

Calculation of points does not take as long as imagined at first glance; in fact, a large number can be determined by inspection. Thirty points can be checked by the constructor in ten minutes; and even though he may use only half of the points on the drawing, too much detail is better than too little. These points will be a constant reference to the constructor.

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## A Control for Japanese Beetle Larvae in Golf Greens

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The larva of the Japanese beetle (*Popillia japonica* Newm.) has become a serious pest in golf greens. The rich soil and heavy turf of the greens attract the beetles, and eggs are deposited in enormous numbers during June, July and August. Under these circumstances it is not unusual subsequently to find as many as 300 larvæ to the square yard of turf. The larvæ feed upon the grass roots, and by late August or early September the turf begins to turn brown and the green is largely ruined from the standpoint of the game of golf. Unless the green is worked up and reseeded it is overrun during the following spring by weeds and coarse grasses.

Considerable experimental work was done at the Japanese beetle laboratory by J. J. Davis<sup>2</sup> using a solution of sodium cyanide in water as a control for the larvæ in turf. A satisfactory kill was obtained by this method and, according to his published results, the injury to grass was negligible. The writers' subsequent experience with this material corroborates the results secured by Davis as far as grub kill is concerned, but in our experience the material is decidedly toxic to the grasses of meadows and golf courses. It kills practically all of the fine grasses and clover in meadows and completely burns the fine grasses used on golf greens.

In connection with the above experiments the writers carried on tests in 1921 using a plain mixture of carbon disulfid in water, the mixture being maintained by agitation in a tank and run out through hose onto the turf. The grub kill by this method was not entirely satisfactory, but it was noted that no injury resulted to the grass; in fact, the material was *decidedly stimulating in its action*. Under these circumstances the work with cyanide was dropped and the experiments were confined to a thorough testing of carbon disulfid. It was found that a plain mixture of the material in water was unsatisfactory, due to the uneven dispersion of the carbon disulfid throughout the water even when agitated.

The writers therefore began a study of carbon disulfid emulsions, using various solutions of soaps as emulsifying agents. It was found that a fairly stable emulsion could be made with soaps in general, but the best emulsion from all standpoints was obtained by using resin-fish-oil soap as follows: Add 1 pound and 3 ounces of resin-fish-oil soap to 1 gallon of water and heat until dissolved; allow the solution to cool; place the solution in a churn or cream freezer and add 3 gallons of carbon disulfid; stir until the ingre-

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<sup>1</sup> Riverton Entomological Laboratory, Riverton, New Jersey.

<sup>2</sup> "Miscellaneous Soil Insecticides Tests," by J. J. Davis, in *SOIL SCIENCE*, Vol. X. No. 1. July 1920, page 61.

dients emulsify, which condition is obtained in a few minutes. The emulsion proper is white in color and has the consistency of thick cream, and when added to water it diffuses evenly and stays in suspension indefinitely. Before making large quantities of this emulsion it is advisable for the novice to experiment with the emulsification of small quantities of the ingredients in a flask in order to observe the phenomenon of emulsifying.

CAUTION.—Carbon disulfid is extremely inflammable and explosive, and it must be handled with as great care as is gasoline.

Tests were made with this material, using various concentrations and various amounts of liquid per square foot of turf treated. For instance, 1 pint of emulsion was added to a 50-gallon barrel of water and stirred in with a paddle. The solution was then flowed out upon the turf by means of a hose and Ross watering nozzle, the liquid being applied to an area of 100 square feet, or at the rate of one-half gallon per square foot. The grub mortality was 98 per cent with this concentration.

A lower concentration of solution was not sufficiently effective. On the other hand, the grass was not injured by an application of 1 quart per barrel applied at the rate of 1 gallon per square foot. Some injury occurred when 3-pint and 2-quart concentrations were employed. After being treated with the proper concentration the grass assumes in a few days a vivid green similar to that obtained from an application of sodium nitrate.

The liquid is best applied when the turf of the green is fairly dry, since the soil is then in a condition to absorb the liquid with the minimum of run-off. The turf should not be flooded with the liquid. It should be applied lightly and allowed to soak in, and the operation repeated until the stipulated amount of liquid has been applied. Heavy applications, applied hurriedly, will cause injury to the grass and result in an uneven grub kill due to run-off of the liquid.

Our past season's work has demonstrated the fact that application of the solution to the turf by means of rubber hose manipulated by workmen is unsatisfactory, due to unevenness of application with consequent flooding and run-off and the damage caused by the incessant walking on the wet turf. Our future experimental work will therefore consist in devising a means of automatically applying the liquid to the green. A modified portable overhead irrigation apparatus seems to be the most feasible method.

### **Cotton Hulls As a Surfacing for Putting Greens**

In the December, 1921, number of *THE BULLETIN*, page 244, a method of using cottonseed hulls for the surfacing of greens was described. This method has been tested out at Pinehurst, North Carolina, and Mr. Richard S. Tufts reports that his experience with such greens at Pinehurst has not been satisfactory. Difficulty was experienced in getting the hulls to bind. The surface would pack very well if constantly rolled, but after a rain it would become soft again. Mr. Tufts thinks that possibly there may be a process of treating the surface so as to overcome this difficulty, and in view of this he is not disposed to consider his experiments with the cottonseed-hull green as final. It will be recalled that the cottonseed hull green referred to in the December, 1921, number of *THE BULLETIN* was located in a section having a semi-arid climate.