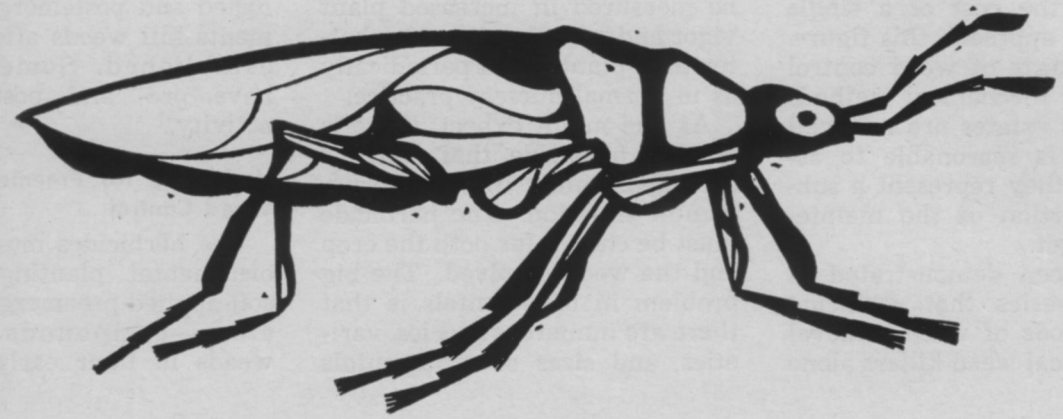

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TECHNICAL CHEMICALS DEPT., NIAGARA CHEMICALS DIVISION, MIDDLEPORT, NEW YORK

Present and Future Uses of Herbicides in Ornamentals

By DR. J. F. AHRENS
Associate Plant Physiologist
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WHEREVER ornamentals are grown, weeds present big maintenance problems. Costs of hand labor for weed removal in nurseries in the Northeast, for example, may average close to $200 per acre per year where the weeds are systematically removed. Where weeds are unduly neglected, the cost of a single hoeing can approach this figure. Although costs of weed control by hand or mechanical methods in parks or estates are not well known, it is reasonable to assume that they represent a substantial portion of the maintenance budget.

It has been demonstrated in many nurseries that replacing hand methods of weed removal with chemical weed killers alone can reduce costs of maintenance by 50% or more.

The injury ornamental plants sustain from mechanical or hand methods of weed control may be ignored but nevertheless adds greatly to the cost of producing ornamental plants. Field examinations of saleable woody nursery stock have indicated that few plants escape eventual barking from the hoe or cultivator. The right herbicides properly used greatly decrease the hazard of plant injury and mortality.

Still other benefits can derive from chemical weed control in ornamental plants. Better utilization of fertilizer by ornamental plants occurs where weeds are prevented with herbicides. Since most ornamentals are by nature slow growing, they offer little competition to the faster growing weeds that are sure to get a lion's share of nutrients and water. In some experiments in ornamental plants, chemical control of weeds that harbor parasitic nematodes also has decreased the nematode populations. The net result of chemical weed control, then, can be measured in increased plant vigor and growth, often 50% better than plants hoed periodically as in normal nursery practice.

As one might expect, there is no one herbicide that controls all weeds safely in every ornamental situation. The herbicide must be chosen for both the crop and the weed involved. The big problem in ornamentals is that there are numerous species, varieties, and sizes of ornamentals that vary greatly in their tolerance of herbicides. Without trial evaluations, it is dangerous to assume that a plant is tolerant of a particular herbicide. Although, generally speaking, woody plants are more tolerant of soil-applied herbicides than are herbaceous plants, and larger, better established plants are more tolerant than are smaller or newly set plants of the same species, it still is wise to use any herbicide on a trial basis the first time it is used in a particular planting. This includes leaving an untreated comparison, even though the herbicide may be labelled for the particular plant type.

Herbicides for ornamentals are discussed in this article under three categories: (a) herbicides for preemergence weed control; (b) herbicides for postemergence weed control; and (c) herbicides for problem weeds. In general, preemergence treatments prevent weeds from becoming established and postemergence treatments kill weeds after they are established. Some herbicides have pre- and postemergence activity.

