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Biology and Management of Masked Chafer Bugs

by Dr. Daniel A. Potter, University of Kentucty

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.

Every fall thousands of acres of turfgrass in home lawns, golf courses and other urban areas are damaged or destroyed by soil-inhabiting white grubs. Homeowners and lawn care companies expend considerable time and money in combatting these pests, but it seems that each year the grubs are back in force. Not many years ago, highly residual chlorinated hydrocarbon insecticides such as chlordane, dieldrin and heptachlor provided a reliable and long-lasting remedy for white grubs. Unfortunately, these materials became less effective as the grubs developed resistance. They also were considered hazardous to the environment, and federal restrictions have now all but eliminated their usage on turf.

Today's turf manager must rely on shorter-lived organophosphate insecticides such as diazinon, chlorpyrifos (Dursban) and trichlorofon (Dylox or Proxol). These chemicals have several important drawbacks. Even when watered in, they tend to become bound in the organic thatch layer before reaching their target (Niemczyk et al. 1977). They also tend to degrade quickly, usually within 1-2 weeks (Sears and Chapman 1979). Hence, proper timing of applications is critical, and success depends upon a knowledge of the pest's life history.

Not all white grubs are alike. Japanese beetles are especially troublesome in the eastern U.S., and much of the literature on grubs pertains to that species. Most grub problems in the midwestern and north central states are caused by the northern and/or southern masked chafer. At the University of Kentucky, we have been working to gain new information on these pests. This article provides an update on the biology and management of masked chafer grubs in urban turfgrass.

BIOLOGY AND DAMAGE

Adult masked chafers are small brown beetles about ½ inch long (Fig. 1). They are similar in appearance to the familiar May beetles, but much smaller. The two species of importance are the northern masked chafer, which damages lawns from Connecticut west to Ohio and Missouri, and the southern masked chafer, which is especially abundant in Kentucky, Indiana, Illinois, Missouri, and west to Texas. Bi-

Figure 1: Adults of the southern masked chafer (left) and the northern masked chafer.

Figure 2. Mating of masked chafers occurs at night on the sod surface. Females are highly attractive, and are sometimes found surrounded by several males.

ology of the two species is similar. The adult beetles emerge from the soil during June and July, mate, and begin laying eggs just below the sod. Swarms of beetles are sometimes noticed flying over the lawn at dusk, and large numbers may be attracted to porch lights at night. Mating occurs at night on the surface of the sod (Fig. 2). Recent studies (Potter 1980) showed that virgin females omit a powerful air-borne attractant, which allows the flying males to locate them in the grass. Individual females are often found surrounded by six or more males.

Since the adult beetles do not feed, they do not directly damage the lawn or nearby plantings. However, when the eggs hatch in 2-3 weeks, the small whitish-gray grubs begin feeding on the grass roots. The grubs grow quickly and by late August have usually reached their full size. Mature grubs are about one inch long, whitish with a brown head, and are usually curled into a C-shape. Feeding continues until mid-late October, when cold temperatures cause the grubs to move deeper into the soil for overwintering. In early spring (late March in Kentucky), the grubs migrate back up into the sod zone where they resume feeding on the grass roots. Feeding ceases in late May, and they again move down in the soil and transform to adult beetles to start the cycle again (Fig. 3).

When making control decisions, it is important to identify the type of grub that is causing the problem. The best way to distinguish between grub species is to examine the pattern of spines on the underside of the hind end, or raster (Fig. 4). A hand lens is useful for inspecting grubs in the field. In masked chafers, the spines are scattered evenly over the raster. In Japanese beetle grubs, the spines form a distinct V-

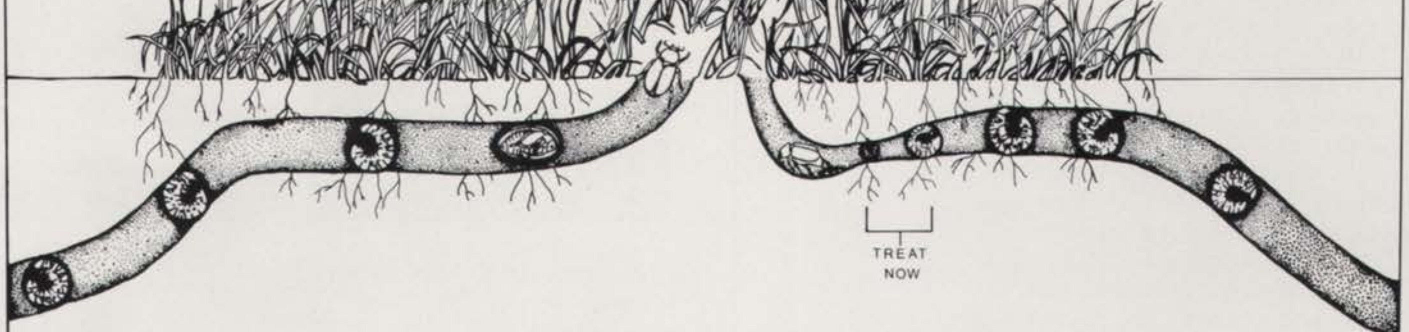

Figure 3: Life history of masked chafers in turfgrass.

Masked Chafer

shaped pattern, while in grubs of May beetles they form two parallel rows.

By chewing off the grass roots, white grubs seriously reduce the ability of grass to withstand the stress of hot and dry weather. Badly infested turf develops irregular dead patches, which can be rolled back like a carpet to expose the culprits feeding beneath (Fig. 5). Visible damage most often occurs on the lawn "hot spots", e.g. in full sun, or on south or southwest facing slopes. Most damage occurs during August or September, especially in years with deficient rainfall. Lawn care companies can expect the number of grub-related service calls to be directly related to the amount of rainfall during late August and September (Fig. 6). Damage from spring feeding is generally not as obvious, since soil moisture is usually adequate and cool season grasses have an extensive root system in spring.

CONTROL CONSIDERATIONS

Unfortunately, by the time that brown, dead patches become evident, it is usually too late to save those areas of the turf. It is better to diagnose and treat the problem early so that extensive damage can be prevented. In research at the University of Kentucky, light traps were operated over the past 3 years to study the flight and egg-laying patterns of the adult masked chafers. These studies showed that in average years, emergence and flight of masked chafers begins about June 10, peaks about June 25-July 5, and it is almost finished by late July. This means that the best time to apply an insecticide is early to mid-August, when the

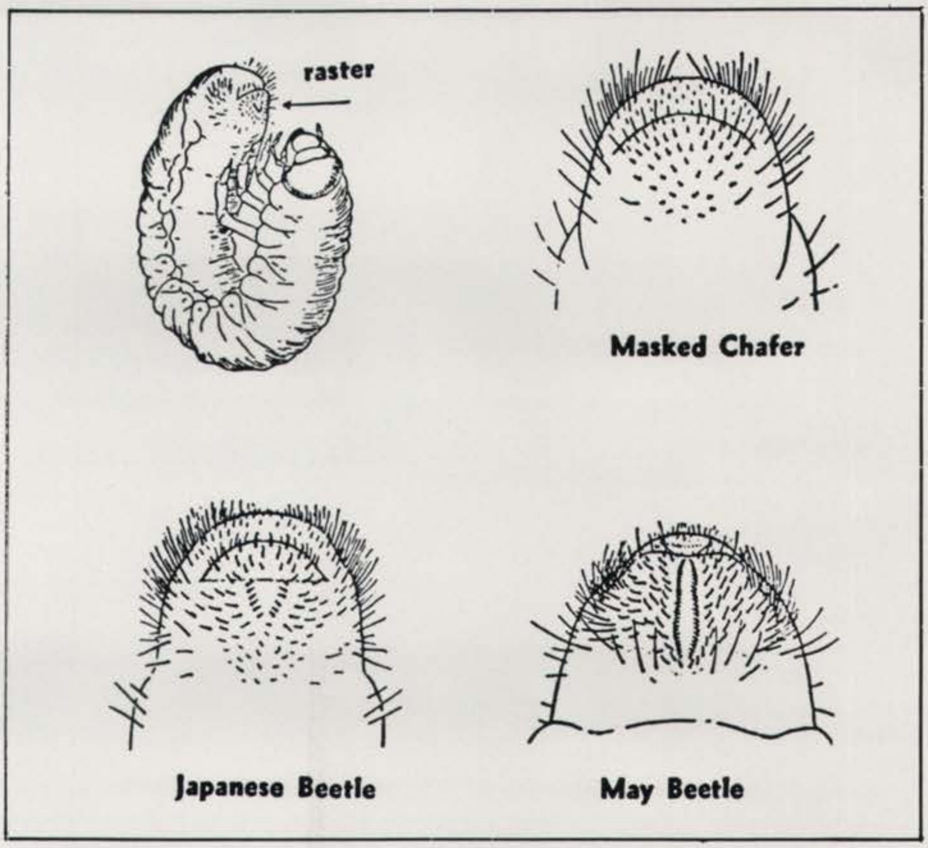

Figure 4: Rastrel patterns of common white grubs. *

Figure 5. Grub damaged turf is not anchored in the soil and can be rolled back like a carpet.

* *Figures modified from "Bug Dope", Cooperative Extension Service, The Ohio State University.*

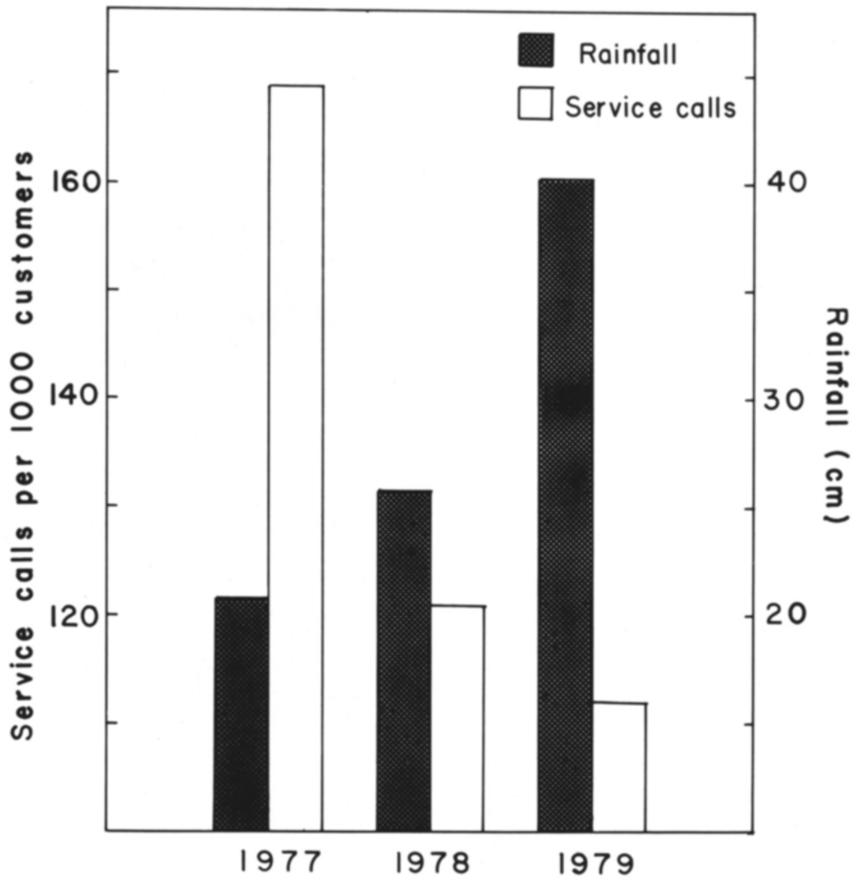

Figure 6: Influence of rainfall on the number of grub-related service calls (per 1000 customers) received by a Kentucky lawn care company. The graph represents the period from Aug. 15 - Oct. 15 for 3 successive years.

eggs have hatched but the grubs are still small and have not yet begun to kill the lawn. Although spring applications will kill grubs, there is little benefit to treating at this time. As mentioned above, spring grubs seldom cause much damage before they transform to adults. Killing spring grubs affords no protection from the lawn being reinfested with beetles flying in from nearby lawns later in the season.

Homeowners and lawn care personnel often ask what the economic threshold is for white grubs; that is, how many grubs must be present before damage will be intolerable and a treatment is warranted. To answer this question, a two year field study was conducted to measure the feeding impact of masked chafer grubs on bluegrass turf. Galvanized steel enclosures (1 ft^2 area) were driven into Kentucky bluegrass sod to a depth of 5", and then artifically infested with varying numbers of white grubs. Half of the enclosures were irrigated with 1 inch of water twice a week, while the others were not watered. Every two weeks, damage ratings were taken on the infested turf, and the clippings were harvested, dried, and weighed as a measure of loss in yield.

These studies indicated that in the non-irrigated turf, at least 9-10 grubs/sq. ft. were required before any damage was evident. Irrigated turf tolerated as many as 15-20 grubs/sq. ft. before showing noticeable damage. At all levels of grub density, visible damage and loss of yield were much worse in the non-irrigated plots.

These results indicate that even in non-watered lawns, low numbers of grubs (0-6/sq. ft.) do not warrant chemical controls. Watering helps the turf to survive grub damage, and it is likely that adequate lawn irrigation during the critical 7-week period from mid-August to late September will be an effective management procedure for all but the most severe grub infestations. Encouraging customers to water properly will go a long way toward helping to minimize grub damage.

Watering helps turf survive grub damage

Home lawns should be sampled before control decisions are made. This is best done in early August, after the eggs have hatched. In several suspected spots, cut out a square foot piece of sod and examine the soil and roots closely for grubs. Remember, at this time the grubs may be not much bigger than a bluegrass seed and not as easily found as when fully grown. After examining a sample, tamp it back down and water well so that no damage will be evident. An average of 9-10 grubs per square foot in a non-watered lawn would suggest a need for an insecticide.

Grub treatments should be thoroughly watered in immediately to wash the insecticide down through the thatch layer into the soil where the grubs are feeding. This is especially important for liquid formulations, which will lose effectiveness if allowed to dry on the foliage. It is doubtful that most lawn care companies apply enough water with their tank mix to drench the insecticides through the thatch, and homeowners cannot be relied upon to irrigate soon enough after treatment. For this reason, granular insecticides have performed much better, since timing of irrigation is less critical. All treatments should be watered in with

Masked Chafer

Table 1. Number of Masked Chafer Grubs/Ft^2 recovered from sod treated with insecticides Aug. 1, 1980 at Lexington, Kentucky. (6 replicates)

Chemical	Rate A.I. Lbs/Acre	Means[A]/ Post-Treatment 1 wk	3 wk
Diazinon 14G	6.0	4.8 A	1.0 A
Diazinon 14G	4.0	10.5 ABC	2.2 A
Dylox (Proxol) 80W	8.2	4.7 A	4.7 AB
Dursban 4E	3.0	8.3 AB	8.8 AB
Dursban 4E	2.0	18.0 ABC	16.7 BC
Dursban 4E	1.0	20.8 BC	23.2 BC
Dursban 4E	4.0	28.0 CD	25.3 CD
Check	-	41.7 D	43.2 D

A/Means in a column followed by the same letter are not significantly different ($P \geq 0.05$) by Duncan's Multiple Range Test.

