considerably greater expenditures in the grove than are usually contemplated.

Scalicides have an obvious effect on fruit color and hence on pack-out. Hedging of tangerines is another approach that has been studied (1, 9). There is some indication of the benefits of open rather than close-grown groves in Figure 1. Block 1B is a fairly open grove. The trees in Block 11 are more crowded. In 1958, when both these blocks were used, the differences between them practically overrode differences due to the scalicides used. Block H.C. is hedged one way, but very close grown within the rows.

It has been pointed out previously (1, 2) that utilization of this type of approach towards the production of more valuable fresh fruit crops involves a close cooperation between production and packinghouse staffs, coordinated by management. This is because pack-outs and returns must be taken into consideration in order to arrive at the most economic (rather than just the cheapest) way of producing a box of citrus for the fresh fruit market.

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Vegetable Section

THE EFFECT OF LAND MANAGEMENT PRACTICES ON THE ROOT KNOT NEMATODE, MELOIDOGYNE INCOGNITA ACRITA, IN SOUTH FLORIDA

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Vegetable crops produced on virgin soil are usually relatively free of virus and soil-borne diseases, most soil insects, parasitic nematodes, and competitive weeds and grasses. The native sod, disked and incorporated into the vegetable seedbeds, promotes good drainage, aeration, and resistance to erosion during heavy rains and winds. In contrast, soils which have been farmed over a period of years have many of these production problems, which increase costs and often reduce the quality and quantity of vegetables produced. Tomato farmers, for example, find it profitable to clear, ditch, dike, install pumps and wells and construct graded roads to virgin land each season in order to escape the problems on previously cropped soils.

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In 1947 Hayslip and Forsee(1) evaluated old tomato land problems on the basis of a survey of commercial farms in the Indian River area. The re-use of "old" vegetable land has been investigated during the past 10 years at the Indian River Field Laboratory. In 1952 Hayslip et al(2) reviewed some of the "old land" problems and described a study of vegetable and pasture rotation as a possible method for

Fig. 1. Tar-coated culvert plots (top) and 2-gallon glazed pots (bottom) used in root-knot nematode studies.

the re-use of land for vegetable production. A progress report on the vegetable-pasture rotation trials was made by Hayslip et al(3) in 1956. Several agronomic and horticultural aspects of the rotation study have been completed since that time. In a recent article Hayslip and Stall(4)presented data on the favorable effect of pangolagrass and Pensacola bahiagrass versus the adverse effect of clover on the severity of rhizoctonia fruit rot of tomatoes. However, the effect of such land management practices on nematode populations has been investigated only recently. This report covers two experiments designed to determine the effect of several improved pasture grasses and legumes, pest grasses, clean fallow, and flooding on populations of the root-knot nematode, *M. incognita acrita.* The third experiment consists of a long-term trial comparing the effect of clean fallow, pangolagrass and volunteer weeds and grasses on this root-knot nematode.

Experiment I

Materials and Methods. Forty-eight two-foot lengths of 18-inch diameter tar-coated metal culverts were placed on end in the ground to a depth which left about three inches of the culverts exposed above the soil surface (Figure 1). These culvert plots were filled with virgin Immokalee fine sand. Root-knot nematodes (*M. incognita* var. *acrita*) were established in the culverts by planting one mature pepper plant, heavily infested with root-knot, in each culvert on January 13, 1959. These plants were allowed to grow for about two weeks and were then cut off at the soil level. Six forage crop species, or combinations of species, and okra were sprigged or seeded on January 29th. These seven treatments plus a clean fallow treatment were replicated six times in a randomized block design.

Soil samples were collected from each culvert plot 4, 6, and 8 months after crops were planted. These samples were placed in 10-ounce paper cups and seeded to cucumbers. About two weeks after seeding the cucumbers, the soil was washed from their roots in order that they could be rated for galling. The ratings from 0 to 5 represented no galling to very severe galling, respectively.