Herbicides for Preemergence Weed Control

The herbicides most useful in ornamental plantings are the soil-applied preemergence herbicides—compounds that kill weeds in their early stages of germination and growth but usually do not kill established plants or weeds. To be effective they must be applied and become activated before weed seeds germinate. Many preemergence herbicides that are used in other crops could be useful in ornamentals but the most promising are those possessing long residual activity in the soil.

Simazine (2-chloro-4,6-bis-ethylamino-s-triazine, available as wettable powder or granules), currently is the most widely used herbicide in ornamental plantings. One of the reasons for its wide use is that it can be applied in either the wettable powder or granular form during any season of the year. Fall or winter applications of simazine at 2 to 4 lbs. per acre can be expected to pay the greatest dividends to

nurserymen because established chickweed *(Stellaria media)* is killed, and most weed growth is prevented until June or later. In the Northeast, fall or winter applications at these rates do not usually affect the growing of an oat cover crop the following September, an added advantage where winter erosion is a problem. Cultivation slightly reduces the effectiveness of simazine for annual weed control, but may be essential if a dry period follows application and weeds escape injury.

As well as controlling most annual weeds, with the possible exception of crabgrass *(Digitaria spp.)*, at low rates of application, simazine also controls many perennial weeds including quackgrass *(Agropyron repens)* at higher rates of application. This is especially true where simazine is applied prior to quackgrass emergence and is combined with cultivation. Annual weed control with simazine may last from 2 months to a season, depending upon the rate of application.

A permanent nursery where herbicides may be tested for effectiveness in ornamental plantings is a feature of the Connecticut Agricultural Experiment Station. Photo was made about 9 weeks after 6th annual application.

Simazine has been safely used on most established field-grown woody plants (those planted for 6 months or more before application) and certain deep-rooted perennials or bulbs such as peonies and tulips and ground covers such as *Vinca* and *Pachysandra*. Woody plants that have been injured by simazine include *Azalea, Euonymus, Forsythia, Salix, Spirea, Lonicera, Syringa, Deutzia gracilis, Rosa rugosa, Philadelphus, Ligustrum,* and *Hypericum*. Unlike *Rosa rugosa,* most of the rose family appears to be highly tolerant of simazine. Since tolerance depends somewhat upon soil type and plant size, several of the above plants have tolerated low rates of simazine without ill effects. Woody plants showing mild discoloration by simazine have made better growth than untreated weed-free plants in some experiments.

Several narrow-leaved evergreens have demonstrated very high tolerance to simazine and newly set field liners often are treated by nurserymen in the Northeast. Exceptions to this rule are hemlocks *(Tsuga canadensis)* and *Taxus cuspidata capitata*. Best results can be expected where the plants are well set and have received a good rain or irrigation before treatment. In smaller plants or newly set plants, the low rates of application (1½ to 2 lbs. per acre) used often provide acceptable weed control for 2 to 3 months.

Other preemergence herbicides labeled for ornamental and nursery plantings, some of which are not tolerant of simazine, include neburon, CIPC, DCPA, dichlobenil, and trifluralin.

Neburon (1-*n*-butyl-3-(3,4-dichlorophenyl)-1 methyl urea, available under trade name "Kloben" as wettable powder), can be safely applied on most of the woody nursery species tolerant of simazine and on a few that are susceptible to injury from simazine if sprays are directed to avoid hitting the plant foliage. With overhead sprays of neburon, discoloration has occurred in deciduous species such as *Forsythia, Philadelphus* and *Spirea* and the evergreen *Tsuga canadensis*. However, dormant overhead applications of neburon are much safer.

At 4 to 6 lbs. per acre, neburon controls many annual weeds and grasses for 2 to 4 months and also is effective against established chickweed in the fall or spring. Applied on the same nursery areas for 6 years, neburon has caused no injury to newly planted or established *Taxus spp., Euonymus sarcoxie* or *Picea glauca*.

CIPC [isopropyl N-(3-chlorophenyl) carbamate] has been used in nurseries for many years. It is safe for use in many species of woody ornamentals and some perennials when applied at 4 to 8 lbs. per acre in granular form or as a directed spray. CIPC is at its best during the cool seasons and can be used to kill established chickweed in azaleas, for example. Warm-season weed control often lasts only 4 to 6 weeks with CIPC and repeated applications are required for longer weed control. Soil disturbance after application decreases the effectiveness of CIPC. It's available as chloro IPC in emulsifiable or granular form.