Counts based on five 8" diam. turf plugs taken from each 6' x 8' plot.

enough water to wet the soil to at least one inch depth. If insecticides can be applied just before a good rain, so much the better. Remember— no watering in, no grub control!

University of Kentucky research trials over the past several years (Table 1) indicate that Diazinon 14G and Dylox (Proxol) 80W, properly applied, will provide excellent control. Results with Dursban 4E have been inconsistent, perhaps because of the material's tendency to be bound up in the thatch layer. A new turf insecticide, Oftanol, has also given excellent control, and should be registered for commercial use in the near future.

Homeowners often ask if milky disease spore powder (Doom, Japidemic) is effective against masked chafer grubs. Milky disease is a naturally occurring bacterial disease of white grubs. When a healthy grub swallows soil containing the spores, the bacteria multiply in the host's blood, turning it milky white before killing the grub. The commercial preparation is made by mixing the remains of pulverized infected grubs with talc. When this preparation is broadcast over the turf, the spores become mixed in the soil and provide control for a number of years. Unfortunately, the milky spore powder available commercially is effective only against Japanese beetle grubs, and its use on any other white grub species is a waste of time and money. At the University of Kentucky, we are currently studying a different strain of milky disease specific for masked chafer grubs. This research could lead to development of a milky spore insecticide suitable for use on masked chafer grubs.

ACKNOWLEDGMENTS

I am grateful to Diane Walton for preparation of the grub life cycle diagram. Dr. A. J. Powell (University of Kentucky) provided a number of helpful suggestions.

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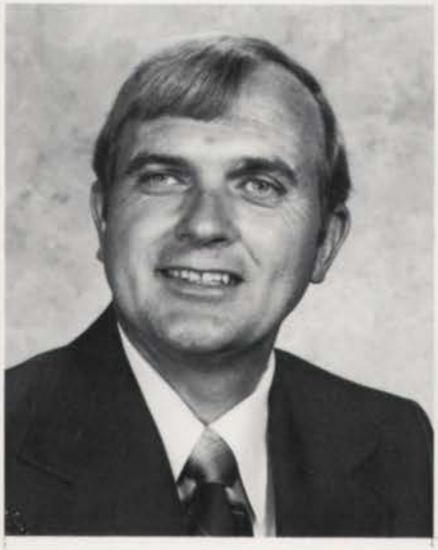
Preemergence Control of Winter Annuals[1]

by B.J. Johnson, University of Georgia



B. J. Johnson is a professor in Agronomy and research project leader on management of herbicides for weed control in turfgrass at the Georgia Experiment Station, University of Georgia, at Experiment. He received his B.S. from Berry College, Rome, Georgia and M.S. in Agronomy from Texas A&M University. For the last 10 years he has conducted studies on management of herbicides for weed control in warm and cool-season turfgrasses. His major interest has been to evaluate herbicides using different management practices to determine the least amount of chemicals needed for effective control of summer and winter weeds. These results have been widely accepted. Mr. Johnson is a member of the Editorial Committee of Weed Science Society of America and member of Weed Science Society of America, American Society of Agronomy, Crop Science of America, The International Turfgrass Society and Gamma Sigma Delta.

To have and maintain an attractive bermudagrass lawn, winter annual weeds must be controlled. The mild winters that occur throughout the southern states where bermudagrass is grown favor rapid growth of these weeds. In addition, when the grass growth is slow in the fall or when plants are killed by frost, the turf can not compete with weeds as readily as it can when actively growing. Fewer weeds will emerge during the winter in a good quality turf than in a poor quality turf. Therefore, fertility and other management practices will aid in controlling winter weeds, but in most instances herbicides must be included to maintain a weed-free dormant bermudagrass turf as shown in Figure 1. Turf not treated with herbicides for weed control may become weedy as shown in Figure 2 by early spring.

WEED CONTROL

It is very important to identify weed species in a turf area before selecting a preemergence herbicide for use. In our studies, we found that no single fall herbicide treatment controlled all of the weed species (Table 1). Preemergence Balan treatments controlled annual bluegrass (Poa annua), corn speedwell (Veronica arvensis), henbit (Lamium amplexicaule) and common chickweed (Stellaria media) effectively but not hop clover (Trifolium agrarium), parsley-piert (Alchemilla microcarpa), or spur weed (Soliva spp.). Ronstar applied at the same time also controlled annual bluegrass, corn speedwell, hop clover, and parsley-piert but not spur weed, henbit, and common chickweed. This shows the importance of weed identification before herbicide application. Since henbit and common

Figure 1: Weed-free bermudagrass dormant turf results in an attractive lawn.

[1] Professor of agronomy at the Georgia Station, Experiment, Georgia 30212. This study was supported by state and Hatch funds allocated to the Georgia Agricultural Experiment Stations. Trade names are included for the benefiit of the reader and do not imply any endorsement or preferential treatments. All herbicide rates are based on the active material/A.

TABLE 1: Effect of preemergence herbicide treatments on control of winter annuals in bermudagrass turf.

Treatments[a]		Weed species						
Herbicide	Rates	Annual Bluegrass	Hop Clover	Corn speedwell	Parsley-piert	Spur weed	Henbit	Common Chickweed
	lb/A	% control[b]						
Dacthal	12.5	32	78	99	23	10	-	80
Ronstar	4.0	98	87	81	98	61	34	18
Kerb	0.75	97	26	98	31	10	13	78
Betasan	12.5	79	5	0	99	26	10	0
Balan	3.0	98	48	100	40	15	92	84

a Treatments were applied in September.

b Weed control ratings were made the following April and averages from 2 or more years where 0 represents no control and 100 represents complete control.

chickweed were the major weeds at one of our test sites, Balan provided complete control while Ronstar failed to control the weeds effectively (Figure 3). Dacthal and Kerb controlled only 3 of 7 weed species while Betasan controlled only two weed species (Table 1). Corn speedwell, hop clover, and common chickweed were controlled effectively with Dacthal while Kerb controlled annual bluegrass, corn speedwell and common chickweed. Annual bluegrass and parsley-piert were controlled with Betasan.

When annual bluegrass was the only problem weed, 97 to 98% of the weeds were controlled with either Ronstar, Kerb, or Balan (Table 1). Similar corn speedwell control was obtained with either Dacthal, Kerb, or Balan while 81% was controlled with Ronstar. Betasan and Ronstar provided excellent parsley-piert control while Balan was the only herbicide evaluated in our studies that controlled henbit. None of the herbicides controlled hop clover and common chickweed completely. Acceptable hop clover control was obtained with Ronstar (87%) and Dacthal (78%) while similar common chickweed control was obtained with Balan (84%), Dacthal (80%) and Kerb (78%). The question arises as to what herbicide to use when several weed species are included in a given lawn. For example, no single preemergence herbicide treatment controlled annual bluegrass, corn speedwell, parsley-piert, and henbit. Since Balan controlled all weeds except parsley-piert, and Betasan controlled parsley-piert, it was necessary to apply a mixture of those chemicals for effective control of all weeds in the same turf area.

Figure 2: Weedy bermudagrass turf results in a poor quality lawn.

Spur weed control was not acceptable from any of the herbicides evaluated in these studies (Table 1). Ronstar provided the highest control of 61% when applied as a single fall treatment. In a later study, two applications of Ronstar applied in September and January controlled 80% of spur weed. This indicates that Ronstar has some spur weed activity, but repeated treatments failed to control the weed completely.

Winter Annuals

TABLE 2: Dates of preemergence herbicide treatments on control of winter annuals in bermudagrass turf.

Date	Treatments Herbicide	Rate	Weed species Annual bluegrass	Corn speedwell	Hop clover	Parsley-piert	Common chickweed
		lb/A	% control[a]				
July 15	Dacthal	12.5	30	51	21	16	56
	Betasan	12.5	39	17	8	52	19
	Balan	3.0	14	50	37	29	28
	Kerb	0.75	26	43	22	0	37
Aug. 15	Dacthal	12.5	43	70	9	14	50
	Betasan	12.5	60	5	10	57	22
	Balan	3.0	18	53	21	14	15
	Kerb	0.75	58	51	17	0	60
Sept. 15	Dacthal	12.5	39	80	33	17	60
	Betasan	12.5	52	8	10	85	35
	Balan	3.0	85	90	18	15	79
	Kerb	0.75	87	60	17	0	61
Oct. 15	Dacthal	12.5	44	99	25	21	98
	Betasan	12.5	71	8	5	92	71
	Balan	3.0	88	96	40	19	95
	Kerb	0.75	98	97	9	4	98

a Weed control ratings were made the following April and averages from 2 or 3 years where 0 represents no control and 100 represents complete control.

Figure 3: The importance in weed identification before selecting a herbicide. Balan in right plot of left picture controlled common chickweed and henbit while Ronstar in the right picture did not.

These results show the importance of weed identification before selecting a herbicide for use. When this is not done poor weed control may occur. In addition, the investment of the chemical may be lost.

DATES OF WEED CONTROL TREATMENTS

Dates of preemergence herbicide treatments are important in controlling the highest amount of weeds in bermudagrass turf. None of the herbicides controlled weeds effectively in our studies when preemergence treatments were applied in July or August (Table 2). Annual bluegrass was controlled 87% with Kerb when applied in September and 98% when applied in October. The control was similar with Balan whether applied in September (85%) or October (88%). Dacthal and Kerb controlled corn speedwell the highest when applied in October while the control with Balan was effective whether applied in September or October. Balan controlled a higher percentage of common chickweed when applied in October than when the same treatments were applied earlier. Either Dacthal or Kerb controlled common chickweed almost completely when applied in October. Treatments applied in July or August were unsatisfactory. Betasan applied in September and October was the only herbicide included in this study that controlled parsley-piert effectively.

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Pests in Florida Turf

However in south Florida, based upon recent studies in Ft. Lauderdale, egg laying continues throughout the year. Peak egg hatching normally occurs during the first half of June in northern Florida and continues through August in southern Florida. A lesser peak of egg hatch occurs in late January to mid February for the southern mole cricket in south Florida. The young nymphs escape from the egg chamber and burrow to the soil surface to begin feeding on roots, organic material and on other small organisms including insects.

Most mole cricket feeding occurs at night after rain showers or irrigation and during warm weather. Some surface feeding has been noted when the soil is dry, but is greatly reduced. All nymphal stages as well as adults come to the surface at night to search for food. Tunnelling of more than 20 feet per night has been observed. During the day the mole crickets return to their permanent burrows and may remain there for long periods of time when weather conditions are unfavorable. When mole crickets come to the soil surface they are subject to predators including fire ants, ground beetles, Labidura earwigs, and Lycosa spiders. Larger animals including raccoons, skunks, red foxes and armadillo also feed on mole crickets, but often damage turf areas when searching for them. Research is underway concerning the introduction of several insect parasites from other countries. In Puerto Rico, for example, a parasitic wasp has apparently provided satisfactory control of mole crickets for a number of years.

Suggested insecticides for control include Baygon or Diazinon spray; Mocap granules; Baygon, Dursban, Malathion or Sevin baits. Mocap granules has been one of the most effective nonbait materials evaluated in University experiments the past several years and is labelled in Florida on commercial turf and lawns. Mocap granules must be applied only by certified pest control operators. The suggested baits appear to be about equal in effectiveness.

Latter June or early July is the optimum time for applying insecticides for mole cricket control. At this time, most of the nymphs are small (1/8 to 1/4 inch) and visible damage will not usually be noticed due to their small size. To determine if mole crickets are present, use the soap flush as described under chinch bugs. Check several places in the turf area and if an average of 3 to 4 per square foot is detected a treatment should be applied. Insecticides can also be applied in August and September but the crickets are larger, more difficult to control and additional damage will have occurred.

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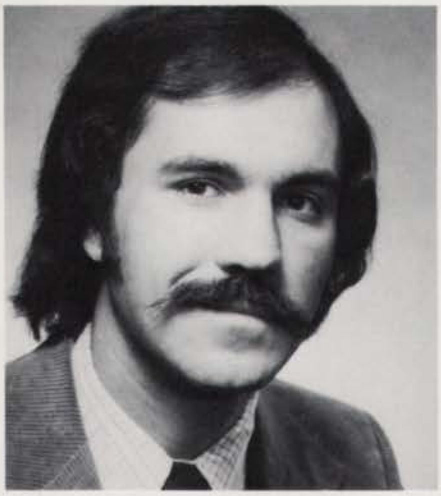
Chinch Bugs: Biology and Control

by Dr. M. Keith Kennedy



Dr. M. Keith Kennedy is an assistant professor and Extension specialist for ornamental crops at Michigan State University. He holds a B.A. degree in biology from Hendrix College, and an M.S. and Ph.D. in insect ecology from Cornell University. Dr. Kennedy's research interests include the biology and control of insects in urban areas.

Chinch bugs are sucking insects which belong to the insect family Lygaeidae (pronounced 'Lye-gee-a-dee"), commonly known as "seed bugs". Most lygaeids feed on mature seeds by injecting saliva into the seed and sucking out the dissolved contents. Others are sap feeders such as chinch bugs while some lygaeid species are predators e.g. *Geocoris* or big eyed bugs.

The most important of the more than 250 lygaeid species in North America are the chinch bugs (rhymes with bench). Native to North America, chinch bugs are thought to have fed on the prairie grasses of the mid-western states before man began planting large acreages of cultivated grass crops, such as small grains, sorghum, and corn. Today, chinch bugs cause millions of dollars of damage to these agricultural crops and also cause serious injury to lawns and golf courses.

DAMAGE TO GRASS

Chinch bugs injure plants principally by piercing the grass blade with their mouthparts and withdrawing large quantities of plant sap. Young tender plants often die within a few days after extensive feeding damage while older, tougher plants are more tolerant. The feeding punctures or wounds also allow additional plant sap to exude and provide a potential entrance for disease organisms. The insect's saliva which is injected into the plant may be in part responsible for plant decline. In addition, the sheaths formed around the insect's mouthparts (stylets) during feeding often clog the plant's conducting vessels (phloem) and further contribute to injury.

