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Original Research Paper

POPULATION DYNAMICS OF PLANT PARASITIC NEMATODES IN RICE BASED CROPPING SYSTEM

Agricultural Science

KEYWORDS: Population dynamics, temperature, moisture, rainfall, nematode population

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ABSTRACT

Population dynamics of plant parasitic nematodes in relation to soil temperature, soil moisture and rainfall in rice was studied in ICR Farm, AAU, Jorhat campus. Maximum nematodes population was recorded during July with soil temperature 28.5°C, soil moisture 26.77 per cent and rainfall 373.7 mm, respectively and minimum population was recorded during January with corresponding soil temperature 18.66°C, soil moisture 13.32 per cent and without rainfall. *Meloidogyne graminicola, Tylenchorhynchus* and *Helicotylenchus* showed positive relationship with soil temperature, soil moisture and rainfall. Soil temperature has significant impact in raise of nematode population in rice.

Introduction

Rice (Oryza *sativa* L.) is major staple food crop of India. It is cultivated in about 42.5 million ha with a production of about 95 million tons meeting food requirements of over 50 per cent population of the country. About 300 nematode species belonging to 35 genera have been reported infesting rice. Among them, nematode species from ten genera are economically important in rice production. It has been estimated that the annual yield loss in rice due to plant parasitic nematodes on world basis is 10 per cent (Sasser and Freckman, 1987). Besides causing yield loss, nematodes also inflict indirect monetary losses resulting from export/ trade restrictions imposed due to the presence of quarantine nematode pests. Among the important nematode species that attack rice, ufra and white tip nematodes find a place in regulatory pest lists of several countries (Varaprasad *et al.*,2006). A study on population behavior of nematodes is essential for successful management . Soil temperature, soil moisture and rainfall play an important role in the population build up of plant parasitic nematodes (Yeates, 1978; Dwivedi & Mishra, 1990; Das *et al.,* 2013; Deori, A. and Das, D., 2013).

MATERIALS AND METHODS

The study was conducted at ICR Farm ,AAU, Jorhat campus. Soil, along with root samples was collected fromaround the rhizosphere of Rice. at monthly interval from fixed spots of the rice field. 200 cc soil was processed for nematode extraction by Cobb's modified sieving and decanting process (Christei and Perry, 1951). Few number of root samples were processed by Baermann's funnel technique. Nematodes thus extracted from soil and root samples were combined to show total nematode population. Nematodes were killed and simultaneously fixed in eight per cent hot formalin and population of each nematode species were counted under stereoscopic binocular microscope. Soil temperature was recorded at the time of sampling with the help of a soil thermometer. At the time of sampling, soil was collected in aluminum cane for determination of soil moisture following Gravimetric method (Khanna & Yadav, 1979). Rainfall data was collected from the Department of Agricultural Meteorology, Assam Agricultural University, Jorhat.

RESULTS AND DISCUSSION

The study on population dynamics of plant parasitic nematodes in relation to soil temperature, soil moisture and average monthly rainfall (hereafter, rainfall) around the rhizosphere of rice was conducted at Instructional Cum Research (ICR) Farm, Assam Agricultural University (AAU), Jorhat.

During the period of study in Instructional Cum Research (ICR) Farm soil temperature ranged from 18.66-28.58^{0}C , soil moisture from 13.32 – 26.77 per cent and rainfall from 0.0 -373.7 mm. Maximum nematode population was recorded during the month of July with corresponding soil temperature of 28.5^{0}C, soil moisture of 26.77 per cent and rainfall of 373.7 mm .Total nematode population decreased to reach its minimum during the month of January with soil temperature of 18.66^{0}C, soil moisture of 13.32 per cent and 0.0 mm rainfall (Fig. 1.).Total nematode population exhibited a significant positive correlation with soil moisture, soil temperature and rainfall.(Table no. 1)

Table 1. Relationship of weather factors (X) to the total nematode population density (Y) at Instructional Cum Research Farm (ICR), AAU, Jorhat campus during 2014-2015

Weather factor	Range	R	Regression equation
Soil temperature (^{0}C)	18.66-28.58	0.894**	Y=-660.693 + 41.954 X^1
Soil moisture (%)	13.32-26.77	0.885**	Y=-426.835 + 36.206 X^2
Rainfall (mm)	0.0-373.7	0.747**	Y= 242.537 + 0.913 X^3

X_1= Soil temperature X_2= Soil moisture X_3= Rainfall

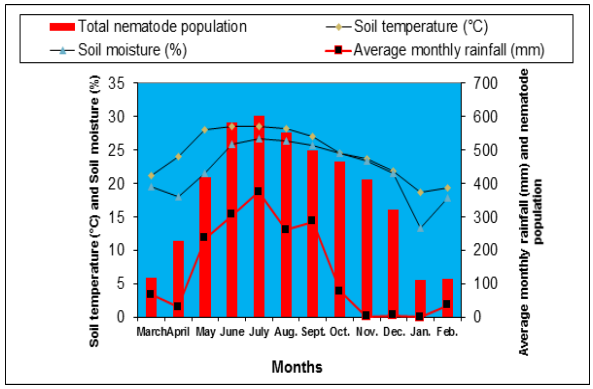

Fig. 1. Effect of soil temperature, soil moisture and rainfall on nematode population

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Multiple linear regression analysis of total nematode population with soil temperature, soil moisture and rainfall indicated that these three abiotic factors are responsible for 85.4 per cent population build up of nematode population in rice. (Table. 2.)

