STUDIES ON THE PROBLEM OF NEMATODES IN SANDY SOIL WITH SPECIAL REFERENCE TO ITS NON-CHEMICAL CONTROL METHOD

By

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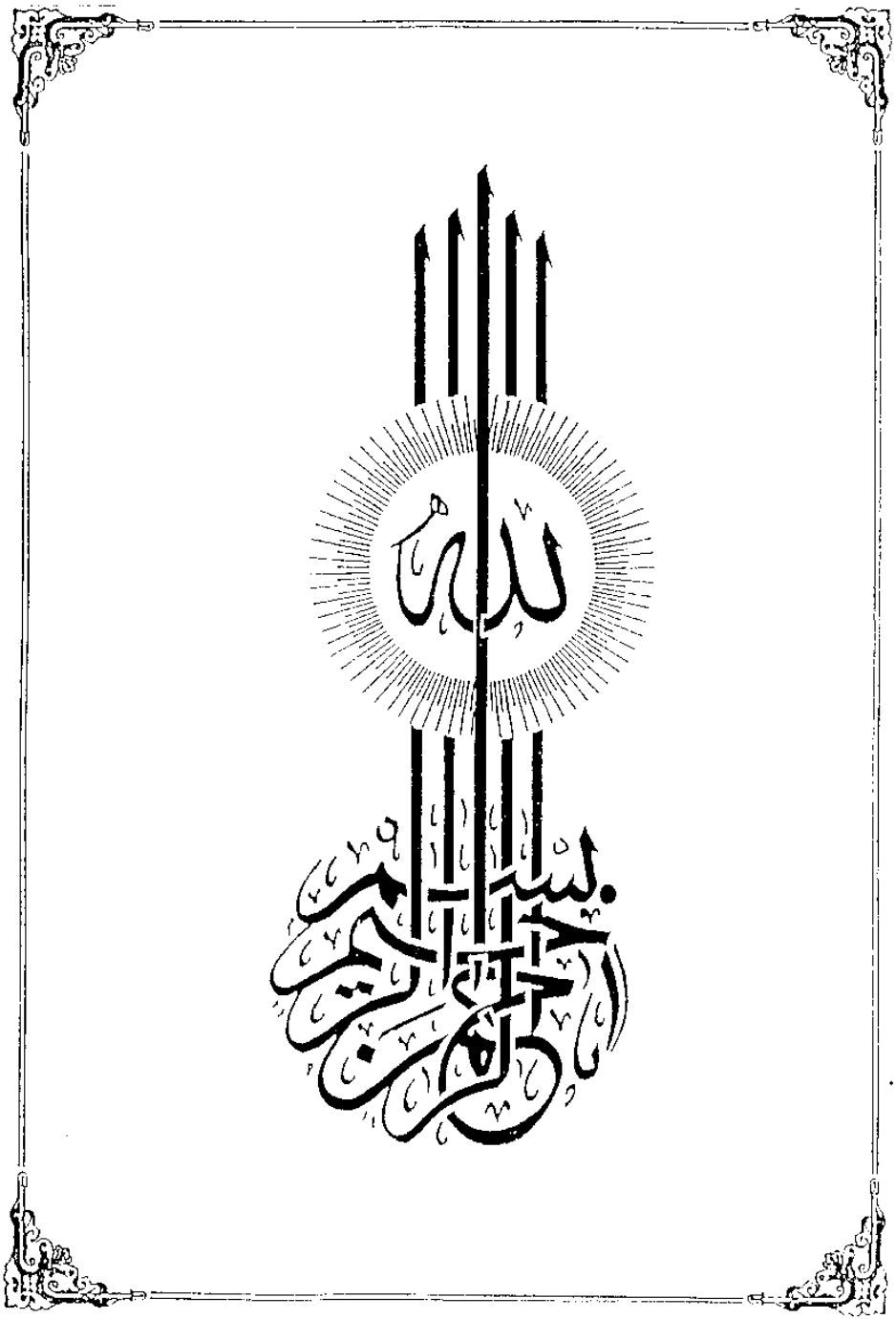

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INTRODUCTION

Common bean, Phascolus vulgaris L., was an important vegetable crop occupying large areas of Tahrir Province, Egypt. The wide spread infestation of root-knot nematodes, Meloidogyne spp. in such newly reclaimed sandy soils inflicted severe damage that present cultivated bean areas diminished to a minimum. Furthermore, the harmful effect exerted by nematodes on nodulation resulted in considerable losses and reduced uptake of nitrogen.

Control of pests is an important facet of meeting the needs of an expanding population. To achieve the purpose of increasing the productivity of the newly reclaimed irrigated lands, control of important plant-parasitic nematodes is essential. The methods employed, however, are and will continue to be dictated by economic considerations. Concurrently, increasing awareness of the importance of ecological and economic limitations is likely to force new emphasis upon the classical cultural control measures like crop rotation and resistant varieties.