Turf damaged by chinch bug feeding frequently appears as irregularly shaped yellow patches 2-3 feet in diameter which eventually turn brown and die (Fig. 1). Clumps of clover and other non-grass weeds may subsequently invade these damaged areas and become established.

Drought or heat stress may cause similar browning of turf but proper watering will quickly rejuvinate the lawn. Diseases such as striped smut can give the lawn a patchy or clumped appearance but there is usually more brown or dying grass present when chinch bugs are the primary problem.

Fig. 1. Chinch bug damage to a blue grass/fescue lawn.

The hairy chinch bug (*B. lecuopterus hirtus*) is the most frequently observed species in the midwest. This insect can be a serious problem in lawns when conditions are warm and dry. Its damage is most frequently observed in late summer or early fall and is often attributed to some other agent. The following information should help in the diagnosis and control of chinch bug problems in lawns.

Fig. 2. Chinch bug adult (about 1/5" long).

HOSTS

Chinch bugs will feed on a variety of northern grasses but there are some preferences according to Dr. Roger Radcliff, USDA SEA, Beltsville, MD. The Kentucky bluegrass varieties Flyking and Barron appear to be less favorable to chinch bugs while Adephi is very susceptible to injury. The perennial rye grass varieties Yorktown, Diplomat and Citation, among others, are especially favored by chinch bugs while Score, Pennfine, and Manhatten are more resistant to feeding damage. Radcliff also notes that fescues are attacked, especially the Jamestown and Barver varieties. Bent grass is also a host for this insect.

Fig. 3. Big eyed bug, a beneficial insect (predator) often confused with chinch bugs (about 1/5" long).

IDENTIFYING FEATURES

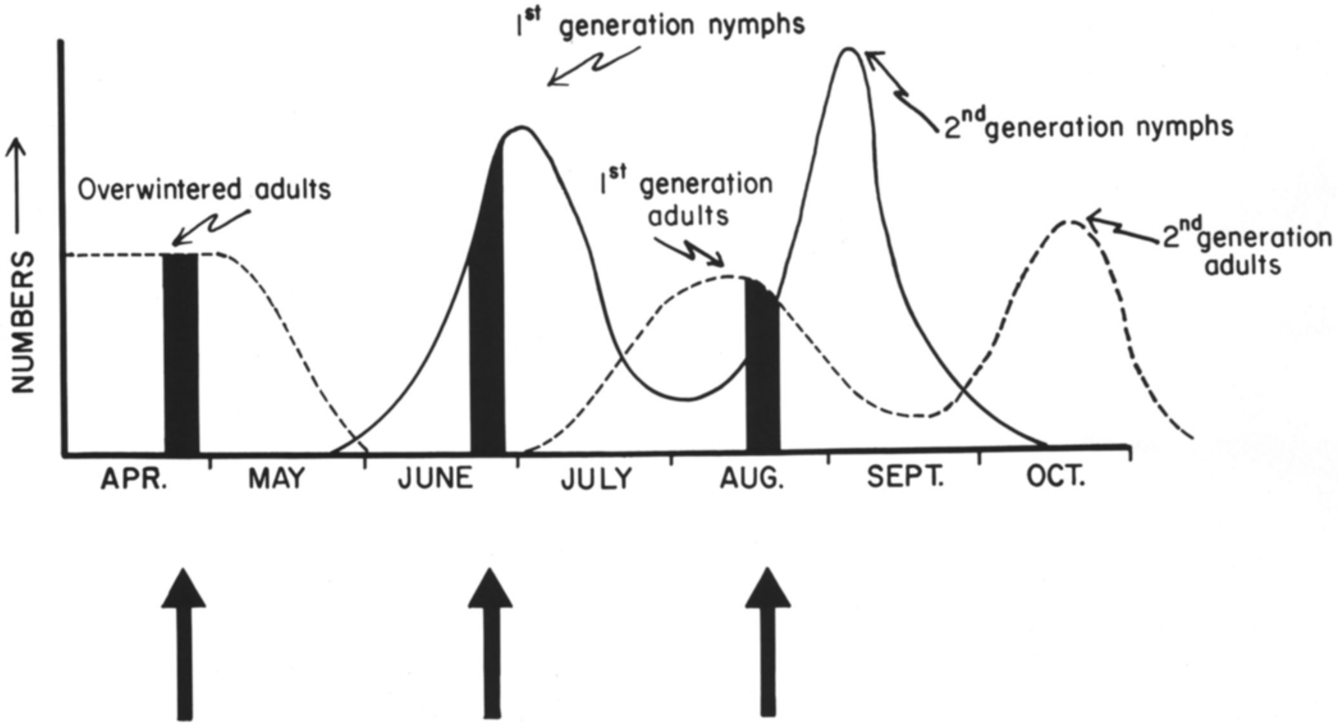
Chinch bug eggs, approximately 0.8 mm long (1/25") are initially white in color becoming red as they mature. There are 5 nymphal stages with the first few stages having a reddish color with a pale yellow to white transverse band on the forward part of the back and abdomen. The nymphs become darker as they mature with the fifth and final stage nymph having a dark grey color with wing pads clearly evident on its back.

The adults are approximately 5 mm long (1/5") with black bodies, reddish legs, and conspicuous white forewings that possess a black triangular spot centered along the outside wing margin (Fig. 2). Both short winged and long winged forms exist. Note that another Lygaeid insect, the big eyed bug (*Geocoris* spp.), inhabits turf and is frequently mistaken for chinch bug (see Fig. 3). These are beneficial insects because they are predators on other turf inhabiting arthropods and may have some effect on chinch bug numbers.

LIFE CYCLE

Adult chinch bugs overwinter in sheltered areas such as clumps of weeds, under leaf litter, or in dense thatch. They become active in spring and early summer when temperatures begin to reach 70°F. Mating takes place and females begin to lay eggs in leaf sheaths, on roots, or in the ground near the plant. Little or no development occurs at temperatures below 45°F. Researchers in New Jersey indicate that hairy chinch bug females lay approximately 1.5 eggs per day with an average total of 54. Others estimate that females can lay as many as 20 eggs per day for two to three weeks.

Fig. 4. Generalized life cycle of chinch bugs. Arrows and solid lines indicate control periods.



Egg hatch occurs in about 10 days and the nymphs feed for 4-6 weeks. Total development time from egg to adult averages 43 days. There are usually 2 generations a year or more in most areas of the midwest with peak populations occurring in late August and early September (see Fig. 4). There is only 1 generation a year in Ontario.

PROBLEMS IN THE SOUTH

The southern chinch bug, B. insularis, is the major pest of St. Augustine grass in Florida and other states of the Gulf Coast Region. It remains active year round and is capable of producing as many as 4 to 7 generations during this time. Research by Dr. Jim Reinert of the University of Florida indicates populations may vary from 500 bugs/ft^2 to over 2300/ft^2.

Control of this pest has been largely through the use of the organophosphates diazinon and Dursban (chlorpyrifos). As many as 6-8 applications per season were required to achieve control of this pest. Unfortunately, such intense insecticide pressure on this pest has resulted in the development of resistance to these chemicals by many chinch bug populations. This is not surprising since insect

New varieties of St. Augustine grass have more tolerance to chinch bugs

pests frequently develop resistance to insecticides when subjected to large numbers of treatments. This particular problem has forced the turf industry to consider grass varieties that show some level of resistance to chinch bug attack. Dr. Reinert has been able to identify several St. Augustine grass varieties that demonstrate high levels of resistance to these insects. As these new varieties become more widely used, the chinch bug problem may diminish to more tolerable levels in this region.

WEATHER AND CHINCH BUG INJURY

The size of chinch bug populations and therefore the severity of lawn damage, is largely determined by weather. These insects are essentially "hot weather bugs" and optimum conditions such as a warm dry spring followed by warm temperatures and below average rainfall in the early summer favors the buildup of chinch bug populations. Conversely, a cold wet spring will drastically slow population growth and heavy rainfall in June and early July during egg hatch will reduce nymph survival. Much of this mortality is due to a fungus (*Beauveria* spp.) that attacks the bugs during cool, wet conditions. The fungus is ineffective during hot dry periods when chinch bug buildup occurs and for this reason it has not been vigorously pursued as a commercially available biological control agent.

Chinch Bugs: Biology & Control

HOW TO DIAGNOSE CHINCH BUG DAMAGE

In attempting to diagnose a chinch bug problem remember that these insects prefer sunny, open areas of lawn so damage located in shaded areas may likely be a result of some other problem. Since chinch bugs generally move outwards from the center of the initial infestation and feed on living grass, closely examine the green borders of the dead or dying turf areas rather than the centers for the presence of nymphs and adults.

Another diagnostic technique is to flood a small area of lawn with water to the puddling point to float bugs to the surface. A refinement of this method is a coffee can without a bottom that is pushed into the turf and filled with water. Chinch bugs present will float to the surface in 5-10 minutes. This technique should be repeated 5-6 times in a lawn in case of uneven bug distributions. Several hundred bugs per square foot may be present in heavily infested lawns.

CULTURAL CONTROL

There are several turf management techniques that can help reduce chinch bug problems. Since chinch bugs are usually not a problem in well irrigated turf, diligent watering of turf during hot weather will help reduce this potential pest. Also, reducing the amount of nitrogen fertilization has been shown to be effective in limiting chinch bug injury. Tests on the southern chinch bug indicated that these insects developed more rapidly on heavily fertilized grass than on grass receiving lower nitrogen levels or when slow-released organic nitrogen sources were utilized instead of fast release inorganic sources.

Heavy thatch may contribute to buildup of populations by providing protection for young nymphs and overwintering adults. Avoiding thatch buildup could possibly reduce a potential bug problem. Planting resistant grass varieties (see hosts), when feasible, is also a good management practice that can head off future problems.

CHEMICAL CONTROL

In most areas of the country, insecticides will provide excellent control of this insect. Diazinon and Dursban are two materials which are used most frequently for controlling chinch bugs. Other materials such as Aspon, Sevin (carbaryl) and more recently Oftenol (isofenfos), are also registered for chinch bug control.

Research done in Ohio by Dr. Harry Niemczyk has shown that treatments made in late April for overwintering nymphs will prevent chinch bugs from becoming a problem later in the season. A spring treatment would be especially helpful in areas known to have chronic chinch bug problems.

When a spring treatment is unfeasible, a single application made in mid-June when nymphs are small will prevent further population buildup. Treatments made in mid-July or August will also control the insects but some damage has usually occurred by then.

Lawns adjacent to the infested areas should be inspected for chinch bugs and treated if necessary to prevent reinfestations by migrating nymphs and adults from occurring.

Hopefully this discussion will help in the proper diagnosis of lawn chinch bug. The most important point is being sure that chinch bugs are in fact the problem and knowing what to do to prevent extensive damage.

^ ^ ^

Part 2

Selection, Care, and Use of Granular Applicators

by Richard L. Parish, PE

Richard L. Parish is Manager of Mechanical Research & Development for O.M. Scott & Sons Co., Marysville, Ohio. He holds BS, MS, and PhD degrees in Agricultural Engineering from the University of Missouri and is a registered Professional Engineer. Prior to joining Scotts, Dr. Parish was Associate Professor of Agricultural Engineering at the University of Arkansas, and a consultant in farm machinery design and testing. He is an officer on the Agricultural Chemical Application Committee of the American Society of Agricultural Engineers.

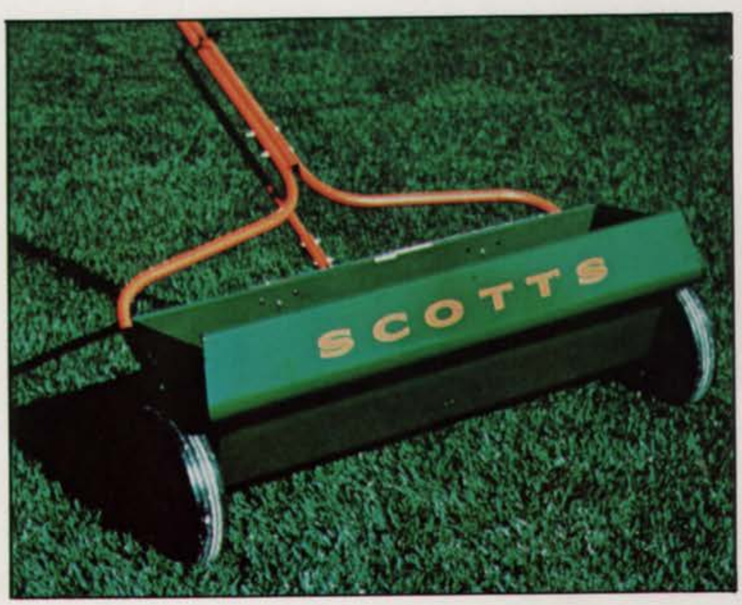
Many lawn care service applicators use granular products as a part of their program or even as a complete program. Proper selection, care, and use of granular applicators can minimize costs and maximize the results obtained. Improper use of granular applicators can reduce product efficacy, cause injury to turf and ornamental plantings, increase costs, and damage the spreaders.

OPERATING PROCEDURES

Experienced lawn care service operators will certainly be familiar with proper operating procedures, but a few tips might be in order for new operators. The first recommendation is that the operator read the operator's manual or instruction booklet provided by the manufacturer and follow the manufacturer's instructions. The second obvious recommendation is that the operator follow the instructions on the product label (modifying rate and pattern settings if necessary for specific conditions).

