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Comparison Between Agriculture Soil and Common Land Soil in Relation to Soil Edaphic Factors and Nematode Community

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Abstract: ***Plant-parasitic nematodes may cause mechanical damage to the roots, stems, leaves, and flower structures of many plants. The host plant is more important in the nematode population. The control of these nematodes is more difficult than that of other pests because they mostly inhabit the inner part of the crops. Some Edaphic factors and secondary metabolites of plants play an important role in nematode control. The present study aims to analyze the comparision between agriculture soil and common land soil in relation to soil edaphic factors and nematode community. For testing nematode infection in crops, different agricultural fields were selected from different areas in and around Junagadh District. We have selected some agriculture sites in which nematode population were widely found. On the other hand, common land soil were no nematode population found. Edaphic factors like soil pH, Temperature, Moisture, Organic Carbon, Electrical Conductivity, Phosphorus, and Potassium were effective in the nematode growth. Results indicate that Soil temperature and Moisture were more affected in the nematode community. Further studies for the control of these nematodes are underway.***

Keywords: Nematode, Edaphic factors, Temperature, Moisture, Organic Carbon

I. INTRODUCTION

A natural population of the plant-parasitic nematodes is usually polyspecific. Species have different niche dimensions. The same species may be present in different proportions in different environmental conditions at different times. The host plant affects populations of plant-parasitic nematodes more than do soil factors. Even though the host-parasite associations are strong and the living part of a community cannot be separated from the physical part. If the species composition of populations is casual, then density-dependent factors are weak. (Norton, 1989)

Biological control of these plant-parasitic nematodes would be incomplete without some consideration of the soil environment. Plant-parasitic nematodes spend most of their life cycle stages in soil. They also develop their relationships with roots during the feeding process, it is considered them as occupying the soil–root interface rather than the bulk soil mass. Eggs of some plant-parasitic nematodes diffuse from roots and feeding takes place of the root system near root tips, root hairs, and in regions where lateral roots emerge. The bodies of ectoparasitic nematodes attach with the surface area of root; adult females of some sedentary endoparasites protrude into this zone and the eggs of many species are aggregated on the root surface. (Stirling, 2018)

Edaphic factors such as soil pH, Temperature, Moisture, Organic Carbon, Electrical Conductivity, Phosphorus, and Potassium were effective in the nematode growth (Norton, 1989). Some Edaphic factors and secondary metabolites of plants play an important role in nematode control.

The present study aims to analyze the comparision between agriculture soil and common land soil in relation to soil edaphic factors and the nematode Community.

II. MATERIAL AND METHODS

A. Study Area and Soil Sampling

This research was conducted on the different areas in and around Junagadh district which is situated in the Southwestern part of the Gujarat state. Soil samples were collected by the Random sampling method. The soil was collected from the 15 cm depth where nematode population was mostly found. Soil samples were collected in polythene bags from different sites. Each bag marked with name of the site and the date. Then soil samples were estimated in a laboratory for different edaphic factors. Based on edaphic factors we found an effect of nematode population in different soil.

B. Soil Edaphic Factors

Soil Temperature [by thermometer at a depth of 15 -20 cm below the ground]

Soil Humidity [in terms of percentage on a dry weight basis. A known amount of soil sample was taken from the different locality and it was dried in an oven at 80ºC for 48 h and weighed again. The percentage of moisture content was calculated by using the following equation:

$$\text{Moisture} = \frac{\text{weight of moist soil - the weight of dry soil} \times 100}{\text{weight of dry soil}}$$

Soil pH [by pH meter]

Soil Electrical conductivity [by ELICO CM 183EC-TDS Analyser]

Organic carbon [by volumetric method (Walkley and Black, 1934)]

Available Phosphorus [by Bray's and Olsen's method (Bray and Kurtz, 1945 and Olsen, 1954)]

Potassium [by flame photometry (Toth and Prince, 1949)]

C. Nematode Extraction and Identification

Nematodes were found from 15-20 cm depth of soil and root materials. For that, we have used the Baerman funnel technique. The extracted nematodes were observed under a stereo microscope and Binocular light microscopes. Identification of nematodes was based on their morphological characteristics. For that, we used 2 different types of identification keys which are the interactive diagnostic key to plant-parasitic, free-living and predaceous nematodes (Tarjan et al., 1977) and the identification key for agriculturally important plant-parasitic nematodes (Mekete et al., 2012).

III. RESULTS AND DISCUSSION

Results show the statistical data for the soil analysis in and around Junagadh district and the status of the nematode population. Table-1 shows the statistical data, where the average has been calculated. In which common land soil have no nematode population found. On the other hand, agriculture soil were found to be rich in nematode populations. In which average temperature and pH were low in agricultural soils as compared to common land soils. Where as average Humidity, EC, Organic Carbon, Phosphorus and Potash were high in agricultural soils as compared to common land soils.

