillon's address to the 1981 Purdue turf conference banquet perhaps indicated the trend-of-the-times as well as anything:

With lawns, "plusher" may not necessarily be better. In relationship to golf courses, we may even have to consider "poorer quality greens and better quality putters". . . . When the energy crunch arrived, the automobile industry discovered that big cars were "expendable", and industry had then to go to the Federal Government to be "bailed out". When the water crunch comes, **green grass will be expendable.** *Will you be ready? Or will you have to run to the Federal Government, too?*

Not with water alone, but for the caring for lawns generally, a long, hard look as to what should be aspired to, and what can be practically realized, may be increasingly required.

xxx

Greenbugs on Turfgrass: An Informative Update

by Dr. Daniel A. Potter, University of Kentucky

Dr. Daniel A. Potter is an Assistant Professor of Entomology at the University of Kentucky, Lexington. He holds a B.S. degree in entomology from Cornell University, and an M.S. and Ph.D. in entomology from the Ohio State University. Dr. Potter's research interests include the biology and control of insect and mite pests of turfgrass, woody ornamentals, and greenhouse crops.

The greenbug *(Schizaphis graminum R.)*, long a serious and widespread pest on small grains, sorghum, and forage grasses, has become an important problem of the turf industry within the last few years. Actually, the greenbug's association with turfgrass is not new. As early as 1907, greenbug damage was reported on bluegrass lawns around buildings of the USDA in Washington, D.C. (4) Because of the recent increase in greenbug outbreaks on home lawns, especially in the midwest (2, 3), it is important that professional turf managers learn to recognize and deal with the problem. The purpose of this article is to review our current knowledge of the greenbug on turfgrass. It should be stressed that although the greenbug's biology on small grains is well known, entomologists have only recently begun to study its life history on turf.

The adult greenbug is a soft-bodied, pear-shaped aphid, 1/16 inch long and light green with a darker stripe down the back *(Figure 1)*. The tips of the legs and the antennae are black. Commonly, 10-50 aphids will be lined up and down the midrib of a single grass blade, mostly on the concave upper surface. Throughout most of the growing season, greenbugs reproduce parthenogenetically (without fertilization), the females giving birth to living young. These mature and begin producing their own offspring in 7-10 days. Winged forms are produced in the fall. It is common in heavy infestations for the turf to harbor several thousand greenbugs per square feet.

The greenbug damages turfgrass by piercing the grass blade with needle-like mouthparts and then sucking out the phloem sap. Since a single grass plant may be infested with several hundred aphids, the effects of their feeding can seriously weaken the plant. The greenbug also injects toxic salivary secretions, causing the leaf tissue around the feeding site to die and giving the damaged plants a burnt-orange color. Translocation of these salivary toxins within the plant may also weaken the root system (2).

Greenbug injury on home lawns usually begins in shaded areas under

Figure 1: Closeup of greenbugs on Kentucky bluegrass.

Figure 2: *Greenbug damage often first appears around the base of trees.*

Figure 3: *In severe greenbug infestations, the whole lawn may be damaged.*

trees, appearing as circular or irregular brown patches up to 15 or more feet in diameter *(Figure 2)*. Active greenbugs are most dense in the live grass around the perimeter of the damaged turf. Damage may also spread into sunny areas, and in severe cases the whole lawn is affected *(Figure 3)*. When observed from the street, the damaged turf typically has a burnt-orange cast. Note that not all greenbug problems start under trees. We encountered one infestation where the damage extended outward 10-30 feet on all four sides of a house *(Figure 4)* and another where greenbugs destroyed a treeless backyard completely enclosed by a tall, solid wooden fence *(Figure 5)*. Most greenbug problems do seem to start around upright structures, but the reason for this is unclear. Note also that even though damage often shows up under trees, the greenbug is not a tree aphid.

In Kentucky, greenbug problems begin to appear in early June and may continue until late fall. In 1981 the most severe damage occurred in mid-November. Despite sub-freezing night temperatures, thousands of active aphids were present on some lawns *(Figure 6)*. Late in the fall, homeowners are likely to assume the lawn is becoming winter dormant and are slow to realize there is an insect problem.