Header strips at ends of turf area are beneficial

Header strips at each end of the turf area provide a place to turn around and realign the spreader and also serve to make the border of the turf area more uniform. The operator should always get the spreader moving at rated speed (normally 3 miles per hour) on the header strip or on a driveway, sidewalk, etc., and then open the spreader as he crosses into the turf area to be fertilized. At the other end, the spreader should be closed while moving, then stopped and turned while in the header strip. A spreader should never be open while stopped, since excessive product will be applied in a small area, and the end turns should never be made with

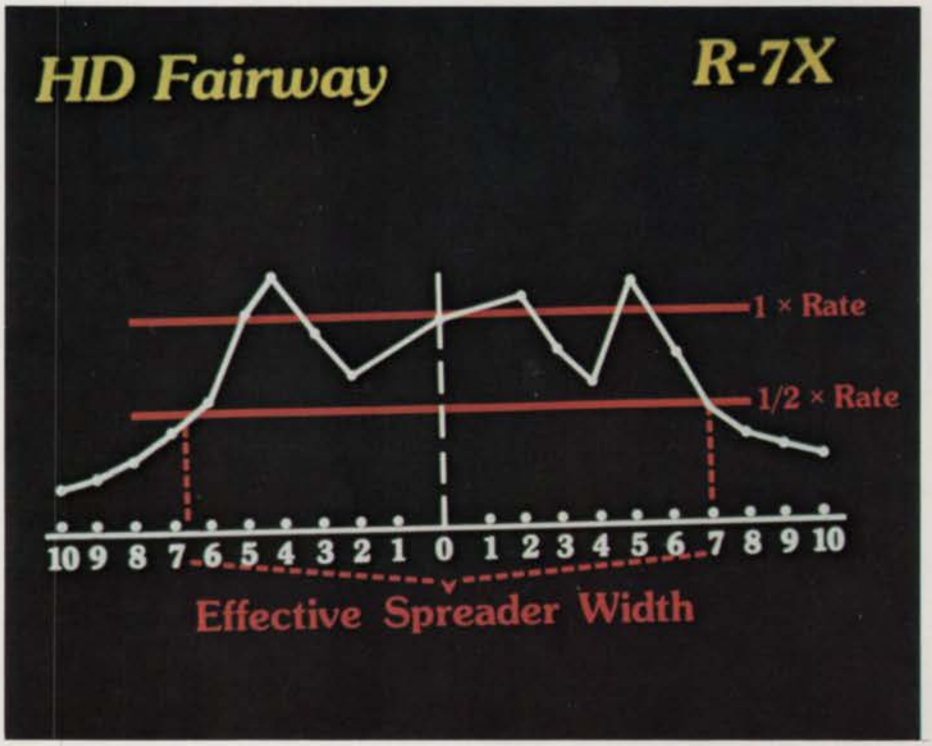


the spreader open, since the pattern will be very irregular while turning. Normally a back and forth pattern is preferred, particularly for small areas. A circuitous pattern may be used on large areas, but uniform distribution is difficult to achieve at the corners. The main advantage of a circuitous pattern is compensation for skewing.

Occasionally, it may be impossible to obtain a completely acceptable pattern with a rotary spreader and striping of the turf may result. A common reaction to this problem is to reduce the setting to a half rate and go over the next lawn twice at right angles. This is not a valid solution to the problem. This approach will not average out the pattern as is usually believed but will merely change stripes into a diagonal checkerboard. If pattern problems cannot be corrected, the proper procedure is to reduce the setting to a half rate and reduce the swath width in half but still go back and forth in parallel swaths.

A spreader should normally not be operated backwards. It is obvious with most rotary spreaders that pulling the spreader backwards delivers an unacceptable pattern, but there is a problem with drop spreaders also. Most drop spreaders will deliver a considerably different rate at the same setting if reversed. In some cases, such as new seedings in loose soil, the spreader may be easier to pull than to push. If it is desired to operate a spreader backwards, a different setting should be determined.

Spreader should be set and filled on paved surface



Pattern graph plotted from weights of material in each catch pan. Determination of effective swath width is shown.

Some rotary spreaders are provided with a means of cutting off one side of the pattern. This feature is desirable when edging along driveways, sidewalks, etc.

Finally, it is usually best to set and fill the spreader on a paved surface rather than on the lawn. If a spill occurs, a driveway is much easier to sweep clean than is turf.

CARE & MAINTENANCE

Proper care and maintenance will not only prolong the life of a spreader, it will also keep the spreader operating precisely and make the operator's job easier. Once again, the spreader manufacturer's instructions should be followed, but the recommendations given here are generally applicable. Even though many spreaders now have an epoxy powder coating for corrosion resistance or are partially plastic or fiberglass, corrosion is still a problem with fertilizers. A spreader should normally be washed thoroughly after each day's use and then allowed to dry. If fertilizer is caked on the spreader, hot water may be needed to break it loose. After the spreader is washed and dried, it should be oiled according to the manu-

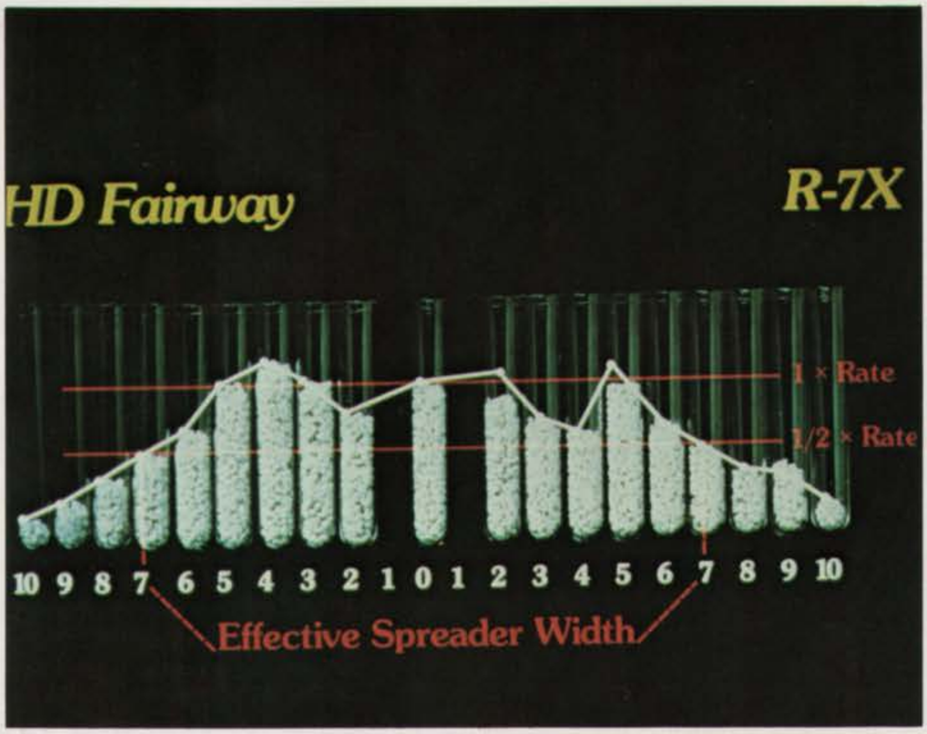
Granular Applicators

facturer's instructions. Tests have shown that proper washing, drying, and oiling can extend the corrosion life of metal parts on a spreader by a factor of 3-4, even under adverse storage conditions.

It is generally not desirable to oil or grease the gears on rotary spreaders, since the lubricant attacts dirt and causes premature wear. Dry graphite lubricant can be used if desired, but many spreader gears have a lubricant impregnated in them and do not require further lubrication.

When not in use, spreaders should be stored in a clean, dry place, out of direct sunlight. Nothing should be piled on the spreaders while stored, since even moderate weight can, over a few months, distort the tires and cause permanent creep of the plastic parts.

Most commercial spreaders are designed to take the normal stresses of continuous lawn care service use, but occasional maintenance and parts replacement will always be needed. Abusive use will shorten the life of the spreader and raise maintenance costs.



Alternate method of visually presenting a rotary pattern. Material from each pan is poured into a test tube or vial and the row of vials matches the previous graph.

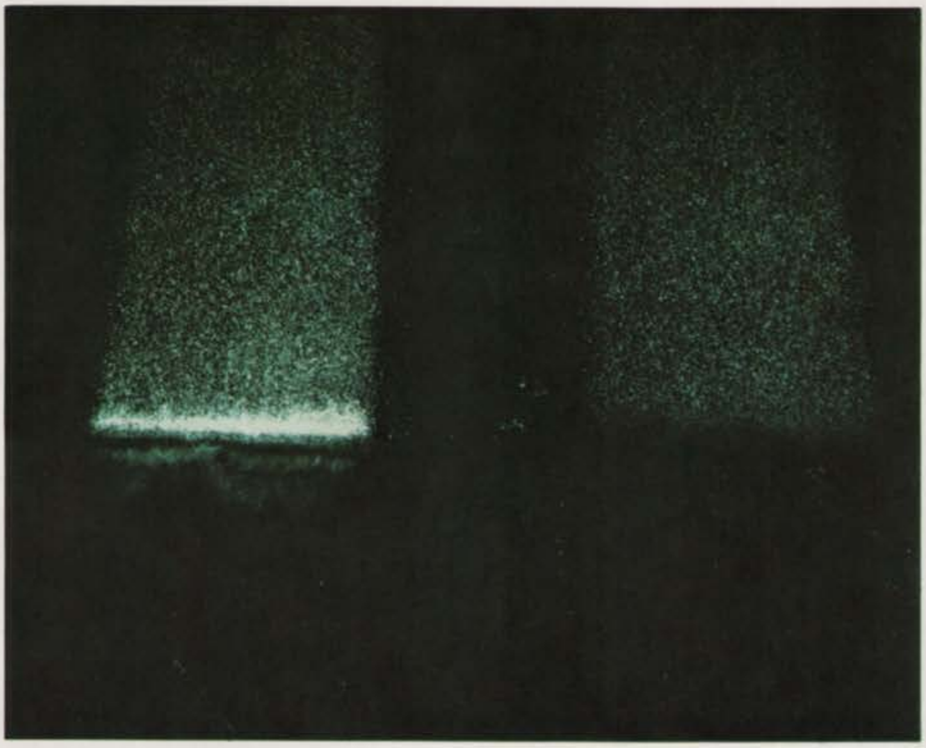
Proper use of header strips for uniform application.

SELECTION OF A SPREADER

Selecting the proper spreader or spreaders can improve application quality, minimize total costs, and minimize labor.

The basic decision is between drop and rotary spreaders. Drop spreaders are generally more precise and deliver a better pattern. Since the product drops straight down, there is less chemical drift and better control, with less chance of applying product to non-target areas. Some drop spreaders will not handle larger granules, and ground clearance in wet turf is a problem with some drop spreaders. Since the edge of a drop spreader pattern is sharp, any steering error will cause missed strips or doubled strips. Drop spreaders usually require more effort to push. Wet foliar applied products are more efficacious when applied with drop spreaders, since the particle velocity imparted by a rotary makes some particles bounce off the foliage.

Rotary spreaders cover a wider swath, thus covering a given area faster, but are less precise than drop spreaders



Effect of opening spreader before starting forward motion (left) versus opening while moving (right).

in terms of uniformity of distribution. Because of the pattern feathering, they are more forgiving of steering errors. Since they do not have a full width agitator to turn like a drop spreader, they require less push force. Rotaries normally handle large particles well, but drift is a problem with fine particles when wind is present. Ground clearance in turf is usually no problem for a rotary. Since rotary patterns vary, more calibration time is needed. A major advantage of rotary spreaders is that rotaries are better suited to the use of plastic and fiberglass; and, thus are more corrosion resistant. Rotary spreaders are also more durable in commercial use and less likely to be knocked out of calibration than some drop spreaders.

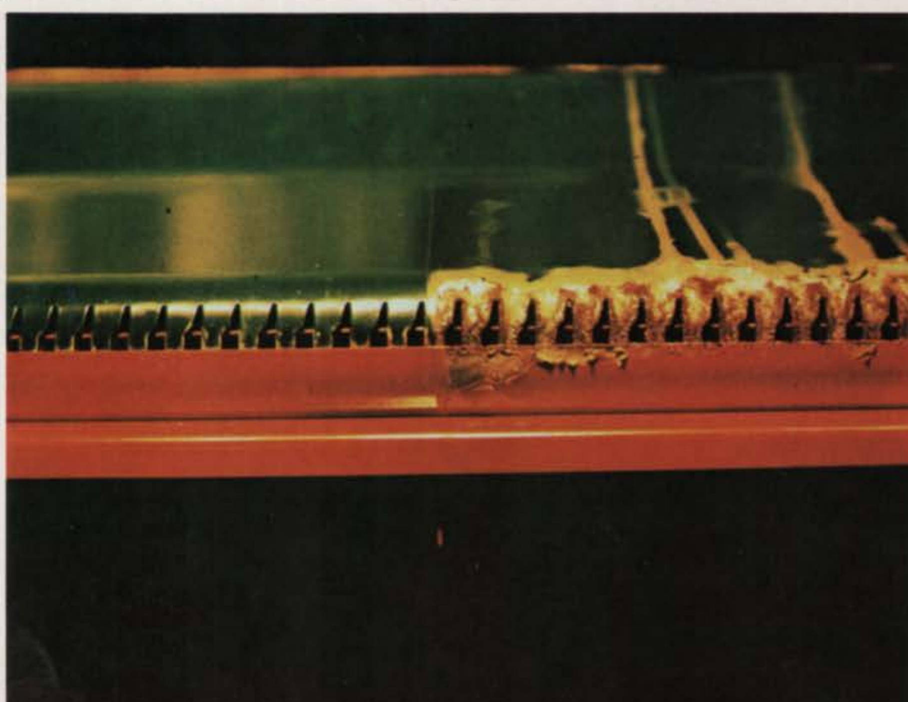
Size of the spreaders needed is determined largely by the size of the areas to be covered, the need for transporting spreaders, and the number of obstacles in the areas to be covered. While generally faster, a large spreader is not necessarily best in small, irregular lawns with trees, flower beds, etc. One factor to consider is that even for large open areas, doubling the swath width will not double the area covered per day. As a general rule of thumb, swath width must be at least tripled to double the area covered per unit time.

Ability to deliver an acceptable pattern with a wide range of products is important. Some means of pattern adjustment is certainly an asset. Manufacturing uniformity is a serious consideration. All spreaders of a given model should be manufactured to give as close to the same rate and pattern with each product as possible. If several spreaders are to be used, it is certainly desirable to have them all delivering the same rate and pattern at the same setting. Even if only one spreader is in use, the setting on the product label is more likely to be correct for the particular spreader if that spreader was manufactured under close quality control specs.

Durability of a spreader is important. Lawn care service use has been found to be the most abusive, damaging use to which push-type commercial spreaders are put. The spreader should be structurally sound and as corrosion resistant as possible. Epoxy powder coating, used by some manufacturers, will at least double the useful life of sheet metal parts.

Any spreader used for lawn care service applications will eventually need replacement parts, so reliable parts service should be a consideration. Easy serviceability is another factor.

A final factor to consider in selecting a spreader is availability of settings for a large number of products in that spreader model. Even though these settings should always be checked and may occasionally need revision to suit particular conditions, they are generally correct and are a real time-saver.



Corrosion protection resulting from epoxy powder coating. Left half of the spreader is epoxy powder coated, right half was painted with liquid enamel. Note: This spreader has been corrosion/abrasion lab test.

The Facts About 2,4-D

by Stephen Brown

Michigan lawn care professionals were jolted by the recent publication of an anti- 2,4-D article on the front page of a major Detroit newspaper. The May 19th article, which refers to 2,4-D as "Agent Green", was based on charges made by a group of "young professionals, attorneys, and teachers" who call themselves the "Grass Roots Organization" (GRO).