DCPA [2,3,5,6-tetrachloroterepthalate] first emerged a few years ago as a crabgrass killer for lawn turf, and now is labeled for use in a wide variety of herbaceous and woody ornamental species, including some newly seeded or newly planted annuals and perennials. Owing to its wide tolerance among ornamentals as well as its proven effectiveness for crabgrass control in turfgrass, DCPA should prove to be a boon to custom applicators and to landscape nurserymen who often grow a mixed variety of ornamentals in the same field. At rates of 9 to 12 lbs. per acre, DCPA is most effective against annual grasses but also controls a number of annual broad-leaved weeds including purslane, lambs-

A dormant application of granular simazine controls weeds for several months, author Ahrens says.

quarters, and chickweed. Like simazine, DCPA can be sprayed directly over plants or applied in granular form. One of the promising treatments of the future for ornamental plantings may well include a combination of DCPA with simazine or some other broad-spectrum weed killer. Applicators may obtain DCPA under trade name of "Dacthal," as wettable powder or in granules.

Dichlobenil [2,6-dichlorobenzonitrile] and *trifluralin* [a,a,a-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine] are relatively new preemergence herbicides that are now labeled for use in ornamental plantings. Both have little foliage activity and can be sprayed directly over growing plants, and both have longer residual activity in the soil when incorporated. Dichlobenil promises to be useful primarily during the cool season because it is somewhat volatile under higher temperatures. Dormant applications of dichlobenil at 4 to 6 lbs. per acre control established sods including quackgrass. During the growing season dichlobenil appears to be effective against several annual weeds and some perennials including nutsedge *(Cyperus spp.)* for 2 months or more. Incorporation of dichlobenil may be required for best results on nutsedge. Commercially, the compound is known as Casoron, and is available as wettable powder or in granular form.

Trifluralin is effective at rates of ½ to 2 lbs. per acre when incorporated into the soil, or 3 to 6 lbs. per acre when used as a surface spray. It has long residual activity especially against grassy weeds and has been used safely over certain established annual and perennial flowers as well as woody plants. Trifluralin, called "Treflan," is available in emulsifiable form.

Since no single herbicide controls all weeds in all ornamental crops it is inevitable that herbicide combinations will be used to a greater extent in the future. Since simazine has long residual activity against broad-leaved weeds at low rates of application, it could be combined with herbicides such as DCPA or trifluralin that have long residual activity against grasses. Other preemergence herbicides are currently being tested in ornamental plants, and one of these new materials (diphenamid) looks very promising alone or in combination with low rates of simazine. Since the writing of this article diphenamid has been labeled for use on nursery stock. Diphenamid, called "Dymid" and "Enide," comes as a wettable powder or in granular form.

In deciduous plantings, such as these maples, a directed application of amitrole plus simazine kills established weeds and prevents further weed infestation for very long periods.

Herbicides for Postemergence Weed Control

To control most established weeds, it is necessary to use a foliage-active herbicide. The one that has found the most usage in ornamental plantings is a combination of amitrole [3-amino-1,-2,4-triazole] and simazine, applied as a directed spray around the base or between the rows of woody plants (Amitrole is available as a powder or liquid under several trade names). A combination of 1 lb. of amitrole plus 3 lbs. of simazine usually produces rapid kill of actively growing weeds and prevents most weed growth for a growing season. This combination kills faster than either amitrole or simazine alone and also provides long residual weed control. The combination, known as Amizine, can be used only where a directed spray is feasible and only around established species that tolerate simazine.

Solan [3-chloro-2-methyl-*p*-valerotoluidide] is safe and effective as an overhead spray during the dormant season on many species of deciduous nursery stock or as a directed spray during the growing season. Solan at 4 lbs. per acre is effective against seedling grasses less than 1 inch high and seedling broadleaved weeds 2 inches high including established chickweed. Since it has no residual activity in the soil, repeated applications of solan are required during the growing season. Solan is cleared for use as a directed spray in greenhouse-grown carnations and roses as well as in woody ornamentals outdoors. Its trade

(Continued on page 29)

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Turfgrass Portraits IX

St. augustinegrass

By DR. ROBERT W. SCHERY
Director, The Lawn Institute
Marysville, Ohio

This is the last of a series of nine articles on the basic traits and maintenance procedures for common turfgrasses.

