White Grubs in Forest Tree Nurseries and Plantations

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White grubs of the genus *Phyllophaga* and related genera live in the soil and feed on roots of plants. Their feeding can sever or girdle roots and cause injury or death. Root feeding of the grubs causes the principal injury to plants. Minor injury to hardwoods and pines is caused by foliage feeding of the adults, which are often called May or June beetles.

Grub damage to forest tree seedlings in nurseries has been recognized as a problem in this country for at least 50 years. Not until the early 1940's, however, did it become evident that grubs might also threaten forest plantations. Damage to plantations in the Lake States was generally restricted to small acreages, according to early reports. Serious injury to larger areas was reported in 1953 when 8,000 acres in South Carolina were heavily attacked.

Because grub populations tend to build up on open land that has been idle for a year or more, preventive measures may be needed before such land is planted.

Host Trees

White grubs normally feed on roots of many plants and do not especially prefer roots of trees. All coniferous and hardwood stock is readily attacked, however.

Damage

Heavy grub damage is generally first noted in the late summer and early fall when formerly healthy appearing seedlings turn color and may die. The symptoms are similar to those of drought injury. A gentle tug on such seedlings will pull them up and reveal that lateral and taproots have been chewed off or girdled (fig. 1).

Survival of discolored seedlings depends on their original vigor, the nature and degree of injury, and weather conditions. Seedlings injured during dry weather are much more likely to die when dry conditions continue than when cool, wet weather follows. Even with cool, moist conditions the trees may not be able to produce new rootlets and recover before the tops dry out. Generally, coniferous stock is more severely in-

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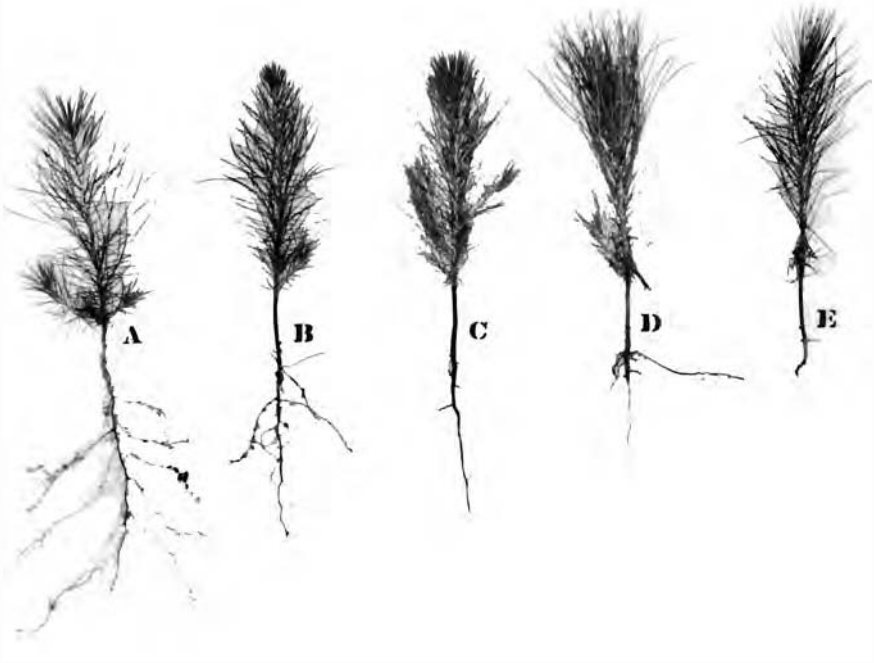

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Figure 1.—Root injury on pine seedlings caused by feeding of white grubs. *A* is a healthy seedling; the other seedlings show varying degrees of grub damage.

jured and makes a slower recovery than hardwood stock. Damage is most severe on light soils.

Description

Adults of the *Phyllophaga* genus, which contains over 100 species, are robust, oval, brown or brownish-black June beetles (fig. 2).

Larvae are milky white. They have six prominent legs. The head is brownish and armed with a strong pair of jaws. The body is strongly curved, all the hind parts are shiny, and the body contents show through the skin. White grubs vary in length from one-eighth inch when first hatched to over an inch when full grown (fig. 3).