Soon after the article appeared in the Detroit News, a bill, which is designed to ban the use of 2,4-D on home lawns, was brought before the Michigan House of Representatives. The bill is sponsored by John Bennett, a Detroit-area law maker.

Both the newspaper article and the proposed legislation are the result of GRO's contention that 2,4-D is "carcinogenic (cancer causing), mutagenic (causing changes in genetic material), teratogenic (causing birth defects), and fetotoxic (causing damage to a fetus). To support their charges, GRO has selectively chosen a limited number of studies and interpretations from the tremendous quantity of research that has been done on the phenoxy herbicides over the past 37 years.

By disregarding a large body of scientific evidence to the contrary and by creating an "impression of fact" (rather than dealing with actual fact), this apparently well-intentioned but misinformed group of activists has threatened the existence of the lawn care industry in the State of Michigan.

Because this is an emotionally-charged issue, it is critical that those who support the continued use of 2,4-D become familiar with the scientific facts that are involved. The present hysteria, which is born of ignorance and misunderstanding, cannot be dealt with on the basis of opinion. It is for this reason that the following information is presented.

2,4,5-T and 2,4-D: SIMILARITIES AND DIFFERENCES

Much of the concern about 2,4-D is the result of its *apparent* similarity to 2,4,5-T, which has been alleged to cause cancer in Vietnam veterans and birth defects in their offspring. These products are, after all, both phenoxy herbicides and their names certainly sound alike.

What is important to understand, however, is that they are *different* chemical compounds, produced in fundamentally different processes. Generally, 2,4-D is manufactured by reacting phenate and chlorine to produce 2,4-dichlorophenate. This intermediate compound is then combined with sodium chloroacetate in the presence of heat to produce 2,4-dichlorophenoxy acetic acid. Production of 2,4,5-T, on the other hand, begins with the reaction of 1,2,4,5-tetrachlorobenzene with menthanol and aqueous sodium hydroxide to form 2,4,5-trichlorophenate. It is 2,4,5-trichlorophenate that can, under the conditions of heat and pressure, produce TCDD, a very toxic dioxin. TCDD has, of course, been alleged to be responsible for the Vietnam vet's problems.

TCDD has never been found in 2,4-D

Whether or not that is the case (and there is considerable evidence to the contrary), everyone should clearly understand that TCDD has *never*, under the most rigorous analysis, been found in 2,4-D. Indeed, the Hazard Alert group in the California Dept. of Health Services (more on that group later) states, in its June 16, 1980 report, "There is currently no evidence for contamination of 2,4-D, either during manufacture or following application, or evidence of any other compound, including TCDD, that would contribute significantly to the toxicity of 2,4-D in the amounts present."

DIOXINS: WHAT, WHERE, AND HOW?

Dioxins, or more correctly chlorinated dibenzo-p-dioxins (CDD's) are a group of organic compounds which can occur as by-products of some combustion processes or in the production of certain chlorinated phenols. The number of chlorine atoms that can be attached to the dibenzo rings (see Fig. 1) varies from one to eight, and there are 75 theoretically possible variations (or "isomers") in this chemical family.

It is important to understand that the toxicity of the dioxins varies tremendously, depending on the location and number of chlorine atoms attached to the dibenzo rings. A dioxin with two chlorine atoms (a dichlorodibenzo-p-dioxin) is relatively non-toxic while the well-known TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) is the most toxic of the group (see Fig. 2).

A dioxin with three chlorine atoms is 15,000 times less toxic than TCDD. The other four chlorine combinations are 50,000 times less toxic than TCDD, and the dichloro (2 chlorine atoms) varieties are one million times less toxic than 2,3,7,8-TCDD.

Canadian scientists, using new and somewhat controversial techniques, have found a dichloro-, a trichloro-, and a tetrachlorodibenzo-p-dioxin in the butyl ester formulation of 2,4-D produced in Canada. This fact is of no particular significance for the lawn care industry because the highly volatile butyl ester formulation is not used in home lawn weed control. In any case, the Canadian report states that the

Now, one-shot white grub control.

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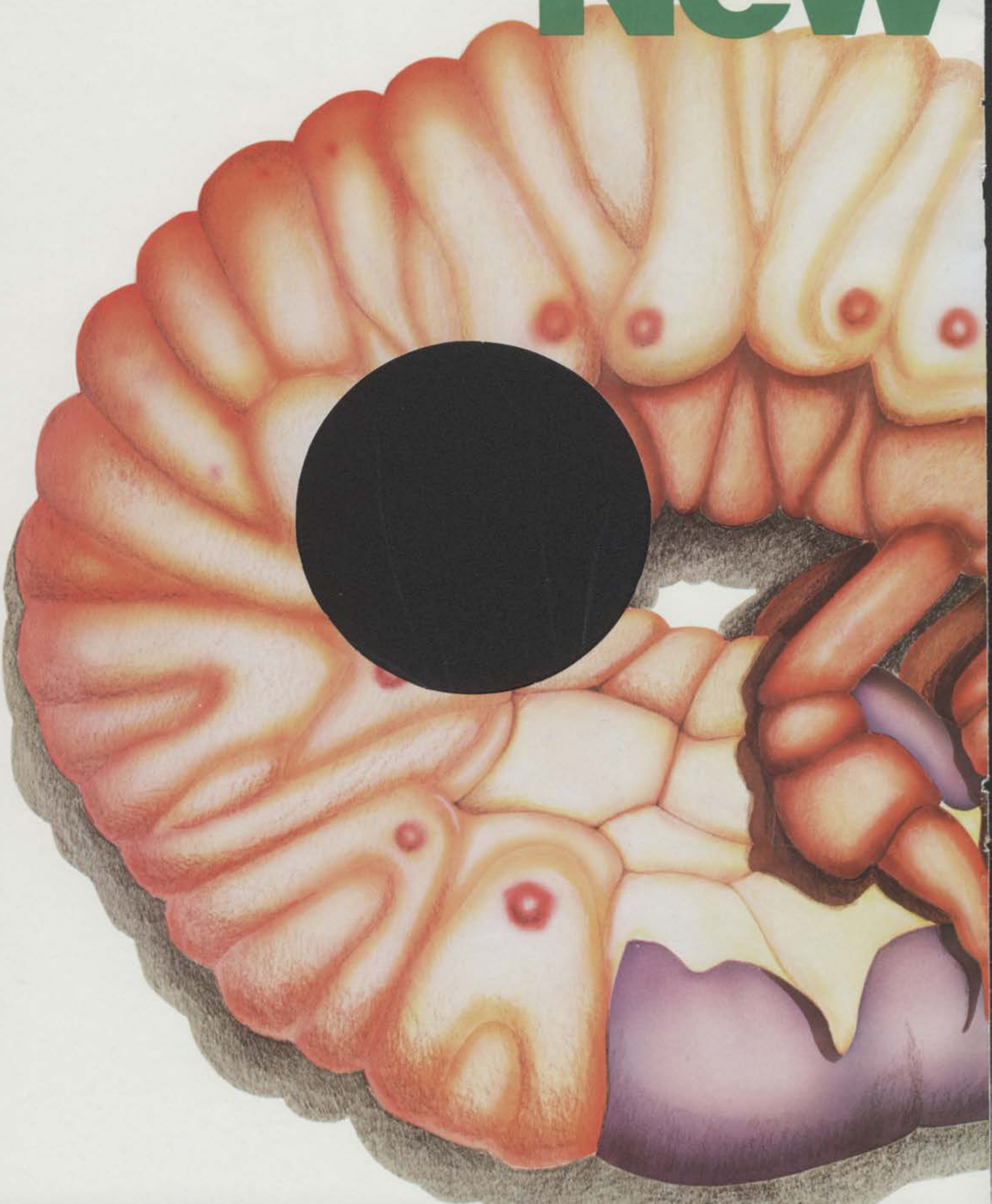

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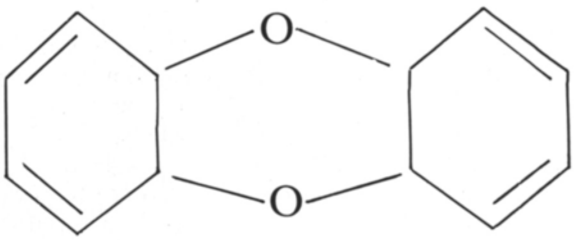

Figure 1

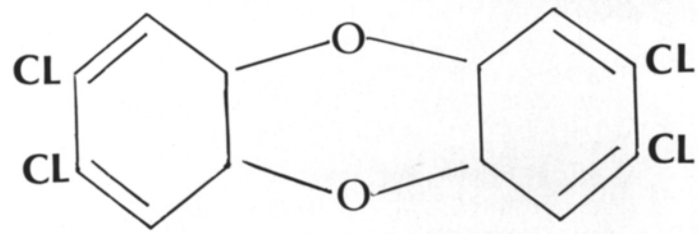

Figure 2

dioxin contaminants found in butyl ester formulation are "of a very low toxicity".

In a position paper concerning the Canadian action on the technical esters of 2,4-D, a Dow Chemical representative wrote, "The mere presence of the specific dioxins found at levels reported does not constitute a hazard to human health or the environment. It should be noted that the Canadian Agriculture Department cited no incidents and/or studies that indicate such a hazard exists. Furthermore, studies conducted in the United States, New Zealand, Australia, Finland, and the United Kingdom on the effects of exposure to 2,4,5-trichlorophenoxy acetic acid (which *does* contain 2,3,7,8-TCDD) report no adverse effects to humans."

A final point of significance to those concerned about dioxins is that they are regularly found in cigarette smoke, deposits in automobile mufflers, fireplace chimneys, particulate matter from incinerators, and in the stacks of coal-burning generators.

ACUTE TOXICITY, CARCINOGENICITY, MUTAGENICITY, TERATOGENICITY, FETOTOXICITY: WHAT THE STUDIES SHOW

Certainly no pesticide has been subject to more research over the past 35 years than the phenoxy herbicides. The number of studies that have been done with bacteria, fruit flies, mice, dogs, pigs, rats, hamsters, chickens, cattle, rabbits, sheep, and even human subjects is staggering. There have been mammalian toxicity studies, human metabolism studies, environmental studies, and reproductive studies. Research on 2,4-D has been done all over the world by every conceivable type of group, from Russian cancer specialists to Swedish epidemeologists, from French embryologists to American pharmacologists. The World Health Organization and the Environmental Protection Agency have established food and water tolerances for 2,4-D and an acceptable daily intake value for humans. In short, the chemical has been studied and re-studied.

There are at least three reasons why it is very difficult for the average lawn care professional to discuss in detail the results of these studies: 1) the volume of information generated over the years is quite overwhelming, and most people don't have the time to read even a small portion of it, 2) the research methodology varies greatly and it is often difficult to know whether a particular study was valid or not, 3) the fact that birth defects may or may not result when pregnant rats are fed huge quantities of 2,4-D daily doesn't seem particularly relevant to the question of whether or not it is safe to apply small quantities of the chemical to weeds in a lawn.

It is likely to be sufficient for those who are not scientists to be aware of the following information from the California Department of Food and Agriculture, and from the United States Environmental Protection Agnecy.

In California, Dr. Peter Kurtz, Medical Coordinator for the Food and Agriculture Department, said, "There is presently no scientifically validated

2,4-D

information which suggests an imminent hazard to health exists, or which warrents additional restrictions of 2,4-D". The Department's "continuing review of the toxicology of 2,4-D has led to the conclusion that: 1)there is no evidence that 2,4-D formulations contain toxic

2,4-D will not accumulate in the soil from year to year

byproducts, 2) the acute toxicity of 2,4-D is relatively low, 3) scientific consensus does not support a current conclusion that 2,4-D is either a carcinogen or a teratogen, 4) mutagenicity testing of 2,4-D has been inconsistent".

In 1980 the EPA completed an exhaustive study of the research on 2,4-D. Its news release of April 29, 1980 says, "Based on the results of this review, EPA has concluded that (a) the presently available information on the potential adverse health effects of 2,4-D does not support a regulatory action to remove 2,4-D products from the market, (b) the information from scientifically valid studies does not indicate that the continued use of 2,4-D poses an imminent hazard or unreasonable adverse effect when used according to label precautions and directions".

THE FATE OF 2,4-D IN THE SOIL AND IN THE HUMAN BODY: WHAT HAPPENS AND HOW FAST?

The public has a legitimate right to know what happens to the 2,4-D that is applied to their home lawns, and if the chemical will stay in the body of someone who is accidentally exposed to it. There has been considerable research on both questions, and the answers are clear.

The Herbicide Handbook of the Weed Science Society of America indicates that 2,4-D can be expected to persist for one to four weeks in warm, moist soil. 2,4-D will not accumulate in the soil from year to year if it is used where conditions are favorable for plant growth, i.e. reasonable rainfall and normal temperatures.

2,4-D is degraded in soil by photodecomposition and by a variety of microorganisms. These microorganisms are able to metabolize the chemical, and reduce it to water, carbon dioxide, and chlorine. When used at label rates, there will normally be one to two parts per million of 2,4-D in the soil immediately following application. That amount will be reduced by ½ within a matter of days, under normal conditions.

Research also shows that 2,4-D does not persist in plant tissues. One study found that 75% of a sublethal dose disappeared from cucumber plants within 24 hours. Another report indicates that 90% of the 2,4-D applied to weeds in a pasture had been broken down into harmless metabolites within 13 days. It is also important to note that 2,4-D breaks down and disappears from dead plants rapidly.

2,4-D similarly does not persist in the human body. Research with human volunteers, who were given oral dosages or who had 2,4-D applied to their skin, clearly showed that the chemical does not undergo any metabolic changes, and is rapidly excreted in the urine. A report in "Toxicology and Applied Pharmacology" in 1976 indicates that more than 95% of an oral dose of 2,4-D was excreted by the human subjects. This is significant because, in human studies, excretion of 90% of a chemical is considered complete recovery. Another study, which utilized radioactive 2,4-D, found that 100% of an intravenous dose and 5.8%

2,4-D does not persist in plant tissues

of a dermal (skin) dose was excreted in the urine within 120 hours. This again confirms that 2,4-D does not persist in the human body, is rapidly excreted in the urine, and is apparently not readily absorbed through the skin.

THE OPPOSITION: WHAT ABOUT RUTH SHEARER, HALTS, AND THE CANADIAN CASE?

Opponents of 2,4-D typically cite three or four situations as "proof" that the chemical should be banned, while neglecting to mention the hundreds of studies and the 37 years of "real life" experience which clearly demonstrate the safety of the product.