Results. The root-knot nematode population declined in the presence of pangolagrass as fast as in fallowed soil. The population increased rapidly on the clover, carpetgrass, Pensacola bahiagrass, and okra (Figures 2 & 3). Root-knot galls were very evident on the roots of clover and okra, however, there was no visible evidence of galls on the roots of carpetgrass and Pensacola Bahiagrass. After four months the clover died, probably due to root-knot injury. In the pangolagrass-clover combination, galling of the indicator cucumber plants was severe at the time the four-month sample was taken, but declined with each sample thereafter. The okra was replanted several times during the test because it was killed by the root-knot and damping-off disease organisms.

Experiment II

Materials and Methods. The rapid reduction of the nematode infestation in pangolagrass, and the population increases on some of the other plants in the first experiment led to this test. Several additional plant species were included, and soil samples were obtained more frequently to determine how rapidly the nematode population would change in the presence of these plants.

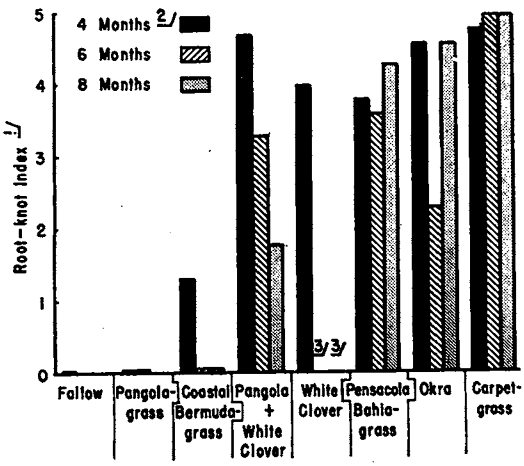

Fig. 2. The effect of several treatments on an established root-knot nematode infestation.
(1) Root-knot index 0 — 5; 0 = no galls, 5 = very severe galling of cucumber indicator plant roots.
(2) Soil samples collected and seeded to cucumbers 4, 6 and 8 months after the treatments were established.
(3) White clover died probably due to root-knot injury.

Two-gallon glazed pots were placed in the soil so that only the top inch of the pots was exposed (Figure 1). The pots were partially filled with virgin Immokalee fine sand. The root-knot nematode (*M. incognita acrita*) was established in these pots by mixing the surrounding soil and galls from cucumber roots with the soil in the pots. Various crop species were then planted in the pots. Twelve treatments were replicated four times in randomized blocks. Soil samples were collected from each pot at the end of 4, 8, 12 and 16 weeks and seeded to cucumbers in paper cups. Root-knot ratings were made two weeks after seeding the cucumbers as in Experiment I.

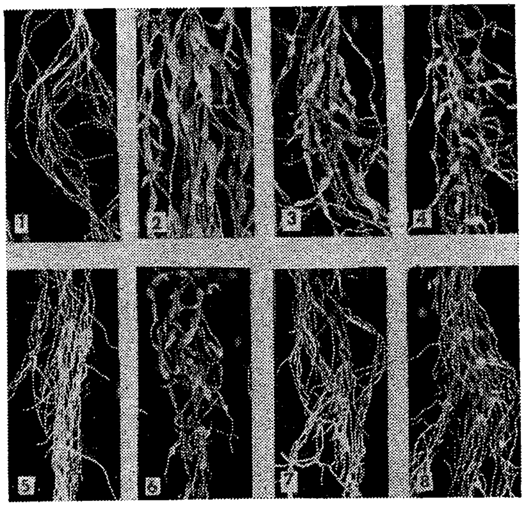

Fig. 3. Cucumber roots, showing effect of land management on population levels of M. incognita acrita. Cucumber plants were growing in soil collected four months after the following treatments were established.
1—pangolagrass
2—white clover
3—pangolagrass plus white clover
4—Pensacola Bahiagrass
5—Coastal Bermudagrass
6—carpetgrass
7—clean fallow
8—okra

Results. Pangolagrass gave no control after growing four weeks in the nematode infested soil, but after eight weeks root-knot was absent. This was similar to the fallowed and flooded treatments. A low nematode population was maintained in the Coastal Bermudagrass plots throughout the test while rather high root-knot nematode infestations occurred in soils planted to the other crops (Figure 4). Clover was planted in non-infested virgin soil to check the effects of root-knot on summer survival of clover. This clover produced significantly better yields than the clover in the infested soil, which was stunted throughout the test. The crabgrass died prematurely probably due to the nematode injury.