ST. AUGUSTINEGRASS, *Stenotaphrum secundatum,* is a rarity among turfgrasses, being, as far as we know, a native to subtropical America, where it has been most used. All other grasses reviewed in our Portrait series have been naturalized from Old World continents or islands.

Stenotaphrum is a small genus, currently thought to embrace but three species, two of them found in southern Asia, and *S. secundatum* along the southern Atlantic and Gulf Coasts in America (introduced into Arizona and California). All are fairly low, creeping grasses, spreading well by stolons. Their preferred habitat is moist climate and mucky soil. St. augustinegrass has been one of the better performing southern turfgrasses near seashores.

Adapted as it is to humid conditions, st. augustine is a "natural" for lawns of the low-lying Coastal Plain, Florida especially. Its comparative hardiness near salt spray, and its ability to recover quickly in the nearly year-round growing weather there, help, too. Although st. augustine will survive in the higher, drier, colder environments north to the Piedmont, Little Rock and Dallas, its uncontested domain has long been the more tropical environments farther south.

Appearance And Growth

St. augustine is not what would be called an elegant turfgrass, being too coarse and of too loose texture for that. Leaf blades may be as much as ½ inch wide, though newer selections have finer texture much like centipede. The leaves exhibit a curious constriction and "half twist" where the blade joins the sheath, a distinguishing feature in telling st. augustine from similar turfgrasses such as centipede or bahia. The leaf blades are smooth except for a cluster of hairs at juncture of the sheath, blunt tipped, in most selections attractively dark green. Leaves (and side branches) occur in groups at the nodes, overlapping the relatively bare internodes. Stems (stolons) are flat, thickish.

Compared to bahia and most bermudas, even zoysia and centipede, st. augustine produces relatively few seedheads, often a mowing nuisance in turfgrasses. The seedheads themselves are rather thick, with the individual flowers (spikelets) embedded in a corky, sinuous rachis, actually the source of the name *Stenotaphrum* (from the Greek meaning "narrow trench," referring to the cavities in the rachis in which the spikelets are embedded). The low frequency of seedheads, combined with apparent sterility of many spikelets, and no established means for collecting seed, limits propagation of st. augustine to live starts.

St. augustinegrass grows with fair rapidity, and is easily established from sod, plugs of rooted grass, or sprigs (individual stolons of several-node length). With fertilization and some weed control it is not difficult to knit a lawn from starts approximately a foot apart in a matter of a few months of suitable growing weather.

Probably the most notable attribute of st. augustinegrass is its ability to grow well in shade. Perhaps more so than any other southern grass, st. augustine is shade-tolerant. In most other respects st. augustine is a moderate, ranking neither best nor poorest.

St. augustine is widely tolerant of soils and pH (usually a pH near neutral is recommended). It is vigorous, and the leaves of lawn varieties lie low to the ground, making mowing easier than might be supposed for such coarse vegetation. In southern Florida it is green nearly year-round, and is off color only briefly in winter in northern Florida.

The ease with which st. augustine is propagated on the immense sod farms of the muck lands near Lake Okeechobee makes this species one of the least expensive turfgrasses of the South.

Difficulties

However, the economy of starting a st. augustine lawn is overbalanced these days by the expense of maintaining it. Not too many years ago st. augustine was considered relatively undemanding. With wider use and better fertilization (yielding "softer" grass), problems arose.

Most serious has been chinch bugs, species of *Blissus,* which have a predilection for st. augustine. They have wiped out many a st. augustine lawn in Florida, and now seem moving westward into Texas. Chinch bugs are small sucking insects, which, if not quickly controlled, "bleed the turf white" in irregular patches, causing it to brown and die. Unfortunately, these southern chinch bugs are a mean lot; no sooner is a good insecticide discovered, than they breed populations resistant to the chemical. Early control with DDT, chlordane and other chlorinated hydrocarbons now fails in most areas, and even some of the newer phosphatic insecticides find chinch bug populations building resistance to them. Recent recommendations by the University of Florida for chinch bug control are sprays of Trithion, Ethion, and Aspon (at 7-10 lbs./A), Diazinon (at 4-8 lbs./A), and V7-C 13 (17-35 lbs./A), every 6-8 weeks. Such sprays will also control webworm, armyworm, and other

insects often a problem. Nematodes, too, may bother st. augustine, dwarfing the root system; if present, a nematocide should yield greener grass.