Three of the most frequently discussed cases include one portion of the brochure, "Literature Reviews of Four Selected Herbicides: 2,4-D, Dichlobenil, Diquat, and Endothal", written by Ruth Shearer for the city of Seattle; the California Hazard Alert System report; and the Canadian government's recent action in banning the butyl ester formulation of 2,4-D. Unfortunately, those opposed to the chemical either don't know or don't tell all of the facts surrounding these cases.

If one takes the time to read the studies referred to in Ms. Shearer's brochure, it becomes apparent that there is a remarkable lack of objectivity on the author's part. By quoting only carefully selected portions of the original articles, Ms. Shearer has created an unrealistic impression of the research. A few examples should demonstrate the quality of the Seattle review.

Ms. Shearer summarized Palmer and Radeleff's 1964 study of the toxicity of selected fungicides and herbicides on sheep and cattle by pointing out that some of the subjects died after 5 to 34 daily doses of 2,4-D. However, she neglects to mention the size of the doses, which varied from 200 to 500 mg/kg. Ms. Shearer also doesn't mention that no adverse effects were seen in sheep after 481 doses of 100 mg/kg, and that no problems developed in cattle after 112 daily doses of 50 mg/kg. What Palmer and Radeleff really said about 2,4-D in their study was, "The remarkable tolerance of 481 daily doses, each of 100 mg/kg, by sheep indicates that there is little probability of acute poisoning in normal application of the compound."

In reviewing a 1972 study by Huston, Ms. Shearer points out that the primary contaminants of 2,4-D are bis (2,6 dichlorophenoxy) methane; 2,2,4,6-tetrachlorodiphenoxy-methane; and bis (2,4 dichlorophenoxy) methane. She does *not* say that these contaminants were found in very small concentrations: 1,10 and 30 parts per million respectively. Interestingly enough, Huston's original report says, "However, from a study of the teratogenic effects of both production grade 2,4-D and purified 2,4-D, it appears that (these) compounds have no adverse effects at the levels administered in this investigation". Furthermore, Ms. Shearer does not mention that the EPA's proposed guidelines (May, 1980) don't even require the identification of impurities that may occur in quantities less than 1000 parts per million.

2,4-D does not persist in the human body

One additional example should illustrate the thrust of Ms. Shearer's review. While discussing a 1959 study of skin tumors in mice, Ms. Shearer indicates that a 20% solution of 2,4-dichlorophenol caused skin cancer after only one initiating dose of dimethylbenzanthracene (DMBA). Predictably, Ms. Shearer doesn't mention that DMBA is itself a well-known cause of skin cancer. Furthermore, as mentioned above, 2,4-D is not metabolized into 2,4-dichlorophenol in man. Up to 95% of the chemical is excreted in the urine, unchanged from the original acid. Therefore, raising the fear that 2,4-dichlorophenol may be toxic in man seems to totally disregard the metabolic facts of the matter.

Unfortunately Ms. Shearer's review will continue to be quoted by opponents of 2,4-D. As most people don't have the scientific background or the time to delve into the accuracy of the Seattle review, it will remain an important part of the campaign to to ban 2,4-D.

A second report given a lot of attention by the anti-2,4-D forces is that of the Hazard Alert group in the California Dept. of Health Services. The facts of this particular situation are extremely interesting, and should be understood by everyone.

A young man, named Richard Overholt, was employed in 1979 in a so-called "hack and squirt" project in California. This work consisted of making hack marks in hardwood timber and squirting in a few drops of Tordon 101R, a combination of 2,4-D and Picloram. According to the testimony of fellow workers, Overholt disregarded safety procedures and regularly made his hack marks at eye level, rather than at chest height. He also, according to testimony, regularly smoked marijuana before and during work hours. Despite orders from his supervisor, Overholt continued to make hack marks too high and, as a result, inadvertently squirted a drop or two of Tordon in his mouth. Approximately one week later, he noticed a weakness in his feet and legs. Later he developed a stiffness in his back and arms, and was unable to walk without assistance. Overholt spent about three weeks in the hospital during which

2,4-D

time doctors debated whether he had a viral infection, known as Guillain-Barre syndrome, or if he was suffering nerve damage from the herbicides. In December of 1979, a doctor in the Northern California Occupational Health Center issued a written opinion that Overholt had indeed suffered a 2,4-D induced neuropathy.

On the basis of that opinion and the reports of six similar situations in the past 37 years, the Hazard Alert group issued a warning that 2,4-D may cause nerve damage, as well as cancer or birth defects. The day after the warning appeared in the Los Angeles Times, Marc Lappe, the Chief of Hazard Alert System, wrote a letter to the editor of that paper. In his letter, he said that he wanted to "correct an erroneous impression left by the article that the Hazard Alert System has, in fact, issued a Hazard Alert on the herbicide 2,4-D." Lappe's letter continues, "2,4-D has been shown to adversely affect animal (rodent) fetuses in some animal tests but only at high doses. With regard to 2,4-D's ability to cause cancer, animal tests are suggestive but *inconclusive*. There is no data at this time that warrants calling 2,4-D a carcinogin, in animals or in humans."

Approximately one week after the article on 2,4-D appeared in the Los Angeles Times, Richard Rominger, the Director of the California Department of Food and Agriculture, issued a news release in which he says that "neither he nor his staff agree with the recently released recommendations from the Hazard Alert group. . . that possible hazards from the herbicide 2,4-D require further restrictions on its use." The Director said further that, "(the Health Services' conclusion) differ significantly from the consensus reached independently by the EPA and the Dept. of Food and Agriculture after subjecting the same information to a multi-disciplinary scientific review".

Rominger stated that, "The occurrence of nerve abnormalities is not an unfamiliar event in medicine. Considering the overall incidence of such problems and the relatively widespread use of 2,4-D, (the seven reported cases in the past 37 years) could be due to chance alone."

The statement ends with Rominger

A communications network should be set up

stressing that "the evidence for carcinogenicity, neurotoxicity, teratongenicity, and mutagenicity does not support the conclusions reached by the Dept. of Health Services (Hazard Alert Group)."

The third situation commonly discussed by those interested in banning 2,4-D is that which is now occurring in Canada. As mentioned above, the Canadian government is concerned because dioxins of a low order of toxicity have been found in the butyl ester formulation of 2,4-D *produced in Canada.* This situation should really have no effect on the American lawn care industry because the butyl ester formulation would not be used on home lawns in the first place and because U.S. producers of 2,4-D do not use the same manufacturing process employed by the Canadian producer of 2,4-D esters. The situation is then uniquely Canadian, and should in no way be used as evidence that the amine formulations of 2,4-D, produced in the United States, are dangerous.

MORE INFORMATION: WHERE TO GET IT, WHAT TO DO WITH IT

The events which have recently occurred in Michigan are likely to be repeated in other states as anti-2,4-D activists gain the attention of the media and the state legislators. For this reason, it is critical that individuals who support the continued use of 2,4-D become more knowledgeable. An excellent publication, entitled "Public Concerns About 2,4-D", has been written by Dr. Wendell Mullison. It includes a bibliography of 134 2,4-D studies with which the concerned reader may want to become familiar. This publication is available, free of charge, from Dow Chemical U.S.A., Agricultural Products Dept., Box 1706, Midland, Michigan, 48640. Dow can also provide a copy of the Hazard Alert System report, as well as the transcripts of the "hack and squirt" incident.

It is suggested that the reader make this information available to his state representatives and to members of the media. 2,4-D committees should be formed by lawn care associations, both at the state and national level. A communications network should be set up so that information can be shared quickly and completely. Other concerned individuals such as golf course superintendents, landscapers, parks and forestry personnel, and university professors should be contacted.

While many people have decided that 2,4-D is no longer in danger from the EPA, it is important to keep in mind that the lawn care industry could very well lose this herbicide at the state level, one state at a time.

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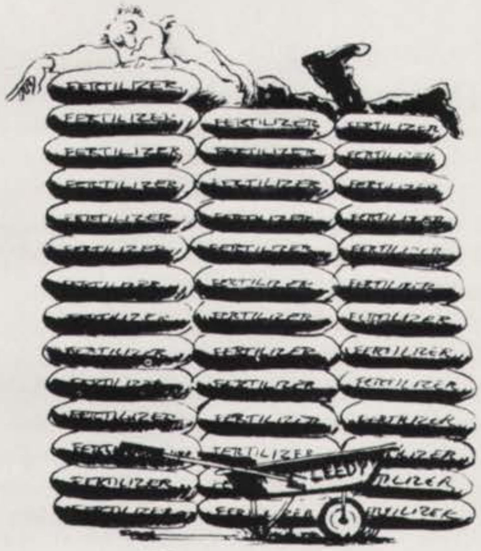

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Part 1
Southern Chinch Bug in Louisiana

by A. D. Oliver and K. N. Komblas, Louisiana State University Entomology Department

INTRODUCTION AND BRIEF HISTORY

The southern chinch bug, Blissus insularis Barber, (Hemiptera: Lygaeidae) (Fig. 1) is the most injurious insect pest of St. Augustine grass in Louisiana and probably in other gulf coast states.

Chinch bugs were first recorded in the United States as economic pests in 1783 in Orange County, North Carolina. Beyer (1924) surmised that from this infestation it spread each year until it covered practically the entire eastern half of the United States, including the Mississippi Valley.

The earliest record of the chinch bug in St. Augustine grass (Stenotaphrum secundatum (Walt.) Kuntze) was that reported by Newell and Berger (1922) in Florida. They observed the insect at the base of grass near the perimeter of dead brown areas in lawns. It was considered to be the same species which attacked cereals, Blissus insularis (Say) Today it is known as the southern chinch bug, Blissus insularis Barber. Barber (1918) identified a chinch bug, B. leucopterus insularis Barber, from material collected along the coastal strip of Florida and from San Juan, Puerto Rico, in wild grass. The specimens from Florida were short-winged forms, while the ones from Puerto Rico were both short-winged and long-winged forms.

In southeastern Florida, Schwarz (1888) found chinch bugs occurring in large numbers on the upper parts of an ornamental grass, Uniola paniculata L, commonly known as "Sea-oats." All the specimens he examined were short-winged. Barber (1918) thought that those specimens belonged to the sub-species B. leucopterus insularis.

Beyer (1924) observed that the chinch bug had become a serious pest in Florida because of its feeding upon St. Augustine grass which had been generally adopted as a lawn grass over the entire state. This is so for the gulf south today. Wilson (1929) also found it causing serious injury each year to St. Augustine grass in the central and southern part of Florida but noted little injury to grasses in other southern states, Cuba or Puerto Rico. Though he considered it to be B. leucopterus, he observed that no other cultivated plant was seriously attacked in the territory where injury to St. Augustine grass was severe.

Chinch bug feeding prevented normal growth

Felt (1933) reported B. leucopterus as causing serious injury to lawns in southeastern New England, western Long Island, northern New Jersey and in the vicinity of New York City. The lawns became badly spotted with brown areas. Walden (1936) found the hairy chinch bug, B. leucopterus hirtus Montandon, attacking lawns in Connecticut. Maxwell and MacLeod (1936) found chinch bugs identified as B. leucopterus hirtus infesting 19 different varieties of lawn grasses. Hamilton (1935) reported the chinch bug, B. leucopterus, as a pest of lawns and golf courses in the eastern United States. Pickles

Figure 1: Life stages of the southern chinch bug, Blissus insularis Barber. Lower-left to right: First, second, third and fourth instar nymphs. Upper left to right: short- and long winged adults and fifth instar nymphs.

(1940) referred to the species, B. insularis Barber, as a lawn pest in Trinidad, especially of Savanna grass (Axonopus compressus "Swartz" Beauv.). The description of injury was similar to that caused in St. Augustine grass.

Kuitert and Nutter (1952) were the first to distinguish the lawn chinch bug in St. Augustine grass as B. leucopterus insularis (now B. insularis Barber).

Several infested areas might fuse

Kerr (1956) believed that the form of the lawn chinch bug found in Florida had been elevated to species status because in addition to morphological considerations, B. insularis was not a pest of corn or other grains in Florida. Kelsheimer and Kerr (1957) found the chinch bug in Florida severly attacking torpedo grass (Panicum repens L.) and occurring occasionally on centipede grass (Eremochroa ophiuroides "Munto" Hack) and rarely on Bermuda grass (Cynodon dactylon (L.) Pers.). Eden and Self (1960) reported the southern chinch bug to be a serious pest of St. Augustine grass in Alabama. Severely infested lawns had an odor that could be detected by walking across them. Stringfellow and Roussel (1960) found the southern chinch bug in devastating numbers in Louisiana St. Augustine grass lawns. Komblas (1962) is credited with conducting the most intensive research on southern chinch bug biology in Louisiana to this date. His findings were used in preparing this manuscript.

DESCRIPTION OF DAMAGE

In Florida, according to Beyer (1924), the lawn chinch bug in St. Augustine grass implanted itself under the laterals of the close fitting leaves. As it fed, it imparted a reddish stain to the plant parts attacked and caused death of the cells. He also believed that the chinch bug feeding prevented normal growth and brought about a dwarfed condition of the plants and that it thrived best when the plants were most tender and succulent, usually from late fall to early spring.

Watson (1925) described the grass of an infested lawn as turning brown in patches which might die out completely. He found that around a dead brown spot would be a circular marginal area where the grass had turned yellow in which the bugs were found feeding. He also reported that the insect did its damage by sucking the juices from the plant.

Wilson (1929) called the injury of grass "dieback" because of the progressive nature of an infestation. He reported that several infested areas might be found in a lawn and that these areas would gradually fuse. He described the type of injury caused by the chinch bug and ascribed its destructiveness to its gregarious feeding habits by which it drained the juices of the plants until they withered. Also, that lawns growing in dry, sandy, or shell soils usually showed damage first, probably because they did not retain moisture and were therefore least able to withstand the stress from an attack. He observed that the injury might occur at any time from May to November. However, injury was most evident during dry weather, because the dryness lowered the vitality

Fig. 2: Typical characteristic of St. Augustine grass resulting from southern chinch bug injury.

Southern Chinch Bugs

of the plants and favored the rapid multiplication of the bugs. Hamilton (1935) believed that the chinch bug caused injury to lawns by sucking out the plant juices and possibly by the injection of a toxin into the stems.

The typical southern chinch bug infestation in Louisiana St. Augustine grass results in asymetrical dead area of turf (Fig. 2). On fairly level terrain, highest bug populations develop in the higher and best drained areas of the lawn. Populations of up to 300 bugs per square foot develop some years, especially in the drier summer season. Such populations cause extensive loss of turf in lawns.