Experiment III

Materials and Methods. A one-acre block of Immokalee fine sand which had been planted to a spring, 1956 tomato crop was divided into plots measuring 24 feet by 250 feet with ten-foot alleyways. The three soil management practices established immediately after the tomato crop were: 1) planted to pangolagrass, 2) disked periodically to keep the soil free of weeds and grasses, and 3) volunteer weeds and grasses were allowed to become established. These treatments were replicated three times in an unrandomized block design. In the spring of 1959, about two and one-half years after these treatments were established, the north half of the plots was planted to tomatoes. The south half of each plot was planted to tomatoes in the fall of 1959. The roots of ten plants from each plot were examined for root-knot after the tomatoes were harvested.

RESULTS. Tomato plants taken from the pangolagrass and clean fallow plots in the spring test were free of root-knot. Seventy-three percent of the plants from the volunteer weeds and grass plots were infested. In the fall test an average of 80 percent of plants from the weed and grass plots had root-knot, 16 percent from clean fallow, and 3 percent from pangolagrass plots.

Discussion and Conclusions

Established populations of *M. incognita acrita* in the small plot experiments reported here were very rapidly reduced when pure stands of pangolagrass were maintained in the plots. Coastal Bermudagrass was also effective in holding the nematode populations at a low level. While no nematodes were found in the soil two months after the establishment of pangolagrass, it is apparent that in commercial practice, where pure stands are difficult to obtain, this interval may be much longer. However, it has been demonstrated in other studies that a pure stand of pangolagrass may be hastened by 1) planting in the spring, 2) using a large amount of planting material, 3) supplying adequate moisture and 4) fertilizing heavily with high nitrogen formulations. The large field plot experiment indicated that