Not only has the "chinch bug problem" made repeated spraying of insecticide necessary, but diseases, too, have made serious inroads in recent years. Brown patch has wiped out a lot of st. augustine in Texas (where PCNB-Terraclor at ¾ lb./M is said to arrest the disease best), and farther east brown patch is reported controlled with mercurials, Thiram and Kromad as well as PCNB. At least two sprayings about 14 days apart are suggested. Other diseases, such as gray leafspot, make serious inroads, too, and though most are preventable with regular fungicidal sprays, adding disease spray bother to the chinch bug burden is enough to encourage many a homeowner to switch from st. augustine to some more self-reliant grass such as bahia.

A final problem with st. augustine is not uncommon with any luxuriant tropical ground cover — the buildup of spongy thatch that insulates growing parts from the soil. In older, unthinned turfs, such thatch may be several inches thick, the grass shallow rooted and tending to wilt easily. The thatch may harbor various weeds and pests (including chinch bug), to contribute to st. augustine's delinquency; it surely impedes penetration of water and pest remedies.

Care

Obviously, from the foregoing, st. augustine cannot be considered a low-maintenance grass. To protect it properly against pests requires equipment, chemicals, and know-how usually beyond the capacity of the average homeowner. As a result there has arisen in Florida a technical lawn service industry more voluminous than in any other part of the nation.

Otherwise, st. augustine is not a difficult grass. It mows rather well with reel mowers (a heavy machine is suggested, for light ones "ride" high on the thatch); it is moderately fast growing, but not so rampant as bermuda; it flourishes in both shade and sun; and it is moderate in its fertility requirements. Of course it wants its fair share of moisture, by irrigation if rain long defaults.

Regular feeding of st. augustine heightens its deep green color. A fertilization schedule suggested by the University of Florida calls for a complete fertilizer spring and autumn, organic nitrogen in summer, as the minimum, about 1 lb./M rate each time. Better kept swards may have two or three additional one-pound fertilizations spread through the year. Tests have shown that organic fertilizers (which don't stimulate so sudden a surge of "soft" growth as do soluble nitrogen sources) may reduce chinch bug damage.

Although lawn varieties of st. augustine may be mowed as close as 1 inch, a tighter, more weed-resistant cover occurs when mowed about two inches. Mowing should be approximately weekly, any time growth reaches twice customary mowing height. A scalping (and raking) in spring, when recovery will be quick, is said to hold down thatch. Clipping removal should also help.

St. augustine is not tolerant of many familiar weed killers, such as 2,4-D and related phenoxys. But it will withstand Simazine and Atrazine. These are usually suggested for new plantings, to control weeds while the st. augustine spreads to what is usually a relatively weed-resistant turf. Of course new plantings do best in a cultivated, fertilized seedbed, watered consistently until thoroughly rooted. Favored planting season is spring or early summer.

Varieties and Selections

As with centipede, there have been relatively few commercial varieties of st. augustine developed. A flourishing sod industry still produces "common," and the tall-growing pasture variety "Roselawn," both coarse and comparatively open (few branches, lengthy internodes).

An early lawn selection was "Bitter Blue," relatively dense, low, dark colored, and reportedly well adapted to coastal environments. Although Bitter Blue is still offered, identity is not always certain, and it sometimes becomes difficult to distinguish pure Bitter Blue from the general run of st. augustine offered in the trade.

More recently the University of Florida has released "Floratine," grown under certification, now widely handled by major sod growers. This selection is even denser and somewhat finer textured than Bitter Blue. It tolerates low mowing well.

In addition to these releases, scores of different-appearing st. augustine clones have been isolated, some dwarf, others exceptionally vigorous, in many shades of color. While some selections have looked quite promising, more testing is needed to confirm performance under a wide range of field conditions.

St. augustinegrass tends to be coarse bladed although newer selections show finer texture.

