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TURFGRASS AND DICHONDRA PESTS IN SOUTHERN CALIFORNIA

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This article is a revision of the one that was published in the April, 1956, issue of Southern California Turfgrass Culture. Principal changes include the restriction of the control recommendations to southern California, and the inclusion of dichondra pests and a section on nematodes.

Symptions of injury from insects and other pests include rhe following: the grass or dichondra turns brown and dies back in irregular areas or small spots; stunting and retardation of growth; and yellowing, bleaching or drying up of the leaves. These symptoms are also characteristic of other troubles caused by diseases, nematodes, and poor cultural conditions. Therefore the presence of injurious pests should be confirmed before insecticides are applied.

Diagnosis of infestations.- -With both turfgrasses and dichondra, probably the greatest difficulty is recognizing the pest before serious injury has occurred. This is especially important with white grubs in turfgrasses, and with cutworms and the vegetable weevil in dichondra. Also, since no single insecticide will effectively control all the pests that may be encountered, accurate identification is essential. When damage from insects or other pests is suspected, the following procedure is recommended for both turfgrasses and dichondra:

1. Use the pyrethrum test. This will bring sod webworms (lawn moth larvae), cutworms and other caterpillars to the surface within 10 minutes. It will also bring up other pests such as earwigs and leaf bugs but will not show the presence of white grubs or billbugs. It is normal to find a few caterpillars; it is not necessary to apply insecticides unless more than 5 cutworms, 10 skipper larvae or 15 sod webworms per square yard are found.

Pyrethrum test.- -Use one tablespoon of pyrethrum extract to a gallon of water; stir thoroughly and apply at the rate of one gallon per square yard. The mixture should be applied to green areas in and around damaged sections of the lawn. Several areas in the lawn should be tested. Pyrethrum irritates and brings to the surface most pests that may be in grass, including those that are not normally injurious.

2. Examine the soil around the roots for white grubs and the grubs of billbugs. In heavy infestations the grass roots will be eaten away and the turf can be rolled back like a carpet. If more than 3 or 4 grubs per square foot are found the lawn should be treated.

3. Carefully examine the crown, stems and leaves for leafhoppers, scale insects, leaf bugs and spider mites.

4. In areas where growth is sparse or retarded, carefully examine the roots for the tiny galls or nodules of root knot nematodes. See section on nematodes.

Pests that Chew on the leaves, Stems and Crown

Lawn moths.--Sod webworms, the larvae of lawn moths, are the most common pests of turfgrasses. The injurious species are *Crambus sperryellus* Klots and *Crambus bonifatellus* (Hulst). Damage from sod webworms may depend upon a number of factors such as the type of grass, the age and condition of the grass, and the prevalence of the moths in the area. The most susceptible grasses are bent and bluegrasses. A bentgrass lawn kept in good condition may require one or two insecticide treatments every year. Bluegrass is most susceptible the first year. Lawns in new housing developments are almost certain to be damaged by sod webworms and preventive treatments should be considered.

The damage is done by the larvae which feeds on the grass blades, the growing tips and the greener portions of the crown, but not on the roots. The larvae (Fig. 1) are slender, grayish, black-spotted caterpillars about 3/4 of an inch long when full-grown. They feed at night and hide during the day in shelters constructed of bits of grass and debris.

The moths (Fig. 2) are whitish or buff-colored with a wing spread of slightly more than one inch. *Crambus sperryellus* has a white or silver stripe along the margin of the forewings which distinguishes it from *C. bonifatellus*. When at rest the wings are folded close to the body, which gives the moths a characteristic slender appearance. The moths, which hide during the day in the grass or shrubbery, can be seen at dusk flying over the grass. In southern California the moths begin flying in April or May and breed continuously through October. There may be 3 or 4 generations a year with the broods overlapping.

The most serious damage from lawn moth larvae occurs during July, August and September. In the Los Angeles area infestations usually are not heavy enough to require treatment before June or after October.

-Cutworms.- -Cutworms are rather fat-bodied caterpillars ranging in length from one to two inches when full-grown. They are usually dull-colored, greenish, gray,

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brown or blackish and often with spots or longitudinal stripes, They feed on the leaves and crown, and may cut off the plants near the soil. Cutworms feed at night and hide during the day in holes, under debris, or in the mat of organic matter at the surface of the ground. The adults are night-flying moths, mostly dull or somber colored. Only the larvae are injurious.

A number of species are found in turfgrasses and dichondra. In turfgrasses the most common ones appear to be the armyworm, *Pseudaletia unipuncta* (Haw.) (Fig. 3); the granulate cutworm, *Feltia subterranea* (Fab.); and the variegated cutworm, *Peridroma margaritosa* (Haw.). Bent, rye and Bermudagrasses are most likely to be injured.