Soil Edaphic factors	Common Land soil	Agriculture soil
Temperature (˚C)	29	25
Humidity (%)	22	26
Soil pH	8.1	7.7
Electrical Conductivity (EC) (dS/m)	0.25	1.11
Organic Carbon	0.87	1.95
Phosphorus (kg/ha)	41.56	52.02
Potash (kg/ha)	276	459

Table I : Stastical data of soil edaphic factors in agriculture soil and common land soil

A. Classification of Nematode

In our study, We have identified 4 nematode species viz., *Monhystera sp., Mesorhabditis sp.*, *Ditylenchus sp.* and *Meloidogyne sp.* from agriculture soil rich in amount. The classification and general characters for each nematode species are as follows:

B. Monhystera sp. Identification

Body mostly tapering considerably posteriorly. Caudal sucker small, somewhat pointed. Esophagus uniform, cylindrical. Vulva about a posterior third of the body. Uterus unsymmetrical. Viviparous or oviparous. Spicules long. (Bastian, 1865). With the above characteristics, the collected specimen was identified by an Interactive diagnostic key to nematodes (Tarjan et al., 1977).

Classification :

Kingdom	:	Animalia
Phylum	:	Nematoda
Class	:	Adenophorea
Order	:	Monhysterida
Family	:	Monhysteridae
Genus	:	*Monhystera*
Species	:	*Monhystera sp.*
Host Plant	:	Ground nut

(*Arachis hypogaea* L.)

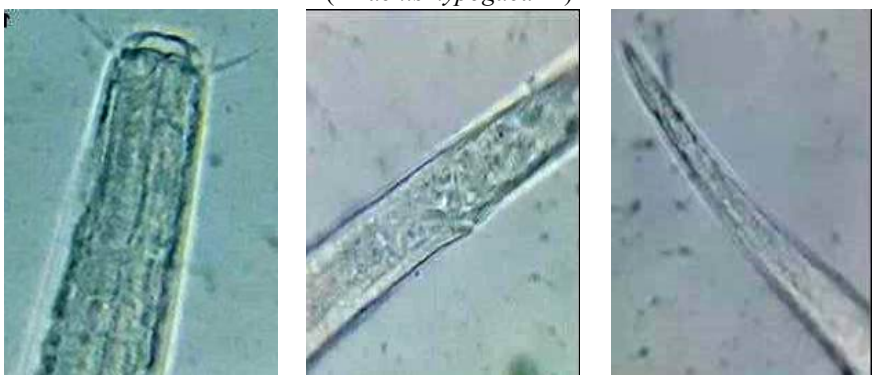

Fig. 1 *Monhystera sp.* A) Mouth part with cephalic setae, B) Vulva opening at the posterior part of the body and
C) Tail region

C. Mesorhabditis sp. identification :

Relatively small nematodes. Lips lobate, strongly cuticularized and in some species, deeply incised. Stoma long and narrow, never prismatic. The anterior part of esophagus is marked with transverse ridging; a median bulb present. No definite oesophageal collar. Vulva posterior and ovary single; female tail conical shaped. Bursa open and not radially arranged. Spicules long and slender, proximally knobbed, distally fused. 2 pairs of preanal papillae (Osche, 1952). With the above characteristics, the collected specimen was identified by Interactive diagnostic key to nematodes (Tarjan et al., 1977).

Classification :

Kingdom	:	Animalia
Phylum	:	Nematoda
Class	:	Chromadorea
Order	:	Rhabditida
Family	:	Rhabditidae
Genus	:	*Mesorhabditis*
Species	:	*Mesorhabditis sp.*
Host Plant	:	Saptaparni

(*Alstonia scholaris*)

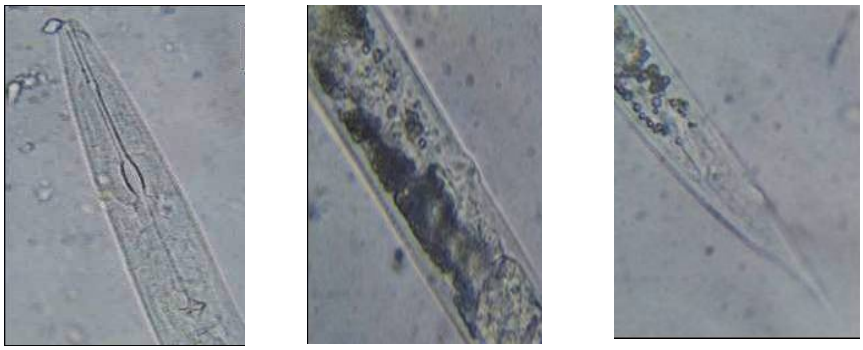

Fig. 2 *Mesorhabditis sp.* A) Mouth part with a stoma, Mid esophagus bulb and Posterior esophagus bulb well developed, B) vulva opening and C) Tail region

