Biological Forum – An International Journal **15(8): 186-190(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of some abiotic factors on Population Fluctuation of Plant Parasitic Nematodes associated with Rhizosphere of Black Pepper

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(Received: 02 June 2023; Revised: 29 June 2023; Accepted: 17 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: Plant parasitic nematodes are considered as one of the major constraints of successful cultivation of black pepper. Damage caused by plant parasitic nematodes depends on population density of nematodes around the rhizosphere of a particular crop. Population fluctuation of plant parasitic nematodes is governed by several biotic and abiotic factors. Among the abiotic factors soil type, soil pH, soil temperature, soil moisture, rainfall etc. are most important. Study on population fluctuation of plant parasitic nematodes in the rhizosphere of black pepper in relation to soil and atmospheric temperature and rainfall was conducted during 2022 at Biswanath College of Agriculture, Biswanath Chariali, Assam. In the present study the month of March-April and September-October appeared to be the most favourable for increasing the nematode population in soil around the rhizosphere of black pepper plants. Two peaks of total nematode population during October and April was observed. Maximum population of all identified plant parasitic nematode genera was observed in the month of October. In the month of October average maximum atmospheric temperature was recorded as 31.22°C, minimum atmospheric temperature 19.46°C, soil temperature 29.14°C and rainfall of 111.2 mm. During winter months, nematode population was found to be decline and least nematode population was recorded in the month of January, when maximum average atmospheric temperature was recorded as 23.36°C, minimum atmospheric temperature 7.98°C, soil temperature 23.1°C and rainfall of 26 mm. The present study evaluated the population fluctuations of plant parasitic nematodes in relation with various weather parameters. The study will help in devising management strategies to reduce the infestation of plant parasitic nematodes in black pepper.

Keywords: Atmospheric temperature**,** black pepper, nematode population, plant parasitic nematodes, soil temperature.

INTRODUCTION

Black pepper (*Piper nigram* L.), is one of the most important spice crop. It is known as king of spice. Black pepper is originated in Western Ghats of India. In India it is mainly cultivated in the states like Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Goa. Now its cultivation is extended in some areas of Assam and other North Eastern States. Cultivation of black pepper is mainly threatened by two important diseases, one is *Phytophthora* foot rot and another is slow decline. Slow decline is mainly due to infestation of phytoparasitic nematodes and also in association with *Phytophthora capsici*. In the rhizospher of black pepper 29 genera and 48 species of plant parasitic nematodes have been reported (Sundararaju *et al.,* 1979; Koshy and Bridge 1990). The plant parasitic nematodes namely *Radopholus similis* and *Meloidogyne incognita* were implicated in the etiology of slow decline of black pepper in India (Nambiar and Sarma 1977; Ramana, 1986; Venkitesan and Setty 1977; Ramana *et al*., 1987) and also in other black pepper growing countries. The damage caused by plant parasitic nematodes mainly depends upon the nematode population density in the root zone of the crop. Population dynamics of plant parasitic nematodes are governed by many abiotic factors *viz*., soil type, soil pH, soil moisture, soil temperature, rainfall etc. Effect of abiotic factors on the population of various insect pests was studied by several workers in different crops (Bajya *et al.,* 2022; Bali *et al*., 2022; Nautiyal *et al*., 2022) but in case of nematode pests it is very limited. Keeping these facts in view the present investigation was undertaken to see the effect of some abiotic factors on population fluctuation of plant parasitic nematodes associated with black pepper plantation to provide a valuable database for the development of effective management schedules and advisory services in the future and thereby increase production of this valuable spice crop.

MATERIALS AND METHODS

The study was conducted at Biswanath College of Agriculture, Biswanath Chariali, Assam during 2022. In this study soil samples were collected from the rhizosphere of black pepper plants (cv.Panyur1) grown in plantation crop garden of Biswanath College of Agriculture [26.7° (26°42') N latitude, 93.5° (93°30') E longitude and altitude of 105m AMSL], AAU,

Biswanath Chariali, Assam, India. Soil samples were collected in last week of every month (January 2022-December 2022). Each samples consisting of 15 cores was randomly collected at a depth of 10cm in about 0.5 bigha area. These cores were pooled together into a composite sample (250cc soil), processed for extraction of nematodes by Cobb's sieving and decanting technique. After extraction nematodes were fixed in 4% formalin and counted subsequently in a counting dish using stereoscopic binocular microscope and individual genera were recorded. The data on mean monthly atmospheric maximum and minimum temperature, soil temperature at 10 cm depth, rainfall and number of rainy days were obtained from the Department of Agrometeorology and laboratory works were conducted at the Department of Nematology, Biswanath College of Agriculture, Biswanath Chariali, Assam.