The present study was carried out in the Southern Sector of Tahrir Province where extensive sandy soils were

cotton (Oteifa, Gibrail & Bekry, 1969). El-Eraki (1970) considered Lannate, and Temik, the leading pesticides in respect to R. reniformis control on cotton. Miller and Taylor (1970), however, found in greenhouse trials that Lannate gave good control of the tobacco cyst nematode, Heterodera tabacum Lownsb. & Lownsb., 3 weeks after addition to soil, but not 6 weeks after addition. [illegible] (1972) in the Philippines successfully controlled root-knot nematodes of cowpea and okra by using 20 kg of Temik 10 G / hectare. In preliminary tests, he found that mungo beans treated with Temik 10 G at 10 Kg/ ha yielded 100 % more than those in the untreated plots. Foliar sprays, e.g. Parathion (Blake & Ford, 1950) and OS-1836, active ingredient diethyl 1-chlorovinyl phosphate, (Bergeson, [illegible]), were partially successful against stem and leaf nematodes. Ditylenchus dipsaci (Kühn) Filipjev and Aphelenchoides ritzema-bosi (Schwartz) Steiner, respectively but failed to kill H. [illegible] ([illegible]).

[illegible]

were applied, apparently the rate of nematode development was reduced or the reproductive potential diminished. Miller (1972) found that D-1410 gave 98% control of tobacco cyst nematode, H. tabacum on tomato at rate of 2 lb/ acre and complete control at 6 lb/acre.

MATERIALS AND METHODS

Nematode assay.

Roots of growing plants from each experimental field plot were dug out, washed in tap water, chopped into small pieces, mixed together and 3 g were taken as a represented sample. Each 3-g root sample representing a crop was preserved in a small vial with 10 ml of a 5% formalin. Roots were macerated for nematode extraction. The impracticability of practicing procedures using the commercial enzyme preparations, 50% solution of Pectimal 39L as a liquid pectinase concentrate, to release root-knot nematode stages from galled roots (Dropkin, Smith, & Myers, 1960; Dickson, Sasser & Hussingh, 1970; Hussey, 1971) gave rise to a simple and satisfactory method for root maceration. The preservative was decanted and replaced by 1% solution of NaOH in which the root sample was kept for 10 days. The sample was then treated with 1% solution of ammonium oxalate and kept in it for another 10 days. Roots, consequently, were softened and easily processed in a blender, in which the blades had been screwed upside-down to prevent nematode injury, with water for one minute.

Macerated roots and free-nematode stages were collected on a 60-325 mesh sieve series. The material collected on both sieves was transferred to a 250 ml beaker and diluted to 100 ml. Number of egg-masses, larvae and females per 5 ml of suspension was determined.

[redacted] females released from macerated roots of each host plant under test or bean nodules were transferred into small vials containing cold lactophenol with acid fuchsin and stored in it for not less than 24 hours. The character used to differentiate the species of [redacted] is the posterior cuticular pattern.

Nematode-rhizobium inocula.

Because of the uneven distribution of nematodes in the field an experiment was carried out to explore the influence of the expected variation of nematode infection on bacterial nodule formation. The Sesbania common bean variety was cultivated as test plant and was cultivated in the whole area of the experimental plots. The original inoculum of [redacted] Meyer was obtained from the Department of Bacteriology, Ministry of Agriculture. A suspension of the inoculum was prepared and used to [redacted]

a thin layer in the laboratory for drying. The whole plants were removed after 48 days from growing. On the basis of visually indexing the degree of nematode infection, bean roots were scored on the range 0 to 3 which parallels 0, 25, 50 and 75 % relative to the degree of root-knot damage.

Nodules histological pathology.

Healthy and Meloidogyne-infected nodules were selected from 48-day old Seminole bean plants. Specimens were washed thoroughly with tap water to remove excess associated sand particles. A fine brush was used to facilitate cleaning. Following that, they were fixed in FAA (formalin 40% 6 ml, glacial acetic acid 1 ml, ethanol 95 % 20 ml and distilled water 40 ml) for at least 24 hours, dehydrated with ethyl alcohol dilutions, cleared with absolute alcohol - xylene mixtures followed by 100% xylene, embedded in paraffin, sectioned longitudinally or transversely at 9-micron thickness, and finally stained with the safranine-fast green method according to Jensen (1962) procedure.

Cropping system design.