The most common species of cutworms attacking dichondra appear to be the granulate cutworm and the black cutworm, *Agrotis ypsilon* (Rott.). Damage to dichondra has been severe during the last two or three years, and control has been difficult. This apparently is due to several causes: cutworms are more prevalent in dichondra lawns than previously; they are not discovered until serious damage occurs; when discovered they are nearly fullgrown; and when insecticides are applied often the most effective ones are not used and they are applied against the large larvae which are the most difficult to kill. For these reasons, preventive treatments are suggested in areas where cutworms have been a problem.

Skippers.--The most common skipper found in lawns in the fiery skipper, *Hylephia phylaeus* Drury. Although widespread throughout southern California it is only occasionally injurious. While the larvae will feed on all the common lawn grasses, injury is most likely to occur to bentgrasses.

Larvae of the fiery skipper are about an inch long and brownish yellow in color. They can be readily distinguished from cutworms by the narrow or constricted neck (the first two body segments are smaller in diameter than the head and the remaining body segments - Fig, 4). The adult butterflies have a wing spread of a little more than an inch, the male having orange-yellow wings spotted with black, while the wings of the female are dark brown with orange-yellow spots.

Lucerne moth.- -Caterpillars of the Lucerne moth, *Nomophila noctuella* (D. and S.), seldom cause serious damage to lawns. The caterpillars are similar to sod webworms in appearance, but slightly larger. They prefer clover and other legumes but will feed on grasses in the absence of legumes.

Vegetable weevil. The vegetable weevil, *Listroderes costirostris obliquus* (Klug), has been a pest of increasing importance in dichondra in southern California during the last six years. The grubs (Fig. 5) are small, green, legless larvae about 3/8 of an inch long. They hide in the soil during the day and feed on the foliage at night. Damage so far has occurred only during the winter and early spring, and is accentuated by the fact that growth is slow during this period. The adult weevils (Fig. 6) cannot fly, so infestations usually are localized. When heavy infestations occur, damage is severe and recovery is slow.

Snails and slugs.--Snails and slugs are common pests of dichondra lawns. Control is difficult since there usually is a continual migration of these pests from other areas. Perhaps the most important factor in control is persistence. The common brown garden snail is best controlled with baits; dusts and sprays used by commercial flower growers to control slugs are expensive and not very effective against the brown garden snail.

Pests that Feed on the Roots

White grubs.--White grubs are the larvae of beetles commonly called May beetles or June bugs. Damage from white grubs is quite sporadic, but when heavy infestations occur, it is often necessary to renovate and replant the lawn. A number of species are found in turfgrasses, but in southern California the most common ones are in the genus *Cyclocephala*.

The grubs are about 1 to 1 1/2 inches long when full-grown and are illustrated in Fig. 7. The adult beetles (Fig. 8) are a little over a half-inch in length, yellowish and with a reddish head. These beetles have a one-year life cycle. In the Los Angeles area the adults emerge from the ground in late May and June. The larvae of grubs are approaching maturity by October. Little feeding appears to take place during the winter months or early spring.

Bermuda and rye appear to be the most susceptible grasses although all grasses may be attacked. Damage is most severe during September and October which coincides with the time the grubs are maturing and the slowing-down of the growth of Bermudagrasses. Control of the grubs is slow since the insecticide must be washed down to the root zone. This may take 3 to 6 weeks and may account for reports of the failure of various insecticides to give control.

Billbugs.--The larvae of several species of billbugs (genus *Calendra*, family *Curculionidae)* feed on the roots of grasses and may cause serious damage. They are small, white, legless grubs (Fig. 9) from l/4 to 3/8 inch long when full-grown. The adult weevils (Fig. 10) are small, black beetles with a long snout. Damage is most likely to occur in old lawns and in warm inland areas. As is the case with white grubs, control is slow as the insecticide must be washed down to the root zone. Treatment of the lawn with dichloroethyl ether solution will give an immediate kill of the grubs but has no residual effect. It should be followed by an application of chlordane to prevent reinfestation.

Ground pearls.- -A subterranean scale insect, *Margarodes meridionalis* Morr., infests Bermuda and centipedegrasses in the southern states. The name ground pearls comes from the appearance of the intermediate stages which resemble tiny pearls. Ground pearls are attached to the grass rootlets by means of their needle-like mouth parts. Damage to lawns has occurred as far west as Phoenix, Arizona. In California, ground pearls have been found in Imperial County on grapes and on Bermudagrass in permanent pastures and along irrigation ditches. *Margarodes meridionalis* should be considered a potential

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pest of Bermudagrass in southern California. No satisfactory method of control is known.

Sucking Pests Attacking the Stems, Leaves or Crown

Leafhoppers.- -Leafhoppers (Fig. 11) are small, active insects from l/8 to l/4 of an inch long. The adults fly or hop short distances when disturbed, In color they may be whitish, green, yellow or brownish gray, and often speckled or mottled. Two common species are *Draeculacephala minerva* Ball and *Deltacephalus sonorus* Ball. Both adults and nymphs are injurious, sucking sap from the leaves and stems. Symptoms of injury are a bleaching or drying-out of the grass somewhat similar to that caused by lack of water.