RESULTS AND DISCUSSION

In the present study, the dominant plant parasitic nematode genera were identified as *Helicotylenchus, Hoplolaimus, Tylenchorhynchus, Meloidogyne* and *Xiphinema*. This finding is in conformity with the findings made by Pervez and Eapen (2015). They recorded nine plant parasitic nematodes *viz*., *Tylenchorhynchus* sp., *Meloidogyne incognita, Pratylenchus* sp., *Radopholus similis, Hoplolaimus indica, Helicotylenchus multicinetus*, *Criconemoides* sp., *Xiphinema* sp. and *Scutellonema* sp. in the rhizosphere of black pepper in Idukki district, Kerala. Among the identified plant parasitic nematodes, population of *Hoplolaimus* and *Helicotylenchus* were recorded maximum throughout the year. As compared to that of *Hoplolaimus* and *Helicotylenchus* the population of *Tylenchorhynchus*, *Meloidogyne* and *Xiphinema* were found to be less all throughout the year (Table 1). The month of March-April and September-October appeared to be the most favourable for increasing the nematode population in soil around the rhizosphere of black pepper plants. Two peaks of total nematode population in soil were observed during the month of April (759/250cc soil) and October (843/250cc soil). Anita and Chaubey (2003) also recorded two peaks of total nematode population during the month of April and October in the rhizosphere of *Mangifera indica*. Population of all identified phytoparasitic nematode genera was found to be maximum in the month of October followed by the month of April. In the month of October maximum average atmospheric temperature was recorded as 31.22°C and minimum temperature was 19.46°C. Likewise average soil temperature at 10cm depth was recorded as 29.14°C. This finding is in conformity with the findings of Khan *et al.* (1971). They recorded that temperature between 20-30°C was favourable for increase of stylet bearing nematodes. In the present study nematode population density was found to be declined during the winter months and least nematode population was observed in the month of January. Population fluctuation in nematode may be due to rise and fall in temperature as well as presence of moisture content in soil. During the months of December-January, the temperature of the area come down which proved lethal for nematodes survival and therefore it hindered the nematode multiplication and activities. In the study area during the month of January only 26mm of rainfall was received, that results in decrease in moisture content of soil and also in previous year (2021) from November onwards the study area received only 4.4mm of rainfall. During March-April, the population of nematodes increased gradually this may be due to sufficient soil moisture and increase in soil (27.27-31.53°C) and maximum atmospheric temperature (26.84-30.91°C) which proved congenial for nematode multiplication and survival. The present findings are in line with the earlier findings of Kamra and Sharma (2000) who reported that the optimum soil temperature for development of *M. incognita* was 25-30°C. In this period (March-April) the experimental area received 359.2 mm of rainfall, which ultimately increased the moisture content of soil. The addition of soil moisture either by rainfall or irrigation has profound influences on the behaviour of plant parasitic nematodes. Soil moisture not only governs the life processes of nematodes, it is also the important medium for active migration of nematodes in soil and for passive dispersal (Kumar *et al*., 2014).

Table 1: Month wise population fluctuation of different plant parasitic nematodes in the rhizosphere of black pepper (250 c.c soi).

Month	Nematode population					
	***Helicotylenchus* Sp.**	***Hoplolaimus* Sp.**	***Meloidogyne* Sp.**	***Tylenchorhynchus* Sp.**	***Xiphinema* Sp.**	**Total**
January,22	115	105	60	58	50	388
February,22	140	118	72	76	58	464
March,22	200	185	135	101	105	726
April,22	210	196	140	105	108	759
May,22	180	170	126	98	96	670
June,22	170	155	110	92	88	615
July,22	150	140	105	80	72	547
August,22	176	165	120	90	85	551
September,22	178	162	122	97	90	649
October,22	236	210	165	125	120	843
November,22	168	140	110	100	92	610
December,22	130	116	70	67	60	443