The selected area was previously cultivated with clover which was found infected with the root-knot nematodes, Meloidogyne spp. The clover roots were removed and cut into

small pieces and the sand of the selected area was dug out to 50 cm depth, mixed together thoroughly and used as inoculum. The area was then divided, according to split plot design, into 4 longitudinal sections. Each section, representing a replicate, was divided into 10 main plots for the first cropping system experiment and 11 for the second. These main plots were then subdivided into 5 subplots each (1.5 x 1.5 m for subplot). The main plots were prepared, from the agricultural viewpoint, for cultivating the experimental crops. Ten winter crops were chosen, viz., horsebean, Vicia faba L. var. Giza 2; clover, Trifolium alexandrinum L. var. Giza 3; lupine, Lupinus termis Forsk. var. Giza 2; peas, Pisum sativum L. var. Perfection; tomato, Lycopersicon esculentum Mill. var. Marmande; pepper, Capsicum frutescens L. var. California Wonder; beet, Beta vulgaris L. var. Detroit; onion, Allium cepa L. var. Improved Giza 6; wheat, Triticum vulgare Vill. var. Giza 144; barley, Hordeum vulgare L. var. Giza 118 and marigold, Tagetes minuta L. Marigold was cultivated only in the second cropping system as the 11th winter crop. Each main plot represented one winter crop in the longitudinal sections. Therefore, the crops were replicated four times and randomly distributed. The plants of each crop were treated properly from the agricultural point of view during the whole growing seasons.

At the planting time of common beans, P. vulgaris the vegetative parts of winter crop plants were removed. Then, the whole area was prepared for cultivation of beans in 3 rows per every subplot and with 6 plant holes/row. Rhizobial inoculum was added to seeds in the 2nd experiment to insure nodulation. Five green common bean varieties were tested, viz., Monte Cals, Seminole, Giza 3, Contender and Tendergreen. All the varieties were randomly cultivated in each main plot with one variety per subplot. Only two seedlings were left in each hill. Yield of every subplot was collected and weighed at 3 stages during the growing season.

During summer months after the first cropping system, the whole area was occupied with cowpea, Vigna sinensis End., in order to increase nematode population. Furthermore, large quantities of soil and roots of different plants from heavily Meloidogyne- infested area, plus cowpea-infected roots were cut into small pieces and equally added to the subplots just before the cultivation of the second winter crops. Soil samples of winter crops were taken at harvest time. Soil samples of roots of bean varieties were taken after the second yield collection (90 days after sowing). These plants were individually harvested from each subplot. By squeeze

the effect of different nematode densities, resulted from the tested winter crops, on nodule formation of bean varieties nodules of 3 plants randomly selected from each subplot were counted. Samples were taken at 30 and 55 days from planting.

Nematicidal field trials.

The selected area was predominantly infested with the root-knot nematodes, Meloidogyne spp. Throughout summer months, the experimental area was cultivated with cowpea in order to increase nematode population. At the planting date cowpea roots were removed, chopped into small pieces, thoroughly mixed and then evenly distributed. The area was then divided, according to randomized complete block design, into 4 longitudinal sections or replications. Each section was divided into 8 plots in which the tested treatments were randomly distributed. Each plot (2.0 x 2.5 meters) contained 4 rows with 8 plants/row. Green common bean var. Seminole as a test host plant, was cultivated in the whole area at late september, 1970.

The following [illegible] and carbamate pesticides were tested. These [illegible]

(Terracur P); ethyl 4- (methylthio)-m- toylisopropyl-phosphoromidate (Nemacur) and O,O- diethyl S- (ethylthiomethyl) phosphorodithioate + O,O - diethyl O-2 pyrasinyl phosphorothioate (Thimet + Nemafos), and three carbamates, viz., 2 - methyl 1-(dimethylcarbamoyl) - N - (methylcarbamoyl) oxy) thioformimidate (D-1410); 2 - methyl - 2-(methylthio) propionaldehyde O- (methylcarbamoyl) oxime (Aldicarb, Temik) and S - methyl - N - ("methylcarbamoyl" oxy) thioacetimidate (Lannate) were used. The contact volatile halide nemhicide 1,2 - dibromo - 3 - chloropropene (DBCP, Fumasone) was included for comparison in the screening test. Terracur P, Nemacur and Temik were 10% granular formulations while granular Lannate was 5%. Thimet was used in combination with Nemafos (Thimet + Nemafos) in a granular formulation each contained 5% active ingredient. D- 1410 was 35% in aqueous solution and Fumasone was 75% emulsifiable concentrate. An equivalent of a standard dose of 15 kg / fedden of Terracur P, Nemacur, Thimet + Nemafos, Temik and Lannate was applied to each plot as side dressing one week after germination. A dosage of 4 L / fedden of D-1410 was sprayed on the foliage of the one week growing seedlings, while Fumasone 6 L / fedden, was sprinkled in the irrigation water the day before planting. Doses were based on the equivalent of active ingredient.