Leaf bugs.--Various leaf bugs (Miridae) are found in grasses. One that sometimes causes damage is Spanogonicus *albofasciatus* (Reut.). It is about l/8 inch long, blackish or grayish with white markings on the wings. When infestations become heavy, growth is retarded and the grass may die in spots.

Scale insects.--The Bermudagrass scale, *Odonaspis ruthae* Kot., infests Bermudagrasses, and the Rhodesgrass scale, *Antonina graminis* Mask., is a serious pest of Bermuda and St. Augustinegrasses in the southern states. The adult Bermudagrass scale is about 1/16 inch long and covered with a whitish, clam-shaped shield (Fig. 12). The Rhodesgrass scale is about l/16 inch in diameter, globular, dark purplish brown in color, and with a white cottony covering. The Bermudagrass scale is common in southern California, but so far control measures have not been necessary. Damage is most likely to occur in shady areas. The Rhodesgrass scale is not established as a pest in California although several infestations have been found on St. Augustinegrass in Imperial County.

Mites.--A number of species of spider mites (Tetranychidae) feed on grasses in southern California. Generally however, they are not a problem except when certain species migrate into homes. Spider mites (Fig. 13) are about l/50 of an inch long, globular in shape and reddish, yellowish or greenish in color. They feed by sucking the plant juices and the first symptoms of injury are a speckling of the leaves. This is followed by yellowing or bronzing and the drying-up of the leaves. The mites spin fine webs and with large populations the plants may be heavily webbed with large masses of mites in the webs.

The mite, *Oligonychus stickneyi* (McGregor) is common on Bermudagrass and is considered a potential pest. It appears to prefer grass in poor condition from lack of moisture, Another tetranychid mite may cause serious damage to dichondra. It seems to be more of a problem inland than in coastal areas.

The clover mite *(Bryobia praetiosa* Koch) feeds on grasses, clover, various weeds and shrubs. It differs somewhat in appearance and habits from other spider mites. The adults are about l/30 of an inch in length with long front legs (Fig. 14). The legs are amber or orange colored and the body may vary from reddish brown to a greenish color. Another species, *Petrobia latens* (Muller), resembles the clover mite and feeds on grasses and other monocotyledonous plants. Both the clover mite and *P. latens* may invade homes when large populations build up in adjacent areas.

Control of clover and *Petrobia* mites often is difficult. Before the mites can be satisfactorily controlled indoors, the outdoor population must be destroyed. This usually requires thorough spraying with high-pressure equipment. For a more complete discussion of the clover mite problem with methods for its control, the reader is referred to Newsletter No. 70 by M. M. Barnes and U.S.D.A. Leaflet No. 443 (see list of references).

Nemotodes and Turf

A number of plant parasitic nematodes parasitize turf and dichondra. Unthrifty turf and dichondra of undetermined cause examined from many areas in southern California over the last few years all had plant parasitic nematodes present. Sixteen species of parasitic nematodes in 11 genera have been found. How many of these situations were actually due to nematodes is not known, and investigations on plant parasitic nematodes and treatment for nematode infestations are being conducted at Riverside.

Symptoms and diagnosis.- -Nematode infestations are difficult to diagnose by symptoms as these symptoms are usually not specific for nematodes. Stunted, uneven growth, dieback of grass blades, and chlorosis are caused by nematodes in turf and dichondra. Roots are stunted, necrotic or knotted by nematodes feeding on them. Ectoparasitic nematodes, usually found on grasses, can cause a stubby-root condition in which the feeder roots are lacking. A common nematode of dichondra and clover, root-knot *(Meloidogyne incognita),* causes small knots, often like strings of beads, on the roots which house the adult female nematode.

Treatment.- -The treatment of established lawns is not recommended at present because of the lack of information. Pre-plant treatment of lawn areas can be done with a number of commercial materials. If just nematodes are involved, the cheapest proven materials are ethylene dibromide (EDB) and dichloropropene mixtures (DD and Telone). Other materials are available that will provide weed, fungi and nematode control. All of these should be carefully applied according to instructions on the label.

Miscellaneous Pests not Normally Injurious

Many other insects and small arthropods are found in turfgrasses and dichondra. Some of these become pests if numerous enough.

Ants may invade homes or cause unsightly mounds in lawns. They can be controlled with chlordane, dieldrin or heptachlor applied according to the manufacturer's directions.

Earwigs, springtails, millipedes, sowbugs and pillbugs are common inhabitants of lawns, Their normal food is decaying organic matter, and the use of organic fertilizers is conducive to the build-up of large populations. The European earwig, *Forficula auricularia* Linnaeus, is an introduced species which in addition to

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being a scavenger feeds on living plants. It is present in southern California but as yet is not widely distributed. Dieldrin is effective against earwigs, and malathion sprays will reduce populations of springtails, millipedes, sowbugs and pillbugs.