Turf which is properly managed, fertilized and watered survives moderately heavy bug populations. Frequently, incorrect identification of the causative agent responsible for killing the grass is made. Brown patch (Fig. 3) a disease caused by a fungus pathogen is often referred to as chinch bug injury. This disease infects and kills St. Augustine grass in a more definite circular or half-circle pattern which is unlike chinch bug injury. Chinch bugs kill grass in a ragged indefinite pattern. Brown patch also is usually more prevalent during cool and wet weather whereas chinch bug injury is most likely to appear during hot and dry weather.

Fig. 3: Brown patch disease of St. Augustine grass. Unfortunately some people refer to this as chinch bug injury.

CHINCH BUG LIFE HISTORY

Beyer (1924) found that female chinch bugs laid eggs in the soil near the roots of the grass and that a single female could lay 105 to 250 eggs. He distinguished six developmental stages for the nymphs and at least two annual generations, with an overlapping which might prove to be a third generation, during summer in Florida. Wilson (1929) reported that in Florida during the summer, eggs hatched in 9 to 13 days, while the nymphs required an average of 30 days to reach maturity and molted four times before becoming adults. He stated that the pre-oviposition period ranged from 5 to 13 days, the average being 8 days. Thus he confirmed that it was possible in Florida for the lawn chinch bug to have five or more generations a year. He believed that the egg laying period extended over a considerable period of time, that generations overlap and that even in the spring adults and all nymphal stages might be found together.

Damage is most likely to appear in hot, dry weather

Kuitert and Nutter (1952) found that under favorable conditions in Florida the chinch bug had a life cycle of 45 days from egg to egg, that the eggs hatched in 7 to 11 days, and the nymphal period averaged 28 days. Eden and Self (1960) stated that lawn chinch bugs mated in the spring after winter hibernation and then laid eggs. These eggs hatched in about 2 weeks and the nymphs required 30 days to reach maturity. The adult females began to lay eggs in 7 to 10 days. The total life cycle was 7 to 8 weeks. They reported that two or more generations per year occurred in Mobile, Alabama and that generations overlapped to such an extent that all forms were present after early summer.

HIBERNATION

In northern Florida, Wilson (1929) found that the chinch bug hibernated with the approach of cold weather. Spring infestations often started where the injury stopped the preceding year.

Kuitert and Nutter (1952) reported that in Florida during the cold periods of winter both adults and nymphs might become dormant temporarily, but they did not truly hibernate. Brogdon and Kerr (1958) believed that adults sometimes hibernated in winter in northern Florida. Eden and Self (1960) found that the lawn chinch bug hibernated in the mulch around ornamental plants but moved out into the grass by early June.

OCCURRENCE OF THE SHORT- AND LONG-WINGED FORMS

Van Duzee (1886) found that the chinch bug short-winged form ordinarily predominated except in hot, dry summers when mostly long-winged forms prevailed. He believed that the chinch bug was a tropical long-winged species. Webster (1907) stated that both long- and short-winged forms intermixed along the seacoasts and in the northern section of the United States. Wilson (1929) described two forms of the adult lawn chinch bug as the short-winged and the long-winged in St. Augustine grass in Florida and found them varying in relative numbers during the year.

SEASONAL HISTORY OF THE SOUTHERN CHINCH BUG IN LOUISIANA

The occurrence of the several generations in Louisiana during the year was determined by studying the following stages in the populations of southern chinch bugs found in the field: (1) each of the 5 nymphal instars, (2) the adults, (3) the females with developed eggs, (4) the females with sperm in spermatheca that represent mated females, and (5) the long-winged adults.

Females predominated from late September to early May representing an average of about 62 per cent of the population. Males predominated from early May to late September. During this period females represented an average of about 44 per cent of the population.

4 peaks in population occur regularly during the year

Data obtained suggest that 3 full and a partial fourth generation of the southern chinch bug develops annually in St. Augustine grass at Baton Rouge. All stages of the chinch bug are present during the whole year except during the brief period of time at the end of the winter months. The first instar nymphs population was low during winter months and disappeared completely during March.

The number of first instar nymphs found during winter indicated that possibly some of the adults oviposited during warm days of that season. The percentage of the various nymphal instars collected proved that 4 peaks in the population occurred regularly during the year, indicating 4 progressively developed generations. An overlapping in occurrence of the various nymphal instars was found in all generations. Only the first nymphal instar in spring appeared at a time when practically no other nymphal instars were present.

The successive percentage maxima of the second, third, fourth, and fifth nymphal instars from fall to spring indicated the progressive development of the fourth generation. The first instar nymphs which hatched early in fall developed to adults by the end of the winter months.

The adults appeared to be in peak numbers during the first week of October, and March, June, and August. This indicated that the fourth generation developed in 174 days, the first in 93 days, the second in 56 days, and the third in 62 days. The adults that appeared during the fall were believed to belong to the third generation. The fall adults appeared in two peaks, one during the first week of October and a second during the first week of November. The second peak is attributed to the fact that many of the adults that failed to produce eggs survived during the fall, and their population increased again because new adults from the nymphs developed late in the season were added to this population. Probably some adults developing from eggs of the fourth generation deposited in early September may be included in it. It is very probable that the adults produced early in September gave rise to the fourth generation which developed during the winter months.

It was evident that many of the adults which appeared in late fall survived the winter and together with the adults of the fourth generation gave rise to the first generation in the spring. This is likely since the percentage in the fifth nymphal instar was generally low during the winter and would not account for the continuously high concentration of adults during the winter period.

The females with fully mature eggs appeared in greatest concentration 42, 26, and 17 days after peak numbers of adults of the fourth, the first, and the second generations appeared, respectively. The peak population of females with sperm appeared concurrently with the peak of females with matured eggs. The

Table 1. Incubation period of the southern chinch bug eggs. Baton Rouge, Louisiana.

Generation	Date of Deposition	Incubation Period		
		Number of eggs	Average in Days	Range in Days
First	4/2 - 4/7	89	28.76	25 - 33
Second	5/31 - 6/12	112	15.21	11 - 21
Third Short-Winged	7/30 - 8/30	293	14.26	12 - 19
Third Long-Winged	8/8 - 9/5	78	15.14	13 - 21

population of females with sperm appeared, at a minimum, 5 to 7 days after the low peak in the population of adults.

The activity of the lawn chinch bug observed during winter contradicts the observations of some workers who found chinch bugs present during the winter only as adults in hibernation. It agrees with the observations of Kuitert and Nutter (1952) who found the lawn chinch bugs temporarily hibernating only on cold winter days in northern Florida. The very slow development of nymphs during winter in Baton Rouge might be due to a temporary hibernation, but it appears apparent that most adults hibernated during winter in Baton Rouge, since they failed to produce a new generation before spring.

There is divergent opinions in published data on the number of generations of the southern chinch bug in St. Augustine grass. Wilson (1929) estimated that it is possible for the chinch bug in Florida to have 5 generations while Eden and Self (1960) reported 2 or more generations in Mobile.

A considerable reduction in the total population occurred in Louisiana during the winter months as indicated by comparison of bugs collected per square foot of 81.8 on October 3, 6.7 on February 7, and 13.2 on March 21. Much of this decrease is attributed to natural mortality of the southern chinch bug during the winter months. Decker and Andre (1937) stated that chinch bug mortality during hibernation in grass was as low as 20% to as high as 88%.

The population increased with the appearance of first instar nymphs but decreased after a few weeks in all generations except the first. Examinations indicated that the decrease of the population occurred during the developmental period of the first, second or third nymphal instars and that it was independent of the natural mortality of the adults.

Mortality during hibernation was as low as 20% to as high as 88%

EGGS DEPOSITION AND INCUBATION

The eggs were normally found between the leaf sheath and the stem and occasionally on the roots, the stem, and the leaves of grass. The eggs were usually laid singly, but in some cases, two or three were found together. These small groups of eggs were found between the stem and the leaf sheath. Field collected adults were used for deposition of eggs to determine the incubation period. Eggs were deposited one to 17 days after adults were collected.

The incubation period of the first generation eggs ranged from 25 to 33 days, the average being 28.76 plus or minus 0.22 days. The corresponding monthly average temperature was 62.7° F. Wilson (1929) and Eden and Self (1960) stated that the incubation period of the chinch bug in St. Augustine grass was about 2 weeks. James and Hager (1936) found that the chinch bug egg hatched in approximately 30 days at 67.1° F.

In the third generation eggs laid by short- and long-winged females were studied separately. The average egg incubation period of short-winged females was 14.26 plus or minus 0.07 days and of the long-winged form, 15.14 plus or minus 0.18 days. This slight difference obtained was due to the later start of oviposition in the long-winged form. Data on incubation periods are shown in Table 1.

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This article will be continued in the next issue of A.L.A.

Pests of Three Types of Turfgrass in Florida

by H. L. Cromroy and D. E. Short

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Three common grasses in the state of Florida are St. Augustine, Bermuda and Bahia. In Table 1 we have indicated the use of these three grasses in three common situations and the total acreage maintained as indicated by the Florida Turfgrass Survey of 1974. At that time approximately 911,374 acres were planted in turf. We believe this figure has increased substantially, especially with the increase in the number of golf courses in the state of Florida. The grasses selected were done so on the basis of research done and number of inquiries especially from lawn applicators and homeowners. Currently the most popular and commonly planted lawngrass in Florida is St. Augustinegrass (Stenotaphrum secundatum). The most commonly used grass on golf courses is Bermuda (Cynodon dactylon). This paper will be concerned with five pests— Bermudagrass mites, Banks grass mites, white grubs, chinch bugs and mole crickets.

BERMUDAGRASS MITE (ACERIA CYNODONIENSIS)

The Bermudagrass mite is sometimes a serious pest of Bermudagrass throughout Florida. Generally speaking, the most severe damage occurs to the coarser varieties of Bermuda, like common and Ormond. These are extremely small mites only about 1/125 inch long, yellowish-white in color and somewhat wormlike in shape. To really inspect grass one needs a very strong hand lens or a microscope to see them. A recent article in the magazine of Golf Course Superintendents of Florida indicated that approximately 6-9 thousand dollars a year can be spent for pesticides in control of this mite. Figures 1 and 2 are scanning electron microscope pictures of the mite and indicate what it looks like under extremely high magnification. The mite is unique in that it has only two pairs of legs. Because of the difficulty of spotting this very small mite on the grass one must learn to recognize the symptomology of the mite damage in order to determine whether the mite is present or not. The mites tend to localize between the stem and sheath of the grass blade and their feeding causes the distance between the grass nodes to shorten. Figure 3 shows the types of damage seen from the initial phase to later stage damage. It can be noticed that the initial symptoms are a lightening of the color of the grass and then an abnormal growth pattern. The shortening of the internodes and the grass stems causes the grass to be very short and tufted so that small clumps are noticed. In fact, in a heavily infested grass, one can run one's hand over the grass and feel the little knots produced by these cabbage heads as a result of the shortened internodes. The grass will loose its vigor, thin out and become killed. Generally speaking, the injury is more pronounced during dry weather and especially when the grass is stressed through poor maintenance. Our observations in the field have indicated that whenever there is a secondary stress of any type, effects of the Bermudagrass mite feeding will be greatly enhanced. Therefore, liberal irrigation and fertilization will help infested grass improve its appearance.

TABLE 1. -- Turf Area in Acres Maintained by Dominant grass.*

	Bahia	Bermuda	St. Augustine
Home	212,542	4,836	270,456
Golf Course	394	33,898	94
Schools	24,148	137	1,716

* *For year 1974 - Total turf area maintained 911,374 acres from Florida Turfgrass Survey, 1974.*

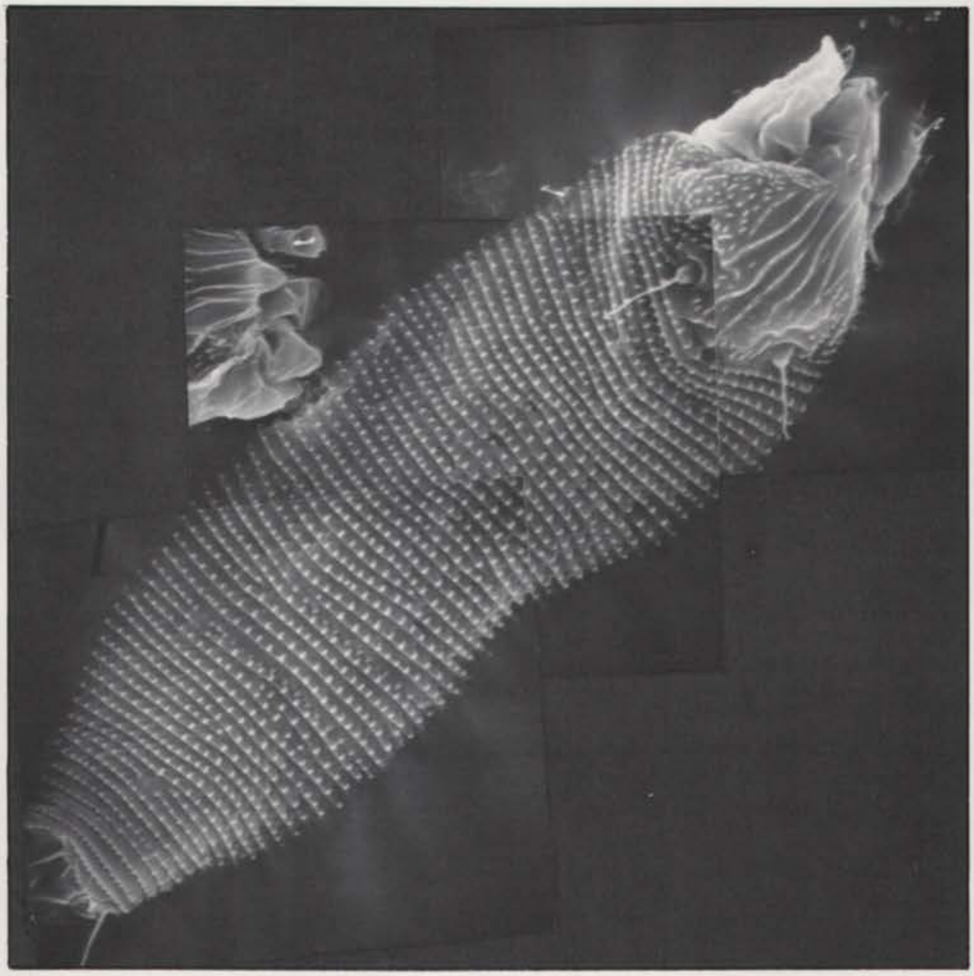


Figure 1: Bermudagrass mite at 1088x magnification.