Pupae have the general appearance and size of adults. They vary from yellowish to brown, growing darker as transformation to adults proceeds. Pupae, inactive in the soil, do not feed.

Eggs are pearly white and oval when first laid and are about one-tenth of an inch long. Later they become cream colored and spherical.

Life History

Life cycles of the various *Phyllophaga* species vary from 1 to 4 years. In the South the species may have a 1-, 2-, or 3-year cycle, the 2-year cycle being most common. In the North Central States they have a 2- or 3-year cycle. Farther north the cycle may be 3 or 4 years, although the 3-year cycle is most common in the Lake States. Different species in the same locality may have different cycles. Also, part of a single brood may emerge at the end of the

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Figure 2.—Adult stage of the white grub, commonly known as a June beetle. (× 3)

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Figure 3.—A full-grown white grub. (× 3)

second year and the remainder of the same brood at the end of the third year.

There is a continual overlapping of broods, with emergence much heavier in some years than others. Because of this overlapping, an overwintering population may consist of adults that have not taken flight from the soil and larvae of several sizes.

The female beetles lay their eggs at depths of 2 to 6 inches in the soil 8 to 10 days after mating. Several eggs may be laid in a single mass, with each egg in a small ball of dirt. They hatch in 2 or 3 weeks. Egg laying continues over a period of several weeks during spring and summer.

Grubs, hatched from the eggs, feed first on organic matter in the soil, but soon attack the tender roots of seedlings and other plants. After hibernating in the soil during the winter at depths determined by temperatures and frost levels, the grubs resume feeding when plant growth starts.

Adults of most *Phyllophaga* species emerge from the soil at dusk on warm evenings and fly to the foliage of trees. Here they mate and feed until dawn, then return to the soil.

Natural Control

White grubs are very sensitive to lack of moisture. They move up or down in the soil as moisture conditions change, in an attempt to remain in a habitat with optimum moisture. Protracted drought causes heavy larval mortality, especially among the newly hatched larvae.

Although the grubs have enemies, such as fungous diseases and insect parasites and predators, these apparently do not normally act as effective controls. Mammals and birds eat the grubs; skunks may greatly reduce populations in local areas. Attempts to control white grubs through the use of bacterial milky disease of the Japanese beetle have not been successful.

Preventive Control

An application of insecticide before planting seed or seedlings may be needed to prevent extensive damage by white grubs. In forest nurseries and in seed-production or open-forest areas, excellent control may be achieved by treating the soil with either an emulsifiable concentrate containing 4 pounds of chlordane per gallon or 10-percent granular chlordane. Mix 2½ quarts of the emulsifiable concentrate in 50 gallons of water and apply the mixture to the soil at the rate of 50 gallons per acre. Or, broadcast the granular chlordane at the rate of 25 pounds per acre and disk the granules into the top 3 to 5 inches of the soil.

Preventive control under field conditions is advisable if the grub population is one or more per 2 square feet. A grub population of 2 per square foot may cause high tree mortality. Areas with such a high rate of infestation should not be planted without control measures. Since young grubs are difficult to detect, even when they are present in considerable numbers, very careful observations must be made when sampling for damaging grub populations.

Protection of young seedlings requires a fast-acting chemical that will repel or kill the grubs before the roots are cut and the seedlings die. A ½- to 1-percent water emulsion of aldrin, applied to the root systems of seedlings during planting, provides good protection against grub damage to the roots. The chemical can be applied by a sprayer attachment on a planting machine or by dipping the roots of hand-planted stock.

Applied Control

Once a plantation is established, control measures are extremely difficult and expensive. The insecticidal solution must penetrate several inches of soil rapidly and kill the grubs before they cause additional damage. This is seldom possible.

Insecticide dust or granules broadcast from either ground machinery or aircraft are not effective because the insecticides generally penetrate only the upper layers of soil and do not reach the root zone where the grubs are feeding.

Insecticide should always be applied before planting where damage is likely to occur, in either nursery or field.

Pesticide Precautions

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or when they may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment

or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

WARNING: Recommendations for use of pesticides are reviewed regularly. The registrations on all suggested uses of pesticides in this publication were in effect at press time. Check with your county agricultural agent, State agricultural experiment station, or local forester to determine if these recommendations are still current.

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