Table.2. Multiple linear regression of different weather factors on total nematodes population at Instructional Cum Research Farm (ICR), AAU, Jorhat campus during 2014- 2015

Variable	Coefficient	S. Ed	t-cal	Regression equation
Soil temperature (°C) (X_1)	25.432*	16.341	1.556	Y=-653.594+18.413 X_1+25.432 X_2-0.0462 X_3(R_2 = 85.4)
Soil moisture (%) (X_2)	18.413^{NS}	10.591	1.739	
Total rainfall (mm) (X_3)	0.0462^{NS}	0.317	-0.146	

*Significant at 5% level N.S= Non significant

Study on the effect of soil temperature, soil moisture and rainfall on individual nematode genera (*Meloidogyne graminicola, Helicotylenchus, Tylenchorhynchus, Hirschmanniella* and *Macroposthonia,*) at Instructional Cum Research (ICR) Farm, AAU, Jorhat revealed that population of *Meloidogyne graminicola, Helicotylenchus* and *Tylenchorhynchus* reached its peak during the month of July with corresponding soil temperature of 28.5°C, soil moisture of 26.77 per cent and rainfall of 373.7 mm. On other hand *Macroposthonia* and *Hirschmanniella* were maximum during the month of September with corresponding of soil temperature, soil moisture and rainfall of 27.08°C, 26.77 per cent and 286.0mm respectively. Minimum population of all the nematode species was recorded during the month of January. (Fig.2.)

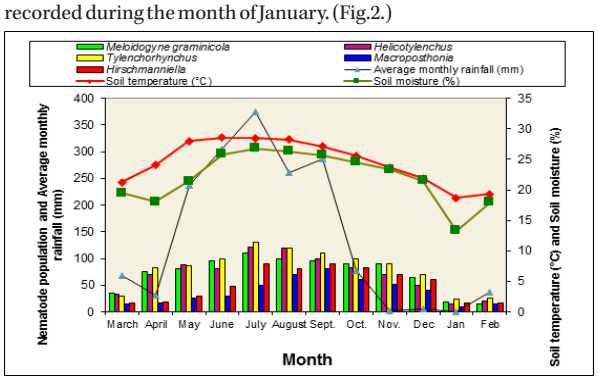

Fig.2 Relationship of weather factors (X) to nematode species (Y) at ICR Farm, AAU, Jorhat campus during 2014- 2015

Correlation study of individual nematode species with soil temperature, soil moisture and rainfall revealed that population of *Meloidogyne graminicola, Helicotylenchus* and *Tylenchorhynchus* correlated positively and significant with soil temperature, soil moisture and rainfall, while *Hirschmanniella* and *Macroposthonia* correlated positively and significantly with soil moisture, but not significantly with soil temperature and rainfall. (Table.3).

Table. 3. Relationship of weather factors (X) to nematode species (Y) at ICR Farm, AAU, Jorhat campus during 2014- 2015

Weather factors	*Macroposthonia*	*Helicotylenchus*	*Tylenchorhynchus*	*M. graminicola*	*Hirschmanniella*
Soil temperature (°C)	0.281	0.943**	0.910**	0.914**	0.514
Soil moisture (%)	0.616*	0.767**	0.764**	0.756**	0.752**
Rainfall (mm)	0.281	0.895**	0.830**	0.824**	0.312

** Significant at 1% level *significant at 5% leve

All the nematodes genera undertaken for the study attained the highest population density during the warmer months, at temperature ranging from 24.10- 28.50°C and it was similar to the findings of Bird and Mai 1967, Gupta and Atwal (1971), John(1981), Das and Rahman (1996) and Deori and Das(2013). Faster growth of nematode is evident in warmer months and a temperature range of 20- 30°C is optimum for devepmental rate of most of the nematodes (Brezski ,1970). In general, nematode takes longer period of time for hatching at lower temperature (Das and Bajaj, 2007). Low population of nematode recorded during January may be correlated with the above statement.

Soil temperature as well as soil moisture are the major factor influencing the population build up, distribution and community structure of nematode in different areas. In the present investigation, nematode population around rice positively correlated with soil temperature, soil moisture and rainfall, where influence of nematode are mostly governed by soil temperature followed by soil moisture. Bakonyi *et al.*,2007 and Deori and Das , 2013 remarked that temperature is more important factor influencing nematode community structure than soil moisture.

Population of *Meloidogyne graminicola, Tylenchorhynchus* and *Helicotylenchus* correlated positively and significantly with soil temperature, soil moisture and rainfall. The findings of the present investigation can be confirmed with the results of the above workers.

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