5. If in doubt, always test a new fungicide on a few plants first. It is possible that under different conditions a specific fungicide will not cause plant injury. However, if it does you will lose only a few plants when a test is made before general use of the spray.

6. Do not use a fungicide as a cure-all. Spray only when necessary. Remember that the treatment may be worse than the ailment.

7. Results of the preceding toxicity tests offer you a variety of choices in the selection of fungicides for use on ornamental foliage plants. Your Experiment Station has been trying since 1947 to put across to growers the importance of this one fact: Whenever it is possible, you should alternate fungicides. This will prevent a residual accumulation of chemicals, and will give you more efficient fungus control.

**THE HUNTING BILLBUG A SERIOUS PEST OF ZOYSIA**

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A carton of zoysia, sod and soil, *Zoysia matrella* and *Zoysia japonica* Meyer strain was submitted for examination for possible fertilizer and/or insect damage. Inspection of the root revealed numerous grubs suggestive of a weevil or curculio and some Curculioned beetles. The specimens did not resemble the larvae of the weevil infesting acorns of the live oak, so frequently found in sod planted near oak trees. Specimens of larvae, pupae and adults were sent to Washington and were
identified as the hunting billbug, *Calandra venatus vestita* (Chttn)*.

**Nature of Damage**

The first indications of an infestation of the hunting billbug in a zoysia planting are the yellowing or browning of areas of sod that can easily be confused with fertilizer burn. The difference between fertilizer burn and insect damage lies in the fact that the grass can be pulled out by the handfuls in the case of insect damage, whereas this is not true of an area burned by fertilizer. Digging into the soil beneath these discolored areas will disclose the presence of the insect.

Damage to zoysia nurseries has been extensive. It is desirable to have a solid compact mat of fibrous roots of zoysia sod, Fig. 1.

![Fig. 1. Normal sod to the left. Infested sod at the right.](image)

These sections or mats are cut into foot square and 1 x 2 foot, alternating the length for stacking purposes. Larvae of the hunting billbug eat the roots and even tunnel into the heavier portions of the plant. The tunneling and eating of the roots causes the sod to fall apart and makes it expensive for the operator to handle all of the little scraps. Most nurserymen want the complete sod so it is important that it holds together. The nature of the damage is best shown in the Fig. 2.

**Description of the Hunting Billbug**

This species ranges from Maine to Florida along the eastern seaboard. It prefers lowland. The color of the fully developed billbug is black. The adults vary in size from 6 to 11 mm. in length, Fig. 3.

The egg is pearly white and rounded at each end (2).

The mature larvae, about 13 mm. in length, has a white body with a head more red than yellow in color. It is a typical curculionidae in body conformation in that the body is thicker in the middle than at either end, Fig. 3.

The pupa is a light tan to reddish color, Fig. 3. The size is from 8 to 13 mm. in length.

The egg is laid in the leaf sheath of the zoysia or top of the crown. From 3 to 10 days are spent in the egg stage. The hatching larvae feed upon the inner leaves as they work their way down into the roots. Some larvae have been found at a depth of 8 inches (may have been driven down by insecticide appli-
As many as 72 larvae per square foot were found on this infestation although the average was between 10-14. As feeding progresses patches of grass turn brown and may die due to the roots being cut off by the feeding larvae. Larvae move around freely in the soil going from plant to plant in search of food. After 3 to 5 weeks of feeding the larvae makes its pupal cell in the plant or nearby soil by packing shredded plant tissue in the ends of the excavation or in the soil. The pupal period is from 3 to 7 days.

The new emerged adult beetle has a red or mahogany-colored head and thorax and a gray to grayish brown body, turning black as it gets older. The newly emerged beetle remains in the soil three or more days before burrowing its way up to the surface. The life span of the adult is unknown. Adults in captivity rarely live beyond the second day. Beetles are vulnerable to attacks from birds.

**Control Measures**

Control of the pest should be fairly easy when the infestation is light and there is no particular rush for the sod. However, this infestation and others at different localities occurred when every one was rushed to fill orders. Commercial spray machines could not or did not put out a volume of spray sufficient to kill the insects. Good, vigorous growing zoysia has a thick strong mat of foliage and a thicker mat of roots which is difficult to penetrate with any spray. For this reason practically all of the control measures used were unsatisfactory. Toxaphene, parathion, chlordane and dieldrin were applied in the emulsion form and
gave some control but, not the complete control that the nurserymen demanded. The sod was salvaged from these heavily infested areas but had to be sold as washed sod because the insects had chewed the roots so badly that the sod fell apart. It was evident that a drench was necessary to penetrate the sod with an insecticide to kill out this heavy infestation. An area of younger grass not ready for market but also heavily infested was treated with 6 pounds of active parathion and 12 pounds of active chlordane to the acre, using 4800 gallons of water (equivalent of 0.2 inch rainfall) to soak it down. The applicator was an 800 gallon capacity water tank with pump attached to give 30 pounds pressure. The dosage was 1 qt. of 4 pound emulsible parathion and 1 qt. of 8 pound emulsible chlordane per 800 gallon tank. Within 24 hours kills were noted and within 48 hours little movement could be detected in any size of larvae. No reinfestation occurred. Once the infestation was killed out and under control, it is now a regular practice to spray the nursery acreage every 30 days with 6 pounds active chlordane emulsible formulation to 100 gallons of water per acre. There have not been any insects observed to date.

**Summary**

The hunting billbug can become a serious pest in zoysia nurseries. Drastic control measures are necessary if the infestations are as heavy as mentioned in this case. Ordinarily spraying with chlordane emulsion at 6 pounds active per acre should control this pest.

**Literature Cited**