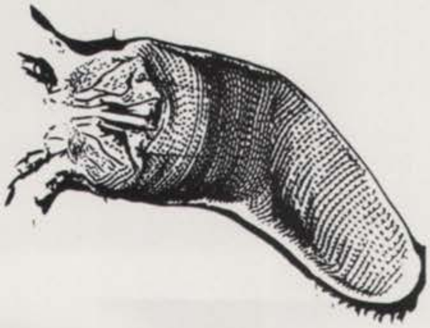


Figure 2: Bermudagrass mite at approximately 3200x magnification, showing 2 pairs of legs.

Figure 3: Stages of damage to common Bermuda produced by Bermudagrass mite.

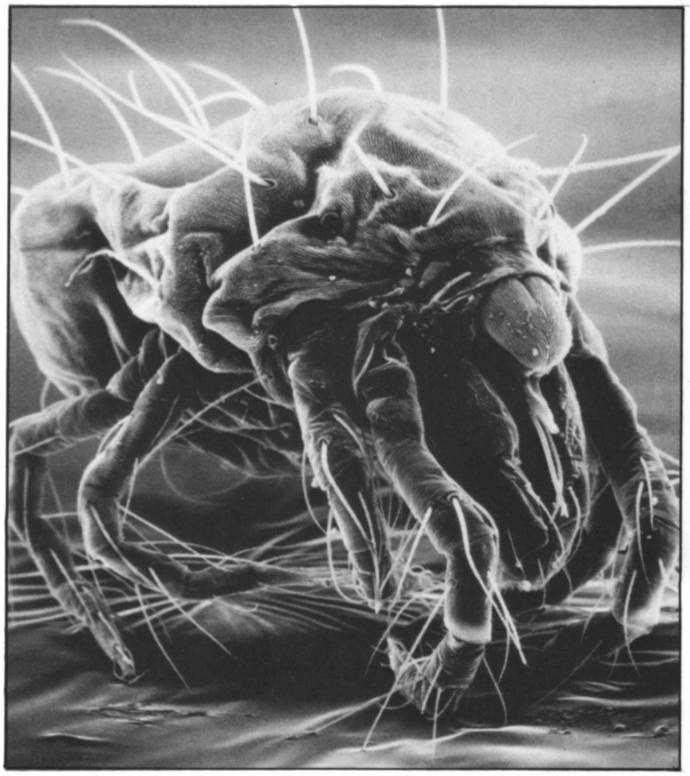
Pests of Florida Turf

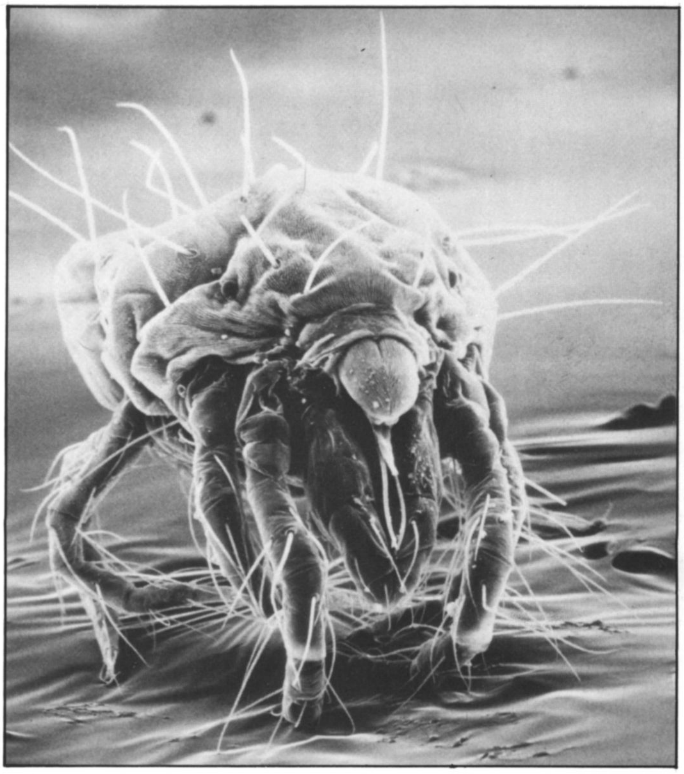
Our recommendations for control therefore, include both cultural and chemical practices. We recommend that all areas of Bermudagrass be mowed as close as possible where the infestation is and that all clippings be destroyed. One of the easiest ways of reinfesting new grass is to spread the clippings around. Our current chemical recommendation is diazinon spray, applied at the rate of 4 lbs ai per acre. We believe a wetting agent in the spray mixture will improve the results since this will help break the surface tension between the grass blade and the stem and allow penetration of the pesticide to the mite. A second application is recommended within one week. We are now testing several new acaricides and will be testing the new Abbott formulation of mycar, which is a biological control agent for this mite. Recent work by Dr. Cromroy and J.A. Reinert of Ft. Lauderdale AREC indicate that the mole cricket may inadvertently be carrying the Bermudagrass mite and be spreading it on its flights and migration from one area to another.

BANKS GRASS MITE (OLIGONYCHUS "RECKIELLA" PRATENSIS)

This mite has been reported as an economic pest of wheat, corn sugarcane, sorghum, dates, bluegrass and Bermudagrass. However, this spider mite has become a pest of St. Augustinegrass in Florida. These mites are smaller than the average-size spider mites. The adult mites are deep green with a very light salmon color over the palpi and the first pair of legs. The green color makes it very difficult to detect in St. Augustinegrass. The average length of the life cycle varies from 8 to 25 days, depending on the temperature, and life span of the adult averages 23 days. Figures 4 and 5 are scanning electron microscope pictures of the Banks grass mite and the common two spotted spider mite to illustrate the morphological differences.

The symptomology of damage observed in Florida has been a stipling produced by the mite's feeding. The stipling effects on the leaves can be confused with either mildew or St. Augustine





Figures 4 & 5: Scanning electron microscope pictures of Banks grass mite.

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CITY____________________ STATE ____________________ ZIP____________________ decline, a viral disease. Reports in other parts of the country have indicated that the most serious damage normally occurs in water stressed areas; thus, it is believed that lawngrasses which are irrigated usually are not attacked. Because of the small size of the mite, it is recommended that if an infestation is suspected, a sample of grass be sent in to an Extension expert to examine under a scope. We are currently testing a series of acaricides to determine which will be the most effective for the control of this mite.

WHITE GRUBS (BOTHYNIS, STRATEGUS, CYCLOCEPHALA AND PHYLLOPHAGA)

White grubs which are the immature stages of beetles are fat grubs which lie in "C" shaped positions (Fig. 6). They are whitish in color with darkened areas at the rear and have brownish heads. The adults lay their eggs in the soil and the grubs live in the soil and feed on the roots. Depending on the species, the life cycle may take from one to four years to complete. To determine whether white grubs are present, cut 2 sides of a foot square of sod about 2 inches deep with a spade at the edge of one of the off-color areas. Push the spade under the sod and lay it back; examine the grass roots for grub damage and sift through the soil observing for any grubs present. As a rule of thumb, if an average of three or more grubs are found per square foot of soil apply a pesticide.

White grubs are not only a pest by themselves but serve as an attractant for nuisance animals, especially in the rural urban areas and on golf courses which are isolated. Rodents of all types come in and rip through the grass looking for the grubs to feed on. In fact, in some areas, the damage done by the armadillo is much more intense than the damage by white grubs. In south Florida the major pest species apparently is Cyclocephala, as reported by the entomologist at Ft. Lauderdale, Dr. Reinert. Recommended State of Florida control is diazinon at 5 lbs ai per acre.

SOUTHERN CHINCH BUG (BLISSUS INSULARIS)

Southern chinch bugs (Fig. 7) are the most important pest of St. Augustinegrass in Florida. Adult chinch bugs are about 1/5 inch long, black with white patches on their wings. Nymphs are 1/20 inch long to nearly adult size. Young nymphs are reddish with a white band across the top of their abdomen, and they gradually become black as they near adult size. Chinch bugs have three generations in north Florida and seven to 10 in south Florida.

Figure 6: Photograph of white grub and adult beetle.

Figure 7: Southern Chinch bugs. Adult on left, nymphs on right.

Figure 8: Chinch bug damage.

Pests in Florida Turf

Grass damage is due to withdrawn of plant sap by their piercing-sucking mouthparts. Chinch bugs apparently cause other internal injury to the grass, resulting in yellowish to brownish areas in the turf area (Fig. 8). These injured areas are frequently first noticed along sidewalks, driveways or in water stressed areas where the grass is growing in full sun. Often whole lawns or entire street blocks may be severely damaged or "killed out" by the feeding of the southern chinch bug. It has been estimated that this insect is second only to the citrus rust mite in amount of money spent for control measures in Florida; more than 25 million dollars annually.

When chinch bugs are present in sufficient numbers to cause yellow or brown areas (15-20/sq. ft.) they can be found by parting the grass at the margins of the off-color areas and observing the soil surface. Another effective survey method to use is the soapy water flush. Mix one fl. oz. of dishwashing soap in a 2 gallon sprinkling can full of water and drench four sq. ft. with this solution. Observe the area for about two minutes. If chinch bugs are present, they will emerge to the grass surface and can be detected.

Cultural practices are extremely important in combating chinch bugs. Rapid, succulent growth, resulting from frequent or high applications of water soluble inorganic fertilizers, acts as an attractant and substantially increases the chances of chinch bug attack. Incidence of damage from these pests can be greatly reduced with applications of minimal amounts of slow release nitrogen fertilizers, in combination with other macro and minor elements.

Improper mowing and excessive water or fertilization can cause St. Augustinegrass to develop a thick, spongy mat of runners and undercomposed clippings above the soil surface. This spongy mat, referred to as thatch, is an excellent habitat for chinch bugs. Thatch also chemically ties up insecticides, therefore reducing control. Proper mowing practices can make the grass more tolerant to chinch bugs and greatly reduce thatch build-up. St. Augustinegrass should be mowed at a height of 3 inches and 4 inches in shaded areas. Chance of a thatch problem is reduced when not more than 1/3 inch of leaf tips is cut at each mowing. However, if the lawn is not mowed frequently enough, excessive clippings can contribute to a build-up of thatch. In this case, clippings should be removed with a grass catcher on the mower, or by raking, sweeping or with a lawn vacuum. When a serious thatch problem exists, it may be necessary to remove the thatch mechanically (vertical mowing, power raking, etc.).

If a new turf area is being established or an old one replaced, it is suggested that Floratam, a variety of St. Augustinegrass which is resistant to chinch bug feeding, be used. Most chinch bugs cannot complete their development when attempting to feed on this grass.

When chinch bugs reach damaging numbers, suggested insecticides for control include Aspon, Baygon, diazinon or Dursban sprays or granules.

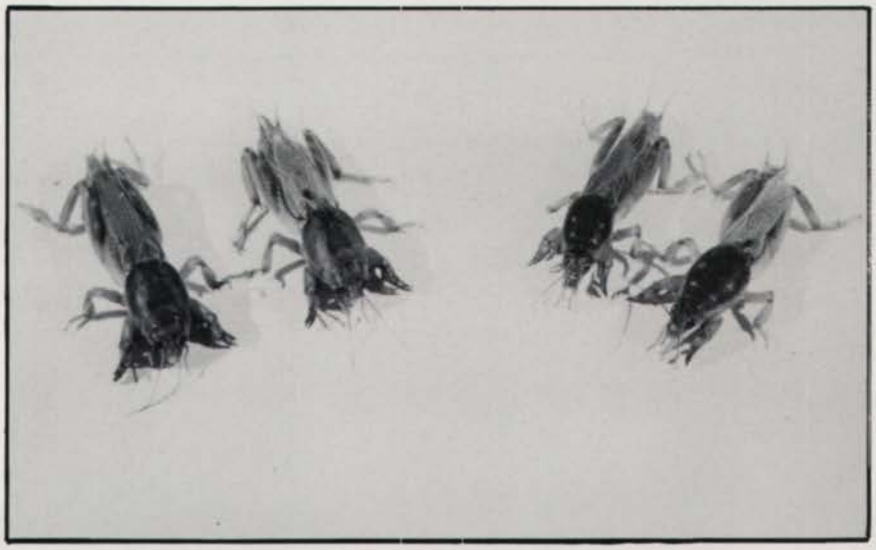

Figure 9: Southern mole crickets on right— Changa mole crickets on left.

MOLE CRICKETS

Two species of mole crickets are prevalent in Florida. The Southern Scapteriscus acletus and the changa (Puerto Rican) S. vicinus (Fig. 9). Their preferred hosts are bahiagrass and bermudagrass. Adults are approximately 1½ inches long, light brown in color and have forelegs which are well adapted for tunnelling through the soil. The southern and the changa mole crickets can be easily distinguished by examining several morphological characteristics. The changa is larger and more robust. The color pattern of the two species is usually distinct; the changa is a lighter creamy brown while the southern is reddish to dark brown. The separation between the 2 tibial dactyls (fingers) on the forelegs is the most commonly used characteristic to separate the two species (Fig. 10). In the changa the dactyls are separated by a space much less than the width of either of them and the space is V-shaped. The space is almost as great as the width of one dactyl on the southern, and it is U-shaped.

Both species are now believed to have been introduced about 1900 into the seaport at Brunswick, Georgia in the ballast material of ships from the Atlantic Coast of South America. Mole crickets have become a serious statewide turf pest in recent years and are considered the most important pest of bahia and one of the most damaging on bermuda.

Mole crickets damage turfgrass in several ways (Fig. 11). They tunnel through the soil near the surface which disturbs the soil so that the grass is often uprooted and dies due to desiccation of the root system. This tunnelling action severs grass roots causing thinning out of the turf and eventually leaves the soil completely bare.

Mole crickets deposit their eggs in chambers hollowed out in the soil. Most chambers are found in the upper 6 inches of the soil, but cool temperatures and/or dry soil result in the chambers being constructed at a greater depth. An average female will excavate 3 to 5 egg chambers and deposit approximately 35 eggs per cell. In north and central Florida, oviposition usually begins in the latter part of March, with peak egg-laying in May through mid June. Approximately 75% of the eggs are laid during these months.

Figure 10: Forelegs of mole crickets: Changa (top) and Southern (bottom).

Figure 11: Mole cricket damage.

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Greenbug Aphids

While we're talking about turf pests, we might as well mention another potential bluegrass pest— the greenbug aphid. This is a funny bug. A few years ago it was tearing up our turf. Last year you could not find an infestation big enough to warrant cranking up the sprayer.

If the greenbug comes to us from the southwest, as some people believe, it may be few and far between again this year. I've been watching greenbug reports from the southwestern states, and up until now they've reported very light infestations. Don't give up yet, though, because there is a lot about this insect that we don't know. It still could be a pest in July and August. Watch for the grass turning a rusty color. Very often this will start from a tree and radiate out.

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