In recent years there have been a number of reports of gnats and other small flies breeding in dichondra lawns, The larvae (maggots) of certain species (Sciaridae, Phoridae, and others) feed on decaying organic matter. When numerous the adults may be a nuisance in patios and yards, and may enter homes. The use of organic fertilizers on dichondra tends to increase this problem. Blood meal, fish, activated sludge and similar materials attract the adult flies and provide more favorable breeding conditions. Spraying the dichondra with malathion may give relief; inorganic fertilizers should be used instead of the organics.

Earthworms are not considered as pests of turfgrasses except in golf and bowling greens. The use of arsenicals for crabgrass control should also control earthworms, Ten pounds of actual chlordane per acre (4 oz. per 1000 square feet) generally has been effective also.

Control of Turfgrass and Dichondra Pests

Fertilization - -The importance of proper fertilization and good cultural practices in pest control cannot be overemphasized. Healthy, vigorous turfgrass or dichondra will "outgrow" the effects of many infestations. When the grass or dichondra is in poor condition, damage from pests is more severe and recovery following insecticide treatments is slower. In many cases, failure to recover, necessitating replanting, is due to lack of fertilizer. From the standpoint of pest control, inorganic fertilizers are preferred to organics.

New turfgrass lawns.--With new lawns an application of dieldrin is suggested after the grass is up and established. This will protect the new grass from sod webworms and should prevent damage from white grubs for about 5 years. The dieldrin should be used at the rate indicated in the chart for white grubs. This treatment is especially important in new housing developments where damage from sod webworms usually is severe. After the initial treatment, insecticides should be applied as needed.

Established turfgrass lawns.--See that the lawn is kept in good condition with adequate fertilization and good cultural practices. If the lawn has not been treated for sod webworms for several years, a preventive treatment for white grubs is suggested. Recent experiments in southern California indicate that dieldrin or Heptachlor applied in July will prevent grub damage that fall, but that treatments made in September or October may not be effective until the following year. For other pests apply insecticides only when needed.

Dichondra --Dichondra should be kept in vigorous growth by a regular fertilization program. A close check should be kept during late fall, winter and early spring for the vegetable weevil. In warm areas with a history of cutworm damage, preventive treatments with DDT may be effective. Three treatments a month apart and starting in July are suggested. The preventive treatment for cutworms is a tentative recommendation and is only made at this time in an effort to alleviate a serious problem. It is subject to modification on the basis of experimental work planned for the current year.

Until information is obtained on the effectiveness of several new insecticides, the only materials that can be recommended for cutworms are DDT or toxaphene. Both materials are rather slow acting. A better kill often is obtained by combining the two, and formulations containing both DDT and toxaphene are available from agricultural insecticide dealers.

Application of insecticides.- -In general, sprays are preferred to other methods of application for the control of turfgrass and dichondra pests. Granular formulations are suitable for white grubs.

The dosages given in the accompanying chart refer to the amount of actual insecticide needed per 1000 square feet. This can be applied in any convenient amount of water provided enough is used to thoroughly wet the grass or dichondra down to the ground. Most operators use about 20 gallons per 1000 square feet. For control of clover and *Petrobia* mites greater volume may be required (see note 3 of chart) and the dosage is given in terms of the amount of the material to be used in 100 gallons of diluted spray.

CAUTION! All insecticides are poisonous. Carefully follow the precautions on tbe label. Do not allow children or pets to play on treated lawns for at least 5 days,

References

Anon. 1958. Clover mites. How to control them around the home. Leaflet No. 443, U.S. Dept. of Agriculture.

Barnes, M. M. 1955. The clover mite problem. News Letter No. 70, Dept. Entomology, Citrus Experiment Station.

Bohart, R. M. 1947. Sod webworms and other lawn pests in California. Hilgardia 17(8):267-308.

Christie, J. R., J. M. Good, Jr. and G. C. Nutter. 1954. Nematodes associated with injury to turf. Soil Sci. Soc. Fla. Proc. I4:167-169.

Marsh, H. L. 1958. Lawn insect control recommendations. Mimeo, Los Angeles County Agricultural Commissioner's Office.

Perry, V. G. 1958. A disease of Kentucky bluegrass incited by certain nematodes (abs.) Phytopath 48:397.

Vance, A. M. 1956. Lawn insects. How to control them. Home and Garden Bul. No. 53, U.S. Dept. Agriculture.

Acknowledgments.- -Much of the information on the life cyles and habits of most of the pests is from the publication by Bohart (1947). Information furnished by L. E. Myers of the Los Angeles County Agricultural Commissioner's Office, L. D. Anderson, R. A. Flock and M. M. Barnes of the University of California, Riverside, is gratefully acknowledged.