Turf Specialists Focus on Water Needs, Practices, At 36th Int'l Turf-Grass Conference in Cleveland

How water affects turfgrass health and soil conditions, and how it should be applied, was a prevailing theme of the educational sessions during the 36th International Turf-Grass Conference and Show February 7-10 at the Sheraton-Cleveland Hotel, Cleveland, Ohio.

Technical lectures on turfgrass science were interspersed with talks on general golf course management, and "free" periods allowed delegates to view the annual trade exhibition, termed "The Greatest Show on Turf." This year saw a record number of exhibitors present, and conference officials, at presstime, expected the final tally of registrants to surpass last year's 2700 attendance in Philadelphia.

"What watering techniques produce the best turf?" Harry J. McSloy, Superintendent of Wilmington Country Club, Wilmington, Del., asked as a springboard to the answers which were the meat of his talk.

"Constant wetness of turf is not the reason for watering grass," McSloy explained. "Alternate wetting and drying is beneficial because it promotes less compaction, roots penetrate more deeply for available water, denser turf is produced, and fewer weeds have a chance to sprout. Such healthy dense turf will bounce back quickly after a bout with disease.

"Change your watering schedule only in the spring" McSloy advised. "Let the turf dry almost to the wilting point, then water it deeply with a nozzle which will prevent puddling and runoff.

"Water to a depth of 6 inches, and test this depth periodically with a soil probe," the Superintendent continued. "Water should be applied slowly to prevent crusting.

"Then hold off watering until the turf loses resilience, or appears just about to wilt," McSloy went on. "Grasses vary in their water requirements; some bermudagrasses will do well if watered only once every 7 days."

The experiences of this superintendent were expanded and substantiated later by Dr. Ralph Engel, Agronomist, Rutgers University, New Brunswick, N. J., who presented some research results from academic studies.

Host member, Malcolm McLaren (left), vice-president of the Northern Ohio GCSA greeted visiting superintendent James Haynes, Denver (Colo.) Country Club. McLaren is a former GCSAA president.

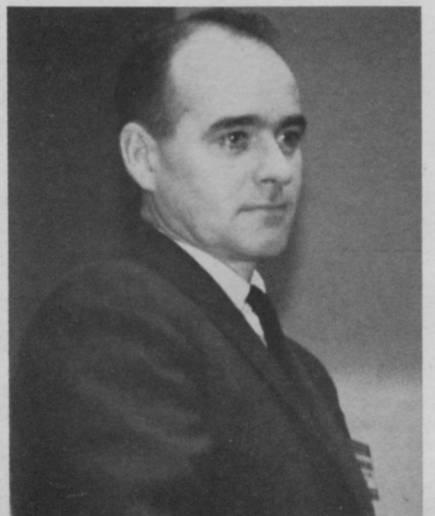
"A good program of watering will include the following points: (1) apply water only when needed; (2) apply it slowly; (3) make certain application is uniform; (4) use fine droplets; (5) apply the proper amounts to avoid runoff, (6) and time application according to weather and rainfall," the turf expert enumerated.

Know Grass Water Needs

Dr. Engel advised superintendents to be familiar with individual grasses and the water requirements of each. "Bentgrass has a high water need, whereas bluegrass and the fescues are not favored by generous watering," he said. This knowledge is important because watering can regulate species balance or dominance. Dr. Engel showed a slide of a bluegrass plot which was receiving too much water and sustained an invasion of bentgrass.

"Thatch prevents proper water penetration, and often comes about because turf has been given too much light watering which increases the amount of shallow surface rooting," Dr. Engel asserted. Other factors which can prevent proper water penetration are algae and slime, and compaction of soil particles.

"Winter injury can be worse than vandalism," Dr. C. Richard Skogley, Univ. of Rhode Island agronomist told the educational assembly at 36th Int'l. Turf-Grass Conference.



Guard Against Winter Injury

A second agronomist followed on the GCSAA program to explain winter injury, damage related to water problems, and how to prevent it. The agronomist, Dr. C. Richard Skogley, University of Rhode Island, Kingston, said that many times winter injury in its various forms can be worse for the golf course superintendent than vandalism.

"Winter and spring are critical times for grasses," Dr. Skogley said. "Summer for cultivated turf is no problem, if it can survive winter.

