impermeable and retentive layers below the tile are much more difficult to wash out. This reserve supply of salts which remains in the lower layers of soil, even after summer and hurricane rains, is then available to be brought back to the surface layers by capillarity and evaporation during the comparatively warm, dry winter growing seasons.

Saline Spot in Celery Field, Sanford, Florida.

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A NEMATODE ATTACKING STRAWBERRY ROOTS

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This disease was first noticed in strawberry fields during the fruiting season 1946-47. Affected areas in a field were small at first but gradually increased in size in a somewhat circular pattern until large areas became involved. In a few cases all the plants in a field were affected.

The affected plants became semi-dormant, no new growth being apparent. Edges of leaflets became dark brown, a typical plant symptom of root injury. There was a gradual dying of leaf tissue from edges to midribs. Plants thus declined gradually, sometimes lingering for several weeks before death finally took place. The root systems of affected plants were lacking in fine feeder roots. The cortex of the remaining larger roots was dead but in most cases the steles or central cylinders remained alive for some time subsequent to destruction of cortex. Later studies showed that root tips were killed then lateral roots developed and their tips in turn were killed. This resulted in the production of root systems consisting of coarse roots with knobby tips.

Roots of affected plants were examined for nematodes but none were found in or on the roots. Isolations made from such roots gave the usual display of various soil fungi but none appeared consistently. Affected plants were collected for future use. The roots were carefully washed under running water and the plants then set either in treated soil in

the greenhouse or in field beds at the Strawberry Laboratory. All plants thus treated put on normal root systems. This proved rather definitely that the causal organism was not of fungal or bacterial origin and that if a nematode was involved, it must be mostly ectoparasitic, i.e. it did not enter the root tissues.

Field soil from around the roots of affected plants was collected and placed in 6-inch pots in the greenhouse. Cucumber and oats were planted in this soil as a catch crop for the meadow nematode, which was suspected at that time as being the casual organism. As soon as sufficient roots had developed they were removed from the pots and carefully shaken free of most of the soil. The remaining soil was washed from the roots into beakers and the clean roots were allowed to soak in water over night. Examination of these roots the following day showed that very few nematodes were present in or on the roots or in the water in which the roots had been soaking. At the same time many nematodes were found in the water which had washed the roots free of soil. This also tended to show that the nematode involved was estoparasitic.

During December 1946 and January 1947 the soil fumigant D-D was tested in several of the affected fields. The fumigant was injected into the soil near affected plants. Injections were made at depths from 4 to 10 inches and at various distances from the plants, from 4½ to 7 inches. Rates of application varied from 3 to 8 ml. per injection. None of the plants were killed by this treatment and a high percentage of them subsequently developed normal root systems. Again, these results tended to show that some ectoparasitic nematode was causing this root trouble. CAUTION: THIS TREATMENT OF BEDS CONTAINING STRAWBERRY PLANTS IS NOT A RECOMMENDED PROCEDURE.

It was not until the season 1949-50 that a correct identification was made of the nematode which might be the cause of this root trouble. It had been incorrectly reported as the meadow nematode, *Pratylenchus pratensis*. In December and January two surveys were made of affected and non-affected strawberry fields in Hillsborough County.

Specimens of diseased and also apparently healthy plants were collected from affected fields together with soil samples, 1-pint each, from the rhizospheres of these plants. These were examined by Dr. Christie and the sting nematode, *Belonolaimus gracilis*, Steiner, was found in almost all soil samples. However, the number of nematodes in the soil samples from around roots of plants showing symptoms of the disease was usually much greater than from plants which were apparently healthy. This was especially true in the December survey. Only one case of nematodes within the roots was observed and these nematodes were in the larval stage. No sting nematodes were found in plant or soil samples from fields in which none of the plants displayed symptoms of the disease.

B. gracilis is rather easy to identify because it is long, almost 2 mm., and slender with an extremely long stylet, 0.157 mm. long as compared for example with that of the meadow nematode which is only 0.015 mm. long.

During the spring of 1950 specimens of *B. gracilis* were found in soil samples from affected strawberry fields in Polk, Hardee and Manatee Counties in addition to Hillsborough County. In the summer, a few specimens were found in soil samples from around roots of corn and crabgrass growing in fields in which strawberry plants had been affected during the winter. Thus far *B. gracilis* has been collected from only one of the nursery fields in east Hillsborough County.

During the past three years strawberry growers have found that soil fumigation, either solid treatment before bedding or row treatment as the beds are made up, has enabled them to grow good crops of strawberries on land in which this root trouble has been destructive to previous strawberry crops.

NITROGEN TRANSFORMATION IN SEEDBEDS AS AFFECTED BY NEMATOCIDAL TREATMENT

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Infestation of soil by nematodes is one of the major problems confronting vegetable growers in many sections of Florida. The root-knot nematode, which penetrates plant roots and causes large irregular swellings, is the most striking and perhaps best known of this group of pests. Economic losses due to nematodes are extremely difficult to evaluate since the damage depends on the stage of growth of the plant at time of attack and the degree of infestation. Affected plants are more susceptible to other parasitic and physiological disorders than are healthy plants and usually produce low yields of inferior quality.

Because of the economic importance of these pests, considerable interest has been shown in the development and use of chemical fumigants having nematocidal value. These materials have been tested quite extensively here in Florida, especially on vegetables and tobacco. The effectiveness of such materials as Larvacide or chlorpicrin, DD or dichloropropane-dichloropropylene, EDB or ethylene dibromide, and MC-2 or methyl bromide mixture, has been clearly demonstrated.

This Laboratory is still hesitant about making definite recommendations on soil fumigation with these new chemicals, even though our early tests on this phase have been most encouraging. There is still much to be learned about these fumigants. Some of the questions as yet unanswered are: Is it safe to use them repeatedly each season? Do they leave any residue in the soil which in time may become toxic? What effect do they have on other soil organisms, especially those known to be important to soil fertility? A few observations have been recorded from time to time on some of these points.

In the Annual Report of the Florida Agricultural Experiment Station for 1948, Burgis and co-workers reported that fumigation of vegetable seedbeds with 2, 4-D, chlorpicrin or a uramon-cyanamid mixture altered the amount of ammoniacal and nitrate nitrogen present in the soil. Similar observations for DD on tobacco acreage have also been reported by Kincaid and Volk in Press Bulletin 655 of the Florida Agricultural Experiment Station.

The object of this paper is to report briefly the results of a study into some of the factors involved in the nitrogen transformation in seedbed soil following nematocidal treatment. When soil organic matter decomposes, ammonia is liberated and under favorable soil conditions is then converted to nitrate. This so-called nitrification reaction has long been considered as a biological process, and it is this process that is apparently affected by soil fumigation.

The fumigation materials used in this study were chlorpicrin, 2.5 pounds per 100 sq. ft., ethylene dibromide (Soilfume 60-40), 13 gallons per acre, and methyl