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SUMMARY OF CONTROL MEASURES FOR TURFGRASS AND DICHONDRA PESTS

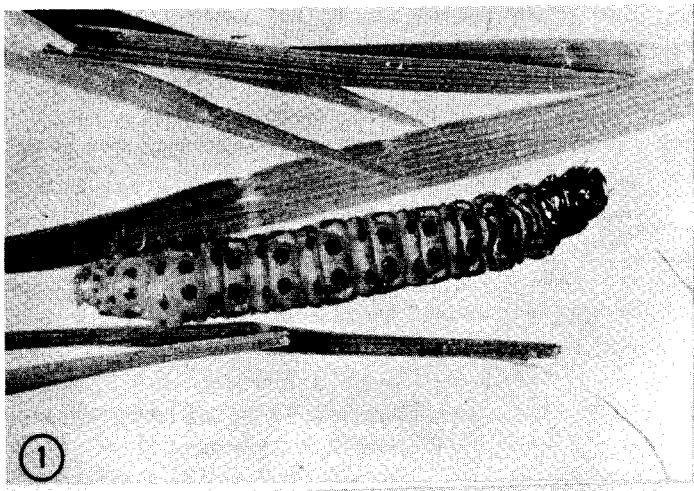
PEST	INSECTICIDE	AMOUNT OF ACTUAL INSECTICIDE PER 1000 SQ. FT. (NOTE 1)	REMARKS
LAWN MOTHS (sod webworms)	DDT, chlordane or toxaphene sprays	2 oz.	Mow grass and water well before treatment. Apply when grass is dry. Do not water again until necessary. Fertilize, if necessary, before treatment.
SKIPPERS LUCERNEMOTH	Aldrin, dieldrin or heptachlor sprays	1 oz.	
CUTWORMS (turf and dichondra)	DDT or toxaphene sprays	2 oz.	
LEAFHOPPERS	Malathion or DDT sprays	4 oz.	
LEAF BUGS	Malathion spray	4 OZ.	
WHITE GRUBS	Aldrin, dieldrin or heptachlor sprays or granules	2 oz.	Water heavily after application to wosh insecticide into soil. Do not wash insecticide away by flooding.
	Chlordane spray or granules	4 oz.	
BILLBUGS	Chlordane spray	8 oz.	
	Dichloroethyl ether	See Note 2	Follow with chlordane treatment after 7- 10 days to prevent reinfestation.
VEGETABLE WEEVIL (dichondra)	Malathion spray	4 OZ.	DDT is slow acting, faster kill with malathion or dieldrin.
	DDT or dieldrin sprays	2 oz.	
SPIDER MITES (including clover and Petrobia mites)	Kelthane spray Dimite spray Chlorobenzilate spray	See Note 3	For outdoor application only. Two sprays two weeks apart needed for effective control.

-NOTE 1. For a 50 per cent wettable powder multiply the amount given by 2 to obtain the proper dosage. For emulsion concentrates, which are measured by volume, the number of liquid ounces to use depends upon the number of pounds of the insecticide per gallon. For example, with an emulsion concentrate containing 4 pounds of the insecticide per gallon, 1 liquid ounce contains 0.5 ounce of insecticide and 4 liquid ounces would be required to give a dosage of 2 ounces per 1000 square feet. To convert to an acre basis, multiply the dosage for 1000 square feet by 43.

NOTE 2. Use 1 part of dichloroethyl ether (beta, beta prime form) to 200 parts of water plus emulsifier and apply at 1 gallon per square yard; apply emulsion concentrates according to manufacturers' directions.

NOTE 3. Use 1 quart of Kelthane 18 per cent emulsion concentrate per 100 gallons. A thorough application is required and should be repeated in two weeks. Other materials that can be used are Dimite, chlorobenzilate or Aramite (use 1 quart of 25 per cent emulsion concentrate or equivalent amount of wettable powder per 100 gallons). Kelthane is preferred by the writers as it is effective against more species of mites than the others.

For control of clover and Petrobia invading homes, thoroughly spray source of infestation -- grass, shrubs and other plants -- and walks, flower beds, outside walls and all other lines of entry into the house. High pressure spraying with power equipment usually is required for effective control.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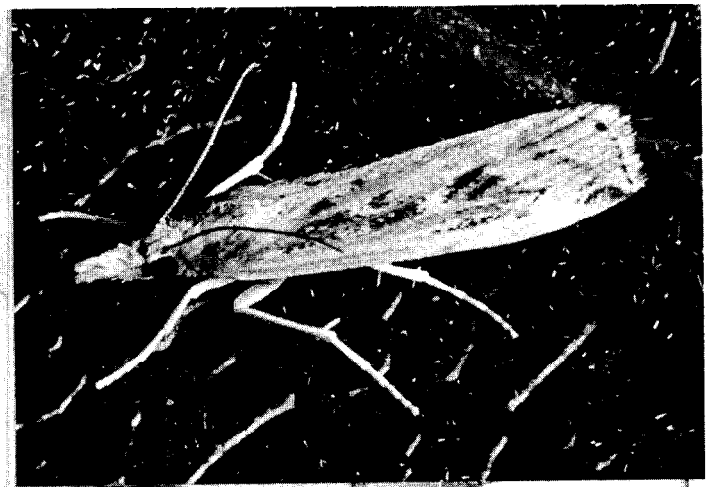