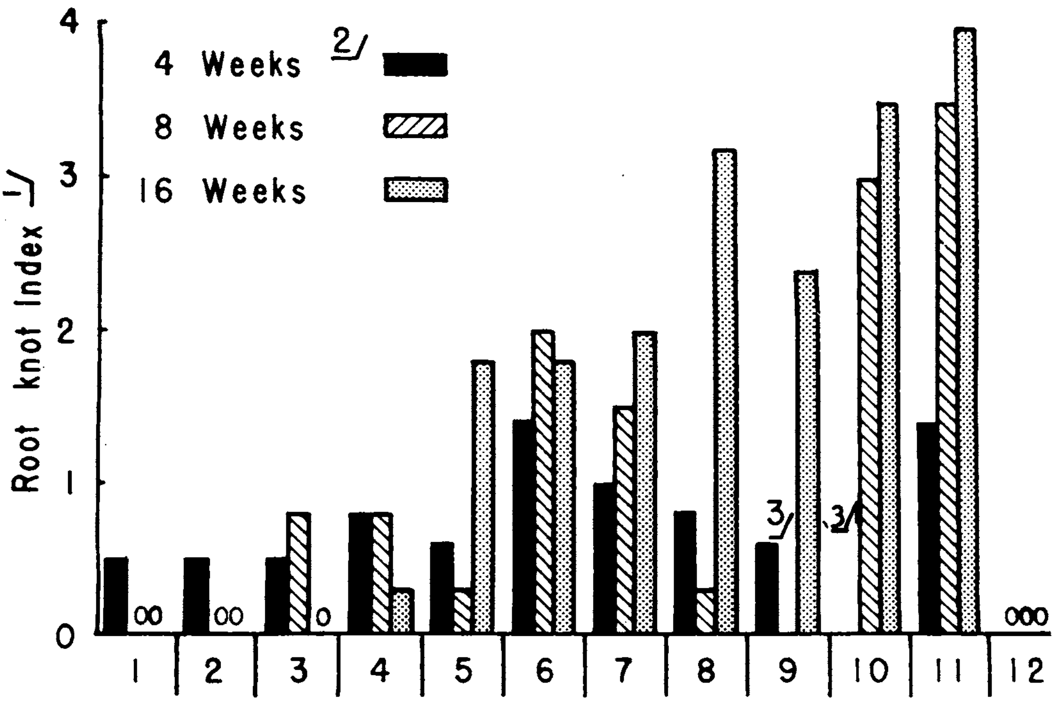

Fig. 4. The effect of several treatments on a root-knot nematode infestation in Immokalee fine sand.
1—clean fallow
2—pangolagrass
3—clean fallow plus flooding
4—Coastal Bermudagrass
5—Common Bermudagrass
6—crabgrass
7—Pensacola Bahiagrass
8—Louisiana S-1 white clover
9—Gahi millet
10—sedge
11—carpetgrass
12—La. S-1 in soil free of root-knot nematodes
(1) Root-knot index 0 — 4; 0 = no galls, 4 = very severe galling.
(2) Soil samples collected in each treatment 4, 8 and 16 weeks after treatments were established.
(3) The indicator plants damped-off and no rating was made.

the root-knot nematode problem can be controlled by pangolagrass. It should be emphasized, however, that the results of these experiments would not be expected following a mixture of pangolagrass and other weed and grass species.

The results suggest that certain grass species, thought by many to be non-hosts to root-knot nematodes, may actually build up or hold that population at a high level. Crabgrass, Common Bermudagrass, and water sedges are widespread on most "old" farm lands. These grasses appear to be excellent hosts for *M. incognita acrita* even though a casual examination of their root systems probably would show no galling.

Clean fallow and clean fallow plus flooding were about equal in their effectiveness in controlling the nematodes, and neither method was superior to pangolagrass. Although clean fallow appears to be effective for root-knot nematode reduction, this cultural practice creates other production problems. The loose sand is easily eroded and blown during heavy rains and winds. This results in a "water-logged" root system and sand damaged plants where clean fallow is practiced. Pangolagrass should be a more effective and economical method of nematode control because (1) the grass may be utilized for planting material, hay, silage, or grazing and (2) the stubble and root system of pangolagrass is highly effective in eliminating bed erosion by wind and water.

Experiments to be reported at a future date indicate that the mature roots of pangolagrass contain a chemical which is toxic to *M. incognita acrita*. Other studies in progress are designed to determine the effect of pangolagrass on other major parasitic nematodes.

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DOSAGES OF TOXAPHENE, HEPTACHLOR, AND PARATHION FOR BUDWORM CONTROL ON SWEET CORN[1]

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In recent years, it became apparent that insecticide treatments long recommended for budworm control (1, 7) were no longer effective (5). Harris (5) ranked the following insecticide treatments from most to least effective: parathion at 0.25, heptachlor at 0.5, DDT at 0.5, and toxaphene at 1.0 pound per 100 gallons. Each of these treatments was significantly different from the others. A dosage study of toxaphene and DDT (5) subsequently resulted in an increase in the recommended dosages of these two insecticides (3). Results with parathion and heptachlor indicated the desirability of dosage studies with these two chemicals and further comparison with toxaphene and DDT. The purpose of the work reported herein was to evaluate several dosages of parathion, heptachlor, and toxaphene and to compare these three insecticides.

Rows were 36 inches apart and plots were separated by single unsprayed buffer rows. Insecticides were applied as emulsions with a custom-made self-propelled small plot sprayer with a 2-row outrigger boom (6). In each experiment, two sprays were applied one week apart through two overhead nozzles per row and a side nozzle on each side of the row. Spraying Systems Disc Type Teejet hollow cone nozzles were used; D2-25 in Experiment I and D4-23 in Experiment II. Emulsions were applied at the rate of 100 gallons per acre at a pump pressure of 250 psi and a speed of approximately 2.4 mph. Pounds of actual toxicant per 100 gallons follow the names of insecticides in the figures.

Each experiment reported upon herein followed a previous experiment on the same planting. Bias from the earlier experiment

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