VOL. I 1939 No. 14

# BLACK ROCK FOREST PAPERS

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## PRELIMINARY NOTES ON A METHOD FOR THE PREVENTION AND CONTROL OF WHITE GRUB INFESTATIONS IN NURSERY SOILS

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# PRELIMINARY NOTES ON A METHOD FOR THE PREVENTION AND CONTROL OF WHITE GRUB INFESTATIONS IN NURSERY SOILS

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WHITE grubs, which are the larvae of various species of May beetles *(Phyllophaga* spp.), are perhaps the most bothersome of the common insect pests which frequent nursery soils and feed upon or otherwise damage seedlings in seed and transplant beds. The grubs usually live in the soil for several years, during which time they feed upon the roots of plants. They are very injurious to nursery stock and, if not controlled, constitute a serious hazard.

An apparently satisfactory preventive measure, which has also proven quite effective in the control of existing grub infestations, was discovered more or less by accident during a series of investigations at the Black Rock Forest nursery. In the spring of 1934 an experiment was started to study the relationship between solar radiation intensity and the dry weight increase of white pine *(Pinus strobus* L.) seedlings. Two parallel series of variously shaded beds were planted with seed from the same lot, all of which had been after-ripened. Since the usual after-ripening treatment for white pine seed—that is, moist, cold storage—results in increased permeability and other changes which may render seeds so treated more susceptible to injury by acids or other chemicals than dry-stored seeds, the soils of one series of beds were not sterilized in any way. Immediately after planting, all beds of the other series were treated with acetic acid, which past experience had proven an effective means of controlling damping off. A solution of 0.8% acetic acid was applied at the rate of 0.75 quart per square foot of seedbed, as recommended by Doran (1932). It was anticipated that this part of the experiment would reveal any harmful effects the acid might have on after-ripened seed.

Within two weeks of planting, germination was nearly complete in all beds of both series. There was practically no damping off, even in the untreated beds, possibly because the soil had not been used previously for a nursery. Seedling counts and comparative dry weights at the end of the first month did not reveal significant differences in either the germination, which averaged better than 90%, or the growth of seedlings in the treated and untreated soils. Acetic acid, in the amounts used, apparently has no injurious effects on after-ripened seeds of white pine. Of greater interest was the observation that by mid-summer white grubs were very numerous and active in the untreated beds, whereas there was no evidence of infestation in the soils which were disinfected with acetic acid (to prevent damping off) at the time of planting. The grubs did so much damage in the untreated beds that by the end of the growing season seedlings grown therein were not worth harvesting. Only data on seedlings grown under varying radiation intensities in the acid-treated beds were reported (Mitchell, 1936).

In order to test the apparent effectiveness of acetic acid for the prevention of grub infestation, further studies were made during the summers of 1935 and 1936. Two parallel series of beds were established in each of three different natural and prepared soils. Both red pine *(Pinus resinosa* Ait.) and white pine were planted. One series of beds was not disinfected. The other was treated with acetic acid as in 1934. Samples were taken at intervals during, as well as at the end of each growing season. Inspection of these samples disclosed evidence of varying degrees of grub injury in the majority of the untreated beds. But there was no sign of infestation or grub damage to either species of pine in any of the acid-treated soils.

Additional studies were made to test the value of acetic acid in the control of existing infestations. Some of the beds which were not disinfected at the time of planting, and in which grubs were numerous, were given the acetic acid treatment in the middle of the growing season. In every case one or at most two applications of acetic acid rid the soil of grubs—as well as earthworms and other insect life.[1] And in no case did the acetic acid stunt the growth, burn or otherwise damage the seedlings in beds so treated. As a precaution, the acetic acid solution remaining on the needles was washed off with water from the sprinkling system immediately after treatment. This may or may not be essential.

Various more or less satisfactory measures for preventing grub infestations have been devised. They include covering seedbeds with ¼-inch mesh wire screens, early fall ploughing and keeping seedbeds and adjacent areas free of vegetation, especially dense growths of sod-forming grasses and weeds. The value of these precautionary measures should not be overlooked since prevention is usually much less expensive than control. For the control of existing infestations, carbon disulphide (Wilford, personal communication[2]), white arsenic, various other chemicals, particularly the salts of heavy

[1] The advisability of using soil poisons or fumigants which destroy not only white grubs, but earthworms and other beneficial soil-inhabiting organisms as well, may be questioned. However, the majority of investigators agree that the chances of finding a *specific* (chemical) remedy for white grubs appear remote; and if a choice must be made, it is obviously better to destroy the beneficial soil animals along with the grubs than to allow the latter to destroy the seedlings. Furthermore, since nursery soils can and should be fertilized, cultivated and otherwise improved at two-to-three-year intervals, the value of the soil animal population is not so great as in forest soils, where it is impossible or impractical to cultivate and fertilize. With the aid of cultural methods, perceptibly better-than-average seedlings can be produced in acetic acid-treated seedbeds which are devoid of earthworms and other beneficial soil animals—as well as grubs (Mitchell, 1939).

[2] According to Dr. B. H. Wilford of the Appalachian Forest Experiment Station, Asheville, N. C., only straight carbon disulphide, of the various chemicals tested to date, has given satisfactory control of white grubs in the sandy loam soils of the North Carolina and South Carolina State nurseries.

metals (alone and in the many combinations found in patented insecticides), and a specially designed tool (Graham, 1929, p. 179) have been recommended. Arsenic and the salts of other heavy metals, especially mercury, although quite effective as insecticides, often have harmful effects on plants. Their application may result in the accumulation of residues in the soil which are as toxic to nursery stock as to the grubs. Continued use is dangerous, as experience in some forest nurseries has shown (St. George, 1935; Fleming, Baker and Koblitsky, 1937), and in this regard nurserymen might well profit by the results of more numerous tests with turf grasses on lawns, athletic fields and golf courses.

The observations here reported *suggest* that acetic acid is not only an effective but an efficient means of preventing and controlling grub infestations. It is relatively inexpensive, easy to transport in concentrated form, apparently harmless to nursery stock in the amounts thus far applied, and has the added advantage of being useful in the control of damping off. However, these observations are not subject to broad interpretation, and most certainly should not be considered as conclusive. It remains to be seen whether acetic acid is equally effective under widely different conditions—of soil, climate, species of insect, etc.—than those which obtained during the tests which this report describes.

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