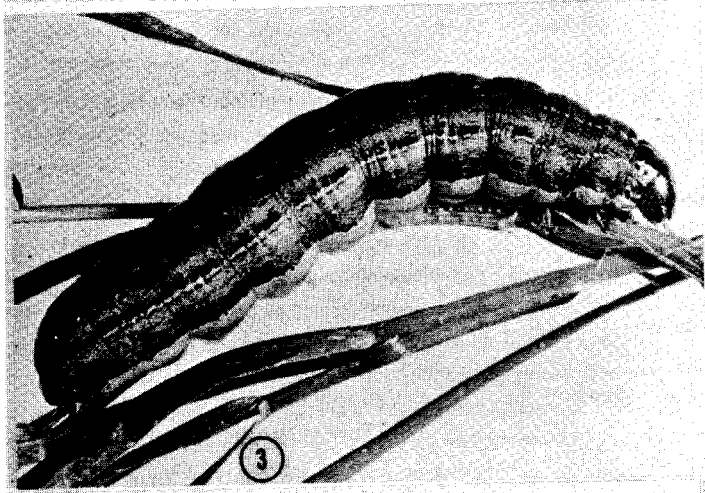
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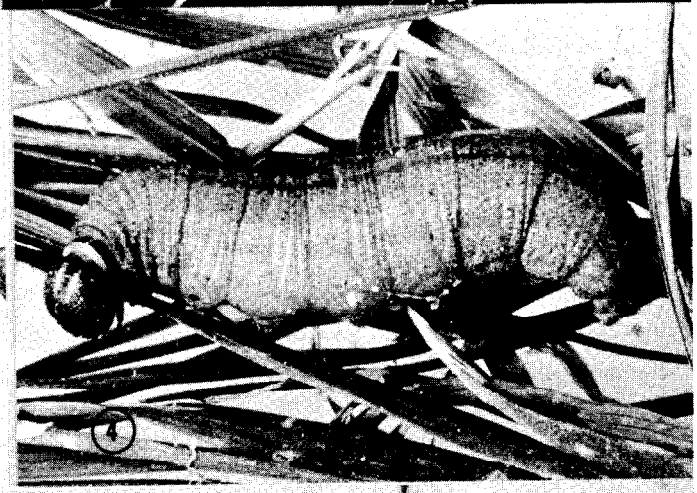
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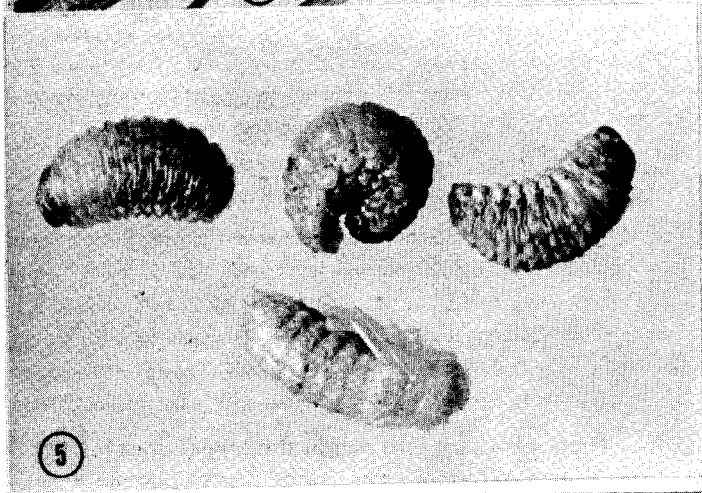
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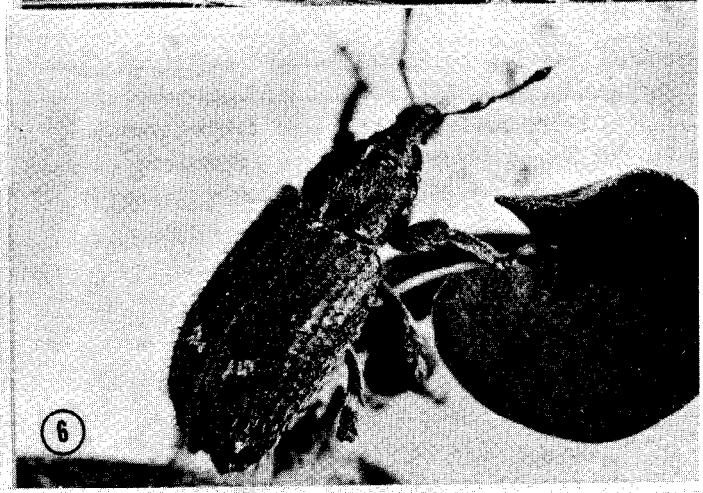
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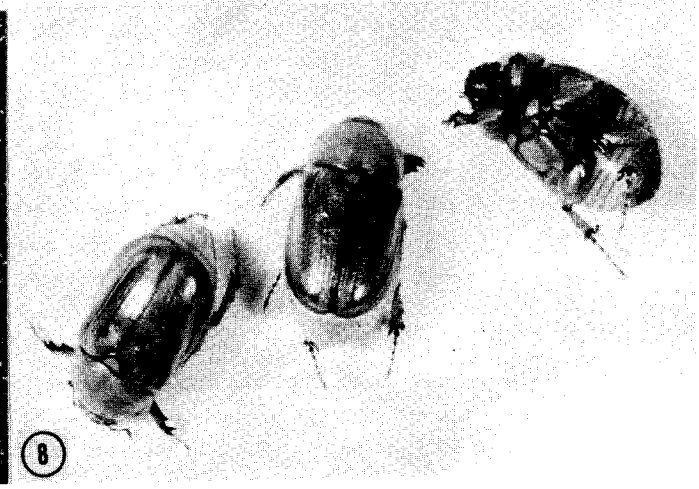
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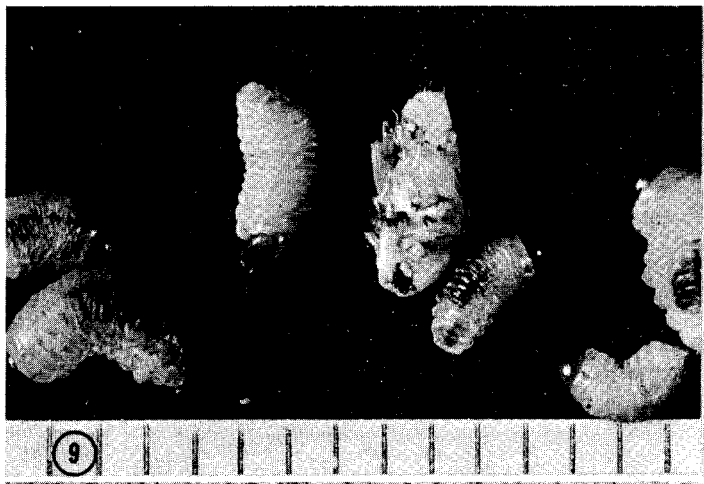

