CONTROL OF WHITE GRUBS

White grubs are among the most widespread and destructive pests of farm crops in Eastern Canada. They are the immature stages of June beetles. They live in the soil and feed upon the roots of pasture and meadow grasses, hoed and grain crops, garden flowers, vegetables, nursery stock, and forestry seedlings. Crop losses due to these insects are frequently very severe; whole corn fields, potato fields, and strawberry patches may be totally destroyed. Literally thousands of acres of rough pasture in a single locality may have their feed value reduced by one-half, and upon hundreds of acres of permanent hay meadow in the same localities the yield of hay may be reduced to but a fraction of the normal yield. A survey of 124 farms in one county in Ontario in 1933 showed, at a conservative estimate, a loss averaging $188 per farm,—a sum greater than the average yearly taxes on the properties.

Such conditions were widespread in areas embracing several counties in Quebec in 1926, 1929, 1932, 1935, and 1938, and in Ontario in 1930, 1933, 1936, and 1939. The great proportion of this crop loss is due to the feeding upon the underground parts of the plants by a soft, white grub with a curved body from ¾ to 1¼ inches in length. This is the two-year-old grub stage of the June beetle, an insect which requires three years to complete its life-history. The beetles lay their eggs by preference in loose sod upon light soil, in June. The eggs hatch into small grubs which live, feed and grow in the soil. Here they remain for the remainder of that summer, throughout a second summer, and until the early part of a third summer. During the warm weather the grubs are two or three inches below the surface of the soil at about the root level of most crops. The winters, however, are spent at lower levels and well below plough line.

In June of the third summer they are full-grown grubs. In a small cavity in the soil they change to a pupal stage, and later on in the season change to the mature June beetle. The beetles remain in the ground throughout the rest of the summer and the following winter, and emerge to fly about, feed, and lay eggs during June, thus starting a new generation.

In Canada, as far as is known, there is but one important brood of June beetles in each locality. This appears every third year, and it is responsible for the injurious outbreak of white grubs the following year. All farmers in white-grub-infested areas, therefore, should determine the year of major June beetle flight and adjust control and cropping practices to its occurrence. The stripping

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of the foliage of the food plants of the beetles is the best single index of the major flight year, and the degree of defoliation from year to year is an excellent guide to the white-grub prospects for the following season.

The beetles feed upon the foliage of elm, oak, poplar, willow, ash, hickory, cherry, plum, basswood, mountain ash, butternut, walnut, dogwood, rose, raspberry, and other plants, and the blossoms of apple, lilac and other shrubs. As the feeding takes place only at night, the cause of the defoliation of trees is frequently not realized and the abundance of the beetle population in a locality is not appreciated.

In its white-grub stage, the insect feeds below ground upon the tubers and roots of farm crops. A little feeding is done in the autumn by first-year grubs, and some injury may be caused in old meadow and pasture sod; but the most severe injury is caused by the feeding of the second-year grubs. It is during this stage that almost all the serious damage to crops takes place.

The roots of meadow and pasture sod are frequently completely cut off, and the sod can be rolled up like a carpet. With corn and strawberries, the attack on the roots results in dwarfed, unproductive plants, and where the grubs are abundant the roots of the plants are completely severed and the plants die. Damage to potatoes is caused both by grubs feeding on the roots, thereby dwarfing the plants, and by the gnawing of more or less rounded holes in the tubers. This, in a badly infested field, may be so severe as to destroy completely both the commercial and feed value of the crop. Beets, carrots, sugar beets, turnips, mangels, and other vegetables, are also severely injured by the insects feeding upon the roots when they are more or less well formed, and in the seedling stages the plants may be entirely cut off. Young forest and shade trees may be killed by having the small roots cut off completely and the bark taken off the larger roots.

Control

Crop Selection

Although white grubs feed on all plant roots encountered in their feeding range, they are much more destructive to tubers and fibrous-rooted plants than to plants with a definite tap-root. For this reason common agricultural crops are classified into groups according to their known ability to withstand white-grub attack.

Crops which are susceptible to injury and which, therefore, should not be planted on land which is known to be infested, include timothy, red top, Kentucky blue grass, corn, strawberries, and potatoes, as well as field crop and garden plants when in the seedling stage.

Crops of the moderately resistant type and which may be planted with safety only on land containing not more than three white grubs per square yard, include barley, oats, wheat, rye, beans, turnips, and carrots. On the other hand, hard-rooted or tap-rooted plants such as white, Dutch, red, and alsike clovers, peas, orchard grass, buckwheat, and sunflowers, are very resistant and may be planted on land containing as high as nine second-stage white grubs per square yard. Sweet clover and alfalfa in turn are *extremely* resistant and will survive a white-grub population sufficient to destroy any other farm crop.

Generally speaking, extreme care is necessary in planting susceptible crops during the year in which second-year grubs are prevalent, especially where sod or pasture has been broken up to be planted to hoed crops. In white-grub infested areas, the beetle-flight periods of the locality should be kept in mind and the crops so arranged as to have the light land occupied with a hoed crop the year of beetle flight. This makes land most susceptible to infestation least attractive for egg-laying and reduces the likelihood of a serious infestation of

second-year grubs the following year. As heavy soils are seldom infested by white grubs in injurious numbers, the more susceptible crops should be planted upon the heavier land in the year following the beetle flight, when the injurious second-year grubs are most likely to be present, especially if the white grubs on the lighter land have not been reduced in numbers by cultural means as outlined below.