"Winter injury is a complex subject," he continued. "There are two basic types: mechanical, caused by man, and physiological, caused by diseases and other maladies which kill grass."

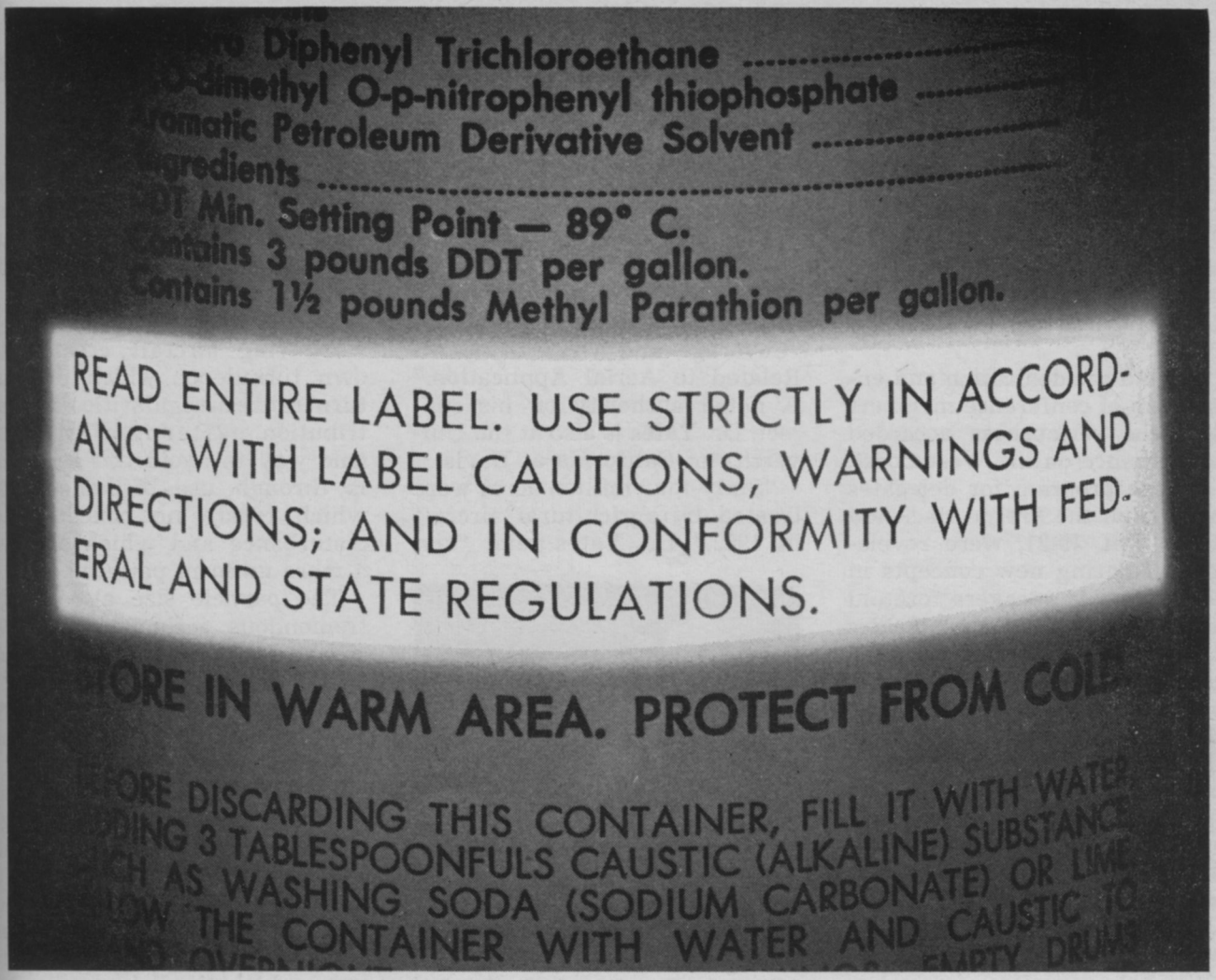
The Rhode Island expert told how mechanical injury can result from walking over frosted grass and bruising the grass plants. Beneath the turf the soil water may freeze and heave; if disturbed by traffic while heaved, permanent ruts may result.