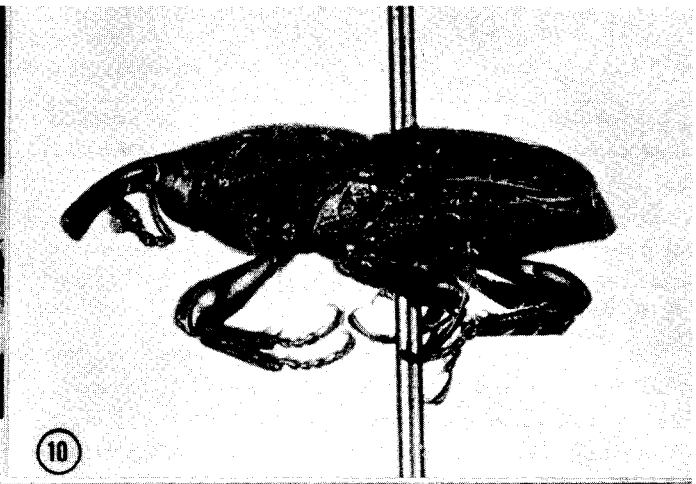

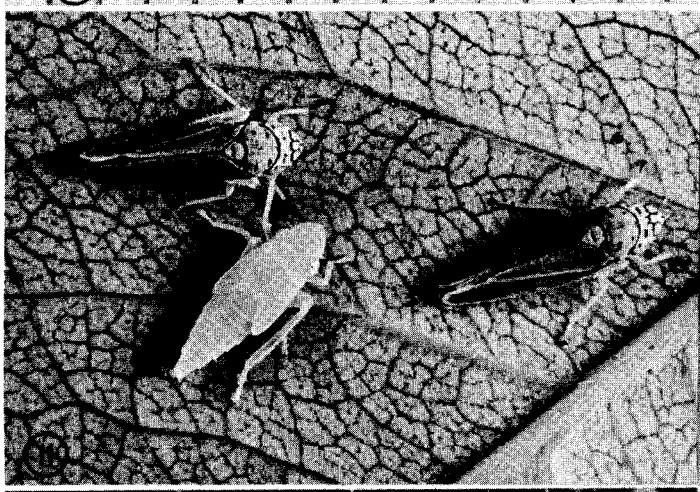

FIG. 1 -SOD WEBWORM (LARVA OF LAWN MOTH).