OVERWINTERING SITE FOUND:

Two important questions are 1) How do infestations on home lawns originate? and 2) Why are some lawns attacked year after year? One explanation for the first question is that infesta-

Figure 4: *On this lawn, greenbug damage occurred on all four sides of the house.*

Figure 5: *Greenbug damage on a completely fenced Kentucky bluegrass yard. Most greenbug problems seem to start around upright structures.*

Greenbug

tions arise when greenbugs are carried north each year on prevailing winds from the south. However, this theory does not account for reinfestation of the same lawns, while others nearby are not infested. Niemczyk (2) reported collecting small numbers of egg-bearing females from infested lawns in late fall, and later recovered young aphids from the same lawns in early spring. He proposed that the greenbug overwinters in the north, probably as an egg.

Eggs are bright green when first laid, later turning jet black

In mid-November 1981, my co-workers and I recovered thousands of active greenbugs from Kentucky bluegrass lawns in Louisville, Ky. Nearly all of these were adult egg-bearing females. Close inspection revealed many tiny eggs glued to the upper surface of the grass blades *(Figure 7)*. Eggs are bright green when first laid, later turning a shiny jet black. By mid-December, the aphids were gone and only the eggs were left on the lawns. This discovery that the greenbug overwinters as an egg on the host plant helps to explain why some lawns are reinfested year after year.

There is little doubt that greenbugs can become wind-borne and spread to new lawns. Dozens of greenbugs are often picked up on shoes or clothing when working in or simply walking across infested lawns, and greenbugs may also be spread by power equipment or in bagged clippings. We have also encountered bad greenbug infestations on sod farms, and it is possible that greenbugs could be transported on infested sod.

Figure 6: Greenbugs collected in 15 sweeps with an insect net on a heavily infested Kentucky bluegrass lawn, Nov. 17, 1981.

Figure 7: Greenbugs laying eggs on Kentucky bluegrass, Nov. 20, 1981. Eggs are green when first laid, later turning black. Aphid at left is dead and shriveled; brown aphid is dying.

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FEEDING PREFERENCE:

Researchers at the University of Kentucky (1) studied the feeding preferences, survival and reproductive rate of greenbugs on nine common cool and warm season lawngrasses. Three Kentucky bluegrass cultivars (Kenblue, Vantage, and Adelphi) which differ considerably in color, growth habit, heat tolerance, and genetic variability; and six other species including creeping bentgrass, bermudagrass, chewings fescue, tall fescue, perennial ryegrass, and zoysiagrass were tested.

The first experiment was a preference test, in which the grasses were interplanted in flats and mass infested. Greenbugs thus had a free choice between the various cultivars and species. The second test measured survival and reproduction of greenbugs confined in cages on potted plants of each grass. The results, summarized in Table 1, show that all three Kentucky bluegrass cultivars were highly suitable hosts. The fact that these cultivars have widely differential morphological and genetic characteristics suggests that existing cultivars with appreciable levels of resistance may not be found. Although previous reports of greenbugs on turf indicate that the aphid will feed and reproduce only on Kentucky bluegrass, we found that both 'Ky 31' tall fescue and 'Jamestown' chewings fescue supported a rapid aphid buildup in the greenhouse. This suggests that fescue lawns are not immune to attack. Greenbugs were unable to survive or reproduce on ryegrass, bentgrass, zoysiagrass, or bermudagrass. These results are supported by the fact that patches of unaffected bentgrass or ryegrass are often seen in greenbug infested Kentucky

Table 1: Greenhouse evaluation of feeding preferences, survival, and reproduction of greenbugs on nine common turfgrasses. In the preference test, greenbugs had free choice of grasses interplanted in flats. In the survival and reproduction test, individually caged plants were inoculated with six adult females. Counts represent averages of total greenbugs alive after 10 days. Numbers followed by the same letter are not significantly different statistically.

TURFGRASS	PREFERENCE TEST	SURVIVAL AND REPRODUCTION TEST
Ky. bluegrass cv. Kenblue	10.7 b*	107.5 a
Ky. bluegrass cv. Vantage	28.8 a	98.6 a
Ky bluegrass cv. Adelphi	19.2 ab	86.2 a
Chewings fescue cv. Jamestown	18.5 ab	57.5 a
Tall fescue cv. Ky. 31	26.7 ab	77.0 a
Perennial ryegrass cv. Derby	0 c	0 b
Bentgrass cv. Penncross	0.2 c	0 b
Zoysiagrass cv. Meyer	0.7 c	0 b
Bermudagrass cv. Midiron	0 c	0 b

*Aphids had begun to abandon severely damaged Kenblue plants when counts were taken at 10 days.