D. Ditylenchus sp. Identification

Median bulb with or without valve; isthmus not separated from glandular bulb by a constriction; glandular bulb short or long, when long may overlap the intestine for a short or long distance. Ovary short or long, sometimes reaching esophageal region and/or flexed; oocytes in one/two rows; columned uterus with four rows of four cells; post-uterine sac (PUS) present or absent. Testes usually without flexures; caudal alae leptoderan, short adanal or long, but never reaching tail end. Mature female not or slightly swollen. Mycetophagous or parasites of higher plants, found in soil or above ground. (Thorne, 1945) With the above characteristics, the collected specimen was identified by an Interactive diagnostic key to nematodes (Tarjan et al., 1977).

Classification :

Kingdom	:	Animalia
Phylum	:	Nematoda
Class	:	Secernentea
Order	:	Tylenchida
Famil	:	Anguinidae
Genus	:	*Ditylenchus*
Species	:	*Ditylenchus sp.*
Host Plant	:	Chickpea

(*Cicer arietinum*)

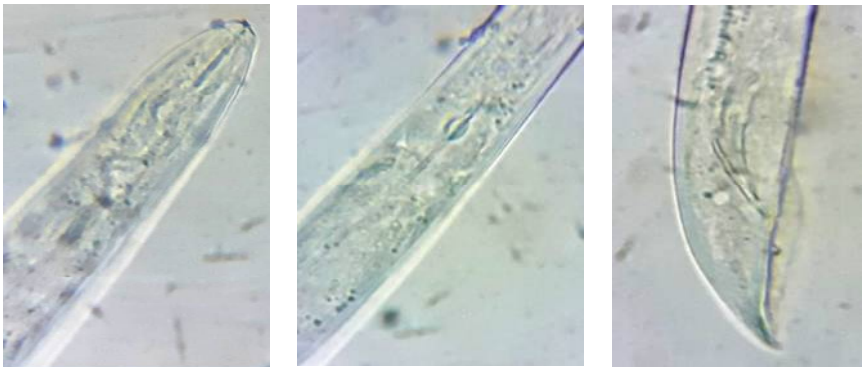

Fig. 3 *Ditylenchus sp.* A) Mouth part with stylet, B) Midian bulb and C) Tail region with spicule and bursa

E. Root-knot Nematode Identification

Cuticle not abnormally thick, annulated in all stages of the male and female. The cephalic framework of medium sclerotization; lateral sectors equal to wider than submedian sectors.

1) *Female:* Sedentary, globose with projecting neck. No preadult vermiform female stage. Cuticle moderately thick; annulationforming finger-print like pattern around vulva and anus. Labial disc dumb-bell shaped, not detached from labial sectors. Cephalic framework and spear delicate. The excretory pore is anterior to the median oesophageal bulb, often only slightly posterior to the stylet base. Vulva and anus terminal; perineal region flush or slightly raised. No cyst stage. Eggs are not retained in the body but deposited in a gelatinous matrix.
2) *Male:* Labial area low, not set-off, irregularly annulated. Lateral field with four lines.
3) *Juveniles:* Second stage juveniles migratory, vermiform. Cephalic framework and spear delicate. Labial area not set-off. Late second-stage sedentary, swollen (spike-tailed). The third and fourth stages occurring within the second stage cuticle, devoid of stylet.

With the above characteristics, the collected specimen was identified by an Interactive diagnostic key to nematodes (Tarjan et al., 1977).

Classification :

Kingdom: Animalia
Phylum : Nematoda
Class : Secernentea
Order : Tylenchida
Family : Heteroderidae
Genus : *Meloidogyne*
Species : *Meloidogyne sp.*
Host Plant : Ground nut

(*Arachis hypogaea* L.) & Chickpea
(*Cicer arietinum*)

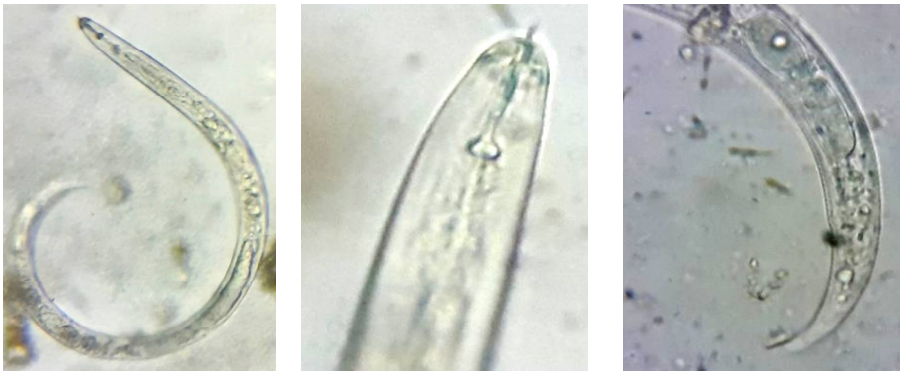

Fig. 4 *Meloidogyne sp.* A) Full Body of *Meloidogyne sp*., B) Mouth part with knob stylet C) Tail region