FIG. 2 -A LAWN MOTH, CRAMBUS SP.

FIG. 3 -THE ARMYWORM, **PSEUDALETIA UNIPUNCTA** (HAW.)

FIG. 4 -A SKIPPER CATERPILLAR.

FIG. 5 -GRUBS AND PUPA OF THE VEGETABLE WEEVIL.

FIG. 6 -THE VEGETABLE WEEVIL, **LISTRODERES** COSTIROSTRIS OBLIQUUS (KLUG)

FIG. 7 -WHITE GRUBS, CYCLOCEPHALA SP.

FIG. 8 -ADULT BEETLES, CYCLOCEPHALA SP.

FIG. 9 · **BILLBUG** GRUBS AND PUPA. SCALE DIVISIONS ARE **I/16** OF AN INCH.

FIG. IO-ADULT **BILLBUG,** CALENDRA SP.

FIG. 11 -LEAFHOPPERS (CICADELLIDAE) SHOWING 2 ADULTS AND A NYMPH.

FIG. 12 · BERMUDAGRASS SCALE, ODONASPIS RUTHAE KOT.

FIG. **13-SPIDER** MITES, TETRANYCHUS SP.

FIG. 14-THE CLOVER MITE, BRYOBIA **PRAETIOSA** KOCH.

THE PHOTOGRAPHS IN THIS ARTICLE ARE NOT TO SCALE. SEE TEXT FOR THE APPROXIMATE SIZE OF THE VARIOUS PESTS.
FIG. 14 FROM KODACHROME BY L. R. BROWN.

FERTILIZER RECOMMENDATIONS FOR TURFGRASSES

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Inadequate or improper fertilization is a common cause of poor quality turf and of numerous turf problems. The purpose of this article is to present the principal considerations in fertilizing park, playground, fairway and general lawn turf. Fertilization of golf greens has been discussed in Southern California Turfgrass Culture, Vol. 8, Numbers 3 and 4

Nitrogen is the fertilizer element of greatest concern to the grower of turfgrasses, but phosphorus and potash, plus some of the minor elements or micro nutrients must not be neglected. Before large quantities of phosphorus and potash are applied a soil test should be obtained, if possible, to determine if a need for these materials actually exists. An adequate supply of phosphorus can usually be maintained by an annual application of about 6 to 8 pounds of single superphosphate or ammonium phosphate (16-20-0) per 1000 sq. ft. of area. Commercial mixed fertilizers may also be used at rates to supply the same amount of phosphorus, for example 12 to 20 pounds of 6-8-6.

Potash is most easily supplied by spring and fall applications of two pounds of potassium sulfate per 1000 sq. ft. As with phosphorus, a complete mixed fertilizer may be used to supply the necessary potash.

Nitrogen in any form in which it is available for plant uptake is readily leached from the soil. Hence it must be applied more frequently than phosphorus or potash. Greater quantities of nitrogen are used by the grass plant than of any other single nutrient and therefore must be supplied in greater amounts. It is these two facts which govern our nitrogen fertilization program on turfgrasses.

Observation of numerous turf areas indicates that a minimum rate of nitrogen fertilization is six pounds of actual nitrogen per 1000 sq. ft. for a 12 month growing season. Most grasses, especially bermudagrass, will respond to rates as high as 12 pounds per 1000 sq. ft. annually.

If soluble forms of nitrogen, such as urea, ammonium sulfate or ammonium nitrate, are used, application is best made at 1/2 to 1 lb. of actual nitrogen per 1000 sq. ft. at monthly intervals. This will assure efficient use of the nitrogen by avoiding excessive loss through leaching and a fairly uniform rate of turf growth.

Organic materials, such as activated sewage sludge or the new synthetic-organic urea-forms may be applied in larger quantities at less frequent intervals to obtain the same results. These materials depend upon bacterial action to convert the nitrogen to an available form. This conversion or mineralization proceeds over a period of time, thus the nitrogen is made available to the grass plant more nearly as needed. Applications may be at 3 to 6 month intervals.

Of the minor elements or micro nutrients, calcium, sulfur, iron and magnesium are the only ones with which the grower of turfgrasses must be concerned. Calcium is usually in adequate supply in our western soils and liming is seldom necessary. Sulfur is rarely deficient as it is supplied as an impurity in many common fertilizers.

Iron deficiency in turfgrasses is common in calcareous western soils.This can be corrected by spraying the turf with iron sulfate at the rate of 2 oz. per 1000 sq.ft. This must not be washed off the leaves for several days. Iron chelates may be used at rates recommended by the manufacturer.

Magnesium can be supplied when needed by the application of 3 to 5 lbs. of dolomitic limestone to each 1000 sq. ft. of area.

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