Greenbug

Figure 8: Patches of unaffected bentgrass or ryegrass are often present in greenbug infested Kentucky bluegrass lawns.

bluegrass lawns *(Figure 8).*

The following weed species were also screened as potential alternate hosts of greenbugs: common dandelion, broadleaf plantain, buckhorn plantain, ground ivy, pigweed, wild strawberry, large crabgrass, violet, and yellow wood sorrel. In our studies, greenbugs failed to survive or reproduce on any of these nine grassy or broad-leaved weeds, suggesting that these plants do not serve as reservoirs from which greenbugs could reinfest a lawn.

CONTROL:

In the past, a single liquid application of either diazinon or chlorpyrifos (Dursban®) generally gave acceptable greenbug control. However, within the past 5 years some greenbug populations have apparently become resistant to chlorpyrifos, diazinon, and malathion, with population resurgence 2 to 3 weeks after application at the recommended rate. Often, damaging numbers remain even after 2 or 3 additional treatments.

Research by Dr. H. D. Niemczyk (Ohio Agricultural Research and Development Center) showed that acephate (Orthene®), an organophosphate with systemic activity, and pirimicarb (Pirimor®), a carbamate, gave excellent greenbug control (2). Orthene emulsifiable concentrate now has a national label for greenbugs on turf, and is effective at the one pound a.i./acre rate. The wettable powder formulation currently has a 24(C) Special Local Needs registration for use in Ohio, Indiana, and Kansas. Since the greenbug already has demonstrated the capacity for developing organophosphate resistance, it would be unwise to apply Orthene on a preventative basis to every lawn. A strategy that has worked for some lawn care firms is to spray Orthene around trees with a hand sprayer when damage is noticed by the applicator. It is also a good idea to alert the homeowner to the appearance of greenbug damage.

In the past 5 years some greenbug populations have become resistant to chlorpyrifos, diazinon and malathion

Greenbugs are fed upon by a variety of insect predators, especially adult larval ladybird beetles *(Figure 9)* and lacewing larvae (also called aphis-lions). They are also killed by tiny parasitic wasps. These natural enemies are abundant in turfgrass and normally help to keep greenbugs in check. It is possible that mortality of these beneficial insects following insecticide applications is a contributing factor in greenbug outbreaks.

Figure 9: Immature ladybird beetles (ladybugs) are common predators of the greenbug. Adult ladybugs eat greenbugs, too.

FUTURE RESEARCH:

The recent alarming increase in greenbug outbreaks on home lawns suggests that a new biotype, or strain of the aphid has evolved which prefers turfgrass over other hosts. However, it is also possible that certain high maintenance practices, such as overuse of insecticides and fertilizers, may be changing the physiology of the turfgrass habitat so as to make it more suitable for the greenbug. Observations during 1979-1981 indicate that greenbug outbreaks occur mostly on well-maintained, intensively managed lawns. Clearly, additional research pertaining to the effects of lawn chemicals and high maintenance programs on greenbug populations is needed. Research is in progress to study further the seasonal biology of greenbugs on turf, and this work should lead to better ways of managing this difficult pest.

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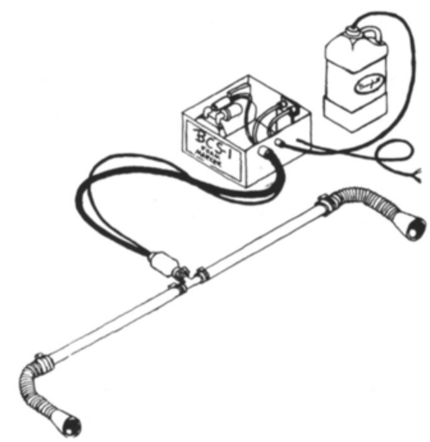

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Mr. Jerry L. Higdon, President of Hawkeye Chemical Company, Clinton, Iowa has announced the appointment of Mr. J. M. (Mike) Scribner to the position of Marketing Assistant, Specialty, Fertilizers. Based in the company's headquarters in Clinton, Iowa, Scribner will supervise national marketing of Hawkeye's liquid "low-burn" nitrogen fertilizers for the lawn care industry and foliar application to special crops.