IV. CONCLUSIONS

From our study, we concluded that these edaphic factors are play important role in the different life cycle stages of the nematode population. We found that agricultural soils are rich in nematode population as compared to common land soil. Average Temperature and pH were low in agricultural soils as compared to common land soil. Where as average Humidity, EC, Organic Carbon, Phosphorus and Potash were high in agricultural soils as compared to common land soil due to the use of fertilizers. So these Agriculture land soil were most effective in the growth of the nematode population. The nematode diversity increased while moving from acidic to alkaline pH and in abundant to phosphorus, Potash, Organic carbon.

V. ACKNOWLEDGMENT

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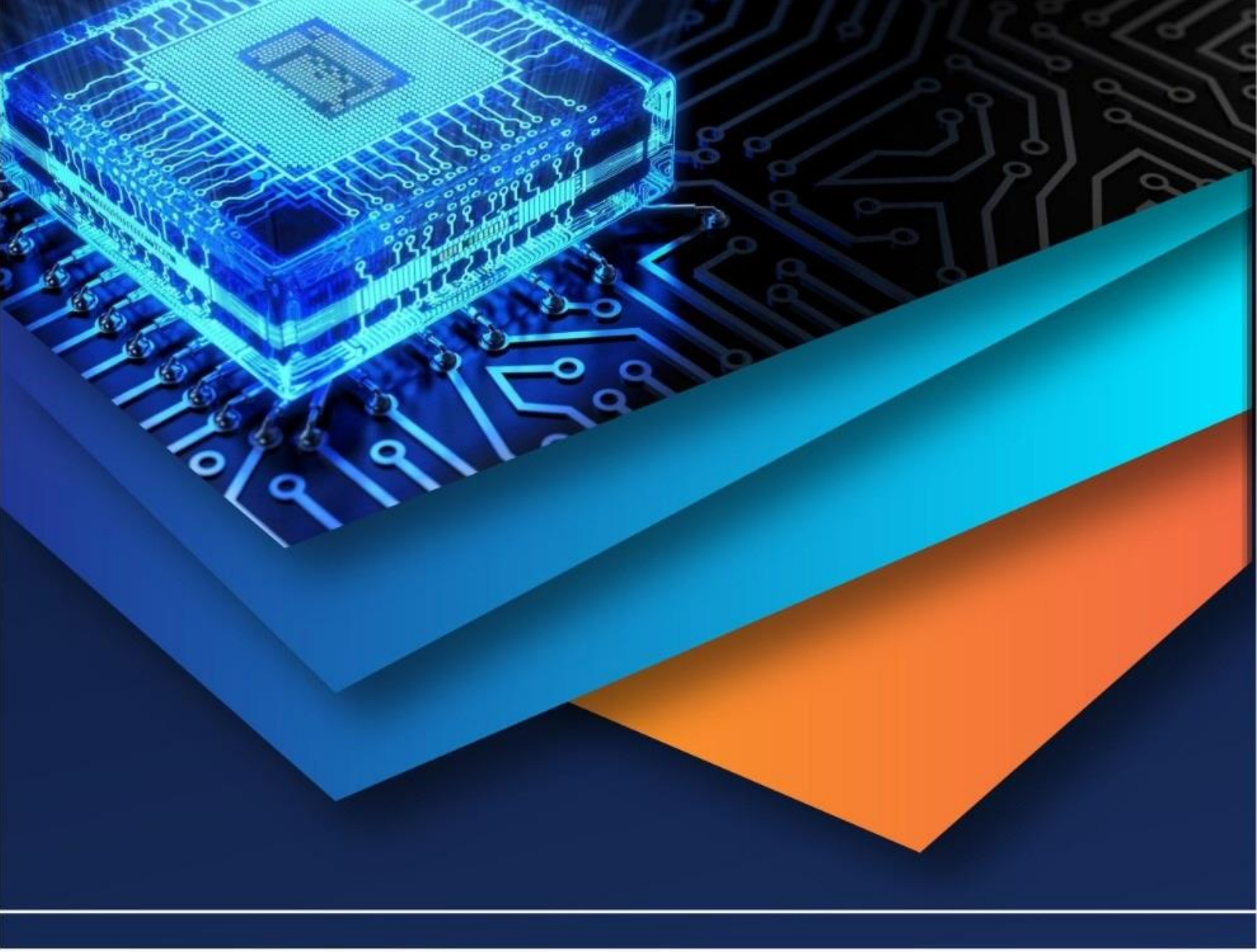

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