Control for Adult Beetles

In districts where white grubs are usually a serious problem, it is often advisable to control the adult beetles with arsenate of lead spray applied to the foliage of the trees upon which they feed, at the rate of one pound to twenty gallons of water, on or before May 26. When the beetles are very abundant, two applications at the same rate should be applied, the first about May 22 and the second about June 1. Where spraying is impracticable, it would be very helpful to cut down isolated trees on which June beetles feed as well as shrubbery along fence rows, replacing these with maple and evergreens, upon which June beetles do not feed.

Control for the Grubs

Crop Rotations

In general, in white-grub-infested land, long rotations are to be avoided and shorter ones should be employed wherever possible. Two rotations are especially suitable. In the preferred "combination" rotation, corn or roots are planted the first year, grain the second year, and clover hay or pasture the third year. One-quarter of the farm is set aside for alfalfa, which is maintained for three years, and then placed in the rotation. This rotation prevents the serious infestation of the land by having it all either under the plough or in alfalfa. Where alfalfa cannot be grown successfully, a five-year rotation is suggested. In the first year, the land would be planted to one of the hoed crops, in the second to grain, in the third to clover hay, in the fourth to grain, and in the fifth to hay or pasture. In this rotation the land is under active cultivation four years out of the five, and important white-grub concentrations need be looked for only in or following meadow or pasture. Where grubs are found to be present in dangerous numbers, the shallow-ploughing multiple-discing treatment (see below) may be applied before planting hoed or grain crops.

Cultural Control (Shallow-ploughing and multiple-discing)

Ordinary ploughing and discing cannot be depended upon to kill a sufficient number of white grubs to protect crops when the grubs are present in injurious abundance. Therefore, in land where white grubs are known to be present to the number of one or more per square foot, *special* ploughing and discing should be undertaken. This will reduce a destructive outbreak of these insects to a point at which economic damage will be small.

Severely infested sod or pasture fields or parts of fields should be ploughed not deeper than three inches, turning the furrows well over, and then thoroughly disced with weighted discs, five times if the work is carried on with horses, and four times if carried on with a tractor. To be effective, treatment should be not earlier than May 8 or later than September 20, as before May and after September the grubs may be in the lower levels of the soil and not within reach of the plough or disc. In very stony land an increase of one discing in each case is advisable. In a field known to be infested, this treatment can be applied in the early season in time to destroy the white grubs and release the land with safety for planting to any crop in the same year.

Cultural Control with an Intercrop

Where sod or pasture have been destroyed by a severe attack of white grubs and autumn or spring pasture is desired, the special ploughing and discing control can be delayed until after haying or until the full extent of the damage to the pasture can be appraised. If, after treatment, the land is sown to a crop such as fall rye, it will provide both autumn and spring feed and will give an extra ploughing and discing to the land before coming into crop the next year. This will provide an added protection, particularly in the case where very susceptible crops are planted in badly infested land.

Prevention of Infestation

If, for any reason, it is desired to keep any given piece of sod land free from infestation by white grubs, such as turf or land later to be used for susceptible crops, this may be accomplished by simply dusting the sod of meadow, pasture, or turf with superfine dusting sulphur at the rate of 300 pounds per acre. The sulphur repels the beetles and prevents egg-laying in land with which it is covered. It should be applied about May 20, just as the beetles begin to fly in the spring, and need only be used every third year.

Turf of golf courses, lawns, parks or cemeteries is often damaged, resulting in an unsightly brownish appearance of the sod, followed by a growth of weeds. Such injury is more likely to occur to weak, patchy, or broken sod, where the surface soil is composed of one of the lighter types. Thick, vigorous, well-rolled, and fertilized sod is likely to escape serious injury.

Protection of Gardens or Nurseries

Ordinarily there is little danger of serious injury by white grubs in well-kept vegetable gardens, flower gardens, or nurseries. Where old sod is ploughed to establish a new garden area, the shallow-ploughing, multiple-discing control will render the soil safe for planting susceptible crops, or infestation can be prevented by the use of sulphur dust. Where the garden is too small for working with horses and must be spaded, the grubs have to be removed by hand from the soil and destroyed, or the grubs can be killed by the application to the soil before planting of arsenate of lead at the rate of 10 pounds per 1,000 square feet. After the poison has been applied to the surface, it should be thoroughly raked or harrowed into the soil.

Owing to the extreme susceptibility of strawberry plants to white-grub injury, by far the greatest number of complaints of injury are received in connection with this crop. Unfortunately, if the patch is found infested with second-year grubs there is no control possible other than to dig out the grubs by hand, a procedure which is only practicable on a kitchen garden scale. The infestation of the strawberry patch, therefore, must be prevented if loss of plants and crops is to be avoided. This may be done by planting only on land free or kept free of the insects by special culture, by the use of sulphur or arsenate of lead as recommended above, and by the renewal of the patch at frequent intervals.

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