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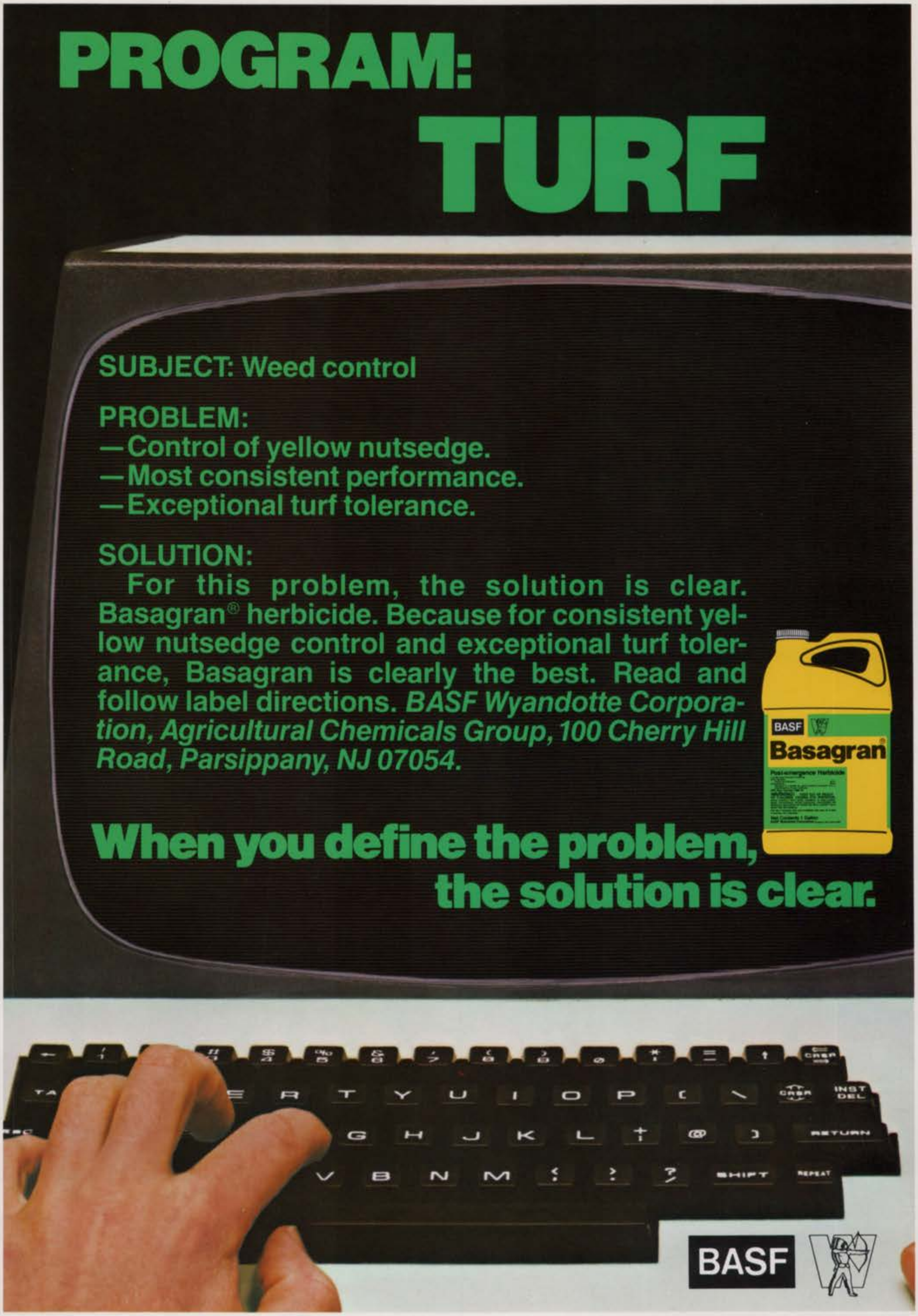

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