On the physiological side, winter injury may be manifest in winterkill, disease, scald, suffocation, or desiccation.

"Actually frost action on soil can be an advantage, because it relieves compaction and will improve play on greens in season," Dr. Skogley said.

He indicated that the two most dangerous times for prize turf are late fall and early spring (late fall because of possible

(Continued on page 24)



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Californians Aflame With New Weed Control Notions

At Biggest Conference Ever, Jan. 19-21 in Fresno

A record-breaking attendance of 660 at this year's California Weed Conference in Fresno leaves no doubt at all that weed control in the nation's most populous state is big business indeed.

Nor did the dedication and enthusiasm of conference members belie the seriousness accorded weed science on the West Coast.

On the program for delegates gathered at the Fresno Hacienda Motel, Jan. 19-21, were revelations of daring new concepts in weed control: speakers foretold the increased use of herbicides in rights-of-way and other crop and noncrop areas; close scrutiny was focused on more viscous formulations (both invert emulsions and "particulate" sprays); and an entire afternoon was surprisingly given over to a thorough analysis of flame weed control, including a demonstration of equipment.

And time after time weed specialists announced from the podium the ever-increasing importance of industrial and urban vegetation maintenance and control.

Of the importance of herbicides in general, it was predicted early in the conference that the sale of weedkillers will outstrip insecticides and fungicides in the not too distant future.

This prediction came from Dr. E. M. Gifford, a weed scientist from the University of California's Davis campus, who remarked that now truly agriculture has come to the city, and that increasing urbanization, with its attendant demand for recreation and residence certainly augurs well for those who pursue weed control. Dr. Gifford pleaded for increased attention to educating the weed control experts of tomorrow.

The Davis scientist preceded a trio of engineering-oriented weed controllers who examined basic application concepts, the problems of drift, and the use of aircraft in weed control.

"The use of agricultural aircraft has become a necessity in certain areas," Dr. Wesley E. Yates commented in his address, "Coverage and Drift Problems Related to Aerial Application." A noted authority on his subject, Dr. Yates is also at the University of California at Davis.

"Sixty-four million acres were treated by agricultural aircraft in 1962," Dr. Yates said, "and that represents only one-sixth of the total pertinent acreage in the U.S."

Defining the basics in weed control was California researcher Dr. Boysie Day (left) who reminisced with John Deere representative David W. Cayton during a coffeebreak.

Problems associated with aerial techniques grow more complicated as time goes on, and of course the hazards of drift are foremost in most applicators' minds. Whereas in the beginning, the concern was for visible damage to adjacent desirable vegetation, which could frequently be readily perceived through such manifestations as "browning," now the chief fear is that residues from sprays will contaminate forage lands and then be taken up into livestock grazing on the fields.

What is to be done to control drift possibilities? Dr. Yates first enumerated the factors which affect the uniformity of distribution of aerial sprays. They are (1) influence of the aircraft itself; (2) size of particles in the spray; (3) the chemical formulation; and (4) climatic conditions.

Dr. Yates explained that a fixed-wing aircraft creates its own turbulence which may in turn cause irregularities in distribution patterns of sprays. One way to avoid this problem is through use of helicopters, which create no concentrated disturbance and which achieve a more uniform pattern.

The particle size also exerts tremendous influence on how sprays are laid on the land. Dr. Yates pointed out that larger particle sizes are not affected by aircraft turbulence as much as small particle sizes.

Contract applicators and others who wish to test the configuration of their sprays may use Dr. Yates' method. He adds a dye to the spray solution and then places white paper strips perpendicular to the flight pattern, which then shows graphically where the spray has gone.

Seek to Reduce Drift

Studies of drift reduction through improved or altered application techniques are being carried out at Davis by Dr. Charles R. Kaupke.

Among the factors which determine spray patterns are nozzle type, pressure, height of release of material (from the ground), a variety of meteorological conditions, and properties of the fluid itself.

Fluid properties were singled out by the California agricultural engineer as a primary steppingstone to improved sprays. Density, surface tension, and viscosity characterize the fluids under study, and Kaupke said, "we are more or less left with the viscosity factor" since it is difficult to alter significantly the other two qualities.

In order to produce larger