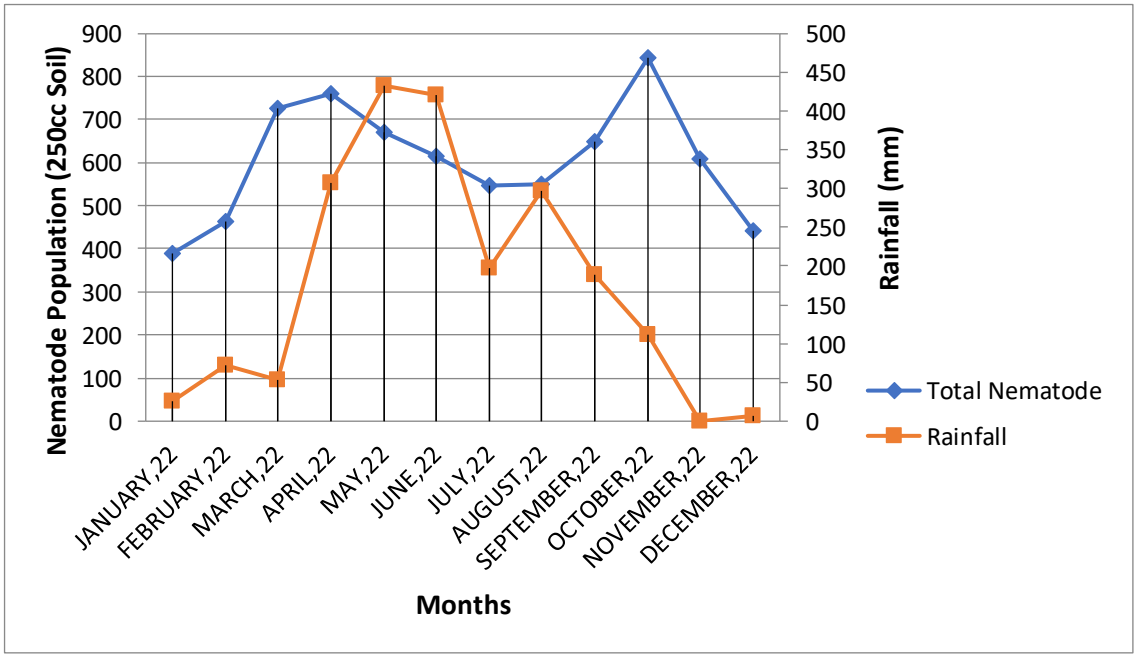

Fig. 1. Seasonal fluctuation of population of plant parasitic nematodes and influence of rainfall.

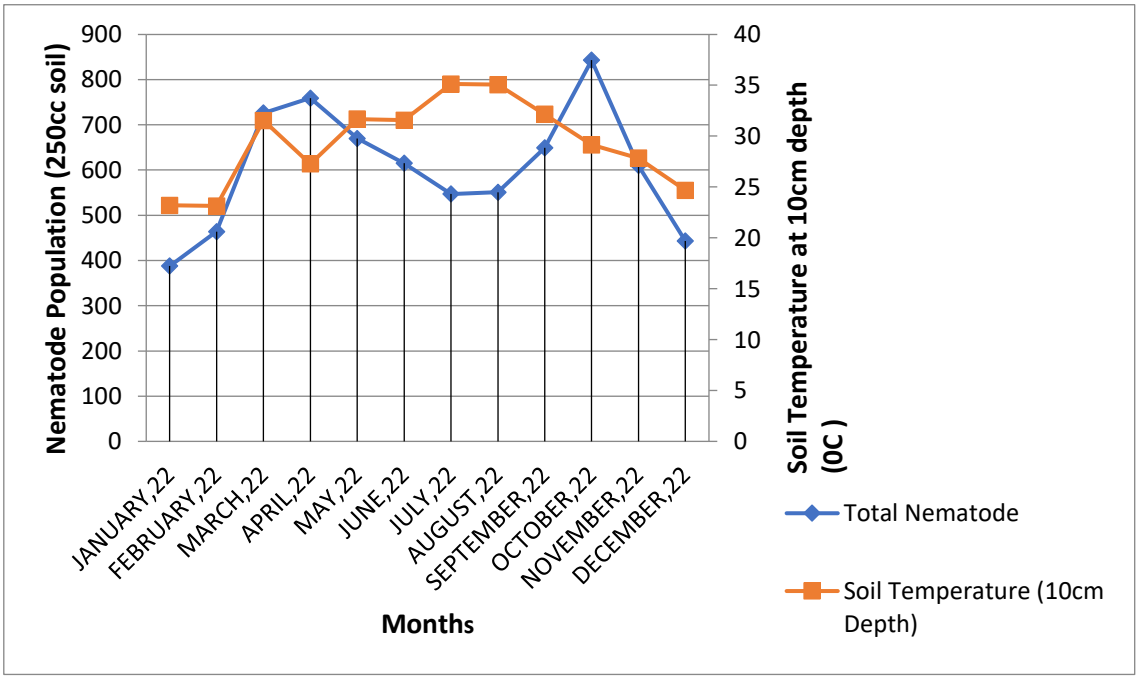

Fig. 2. Seasonal fluctuation of population of plant parasitic nematodes and influence of soil temperature.

As compared to the winter month increase in population of plant parasitic nematodes during summer months was reported by Jones (1980). During the month of July-August the nematode population comes down this may be due to a rise in soil temperature (35.05-35.12°C) as well as maximum atmospheric temperature (33.64-33.81°C) which affect the activities of nematode. Similar results were also observed by several other researchers on different crops (Sivaprakash *et al*., 2009; Askary *et al*., 2012). When moisture becomes excessive due to rainfall or irrigation the nematode numbers often decline (Kumar *et al*., 2014). During the month of July-August the experimental area received 495.8 mm rainfall, which may be the other reason for decline in nematode populations during this period. Queneherve (1989) found that population build up of *R. similis* on banana was decreased with the increase of number of rainy days or total rainfall which support our findings.

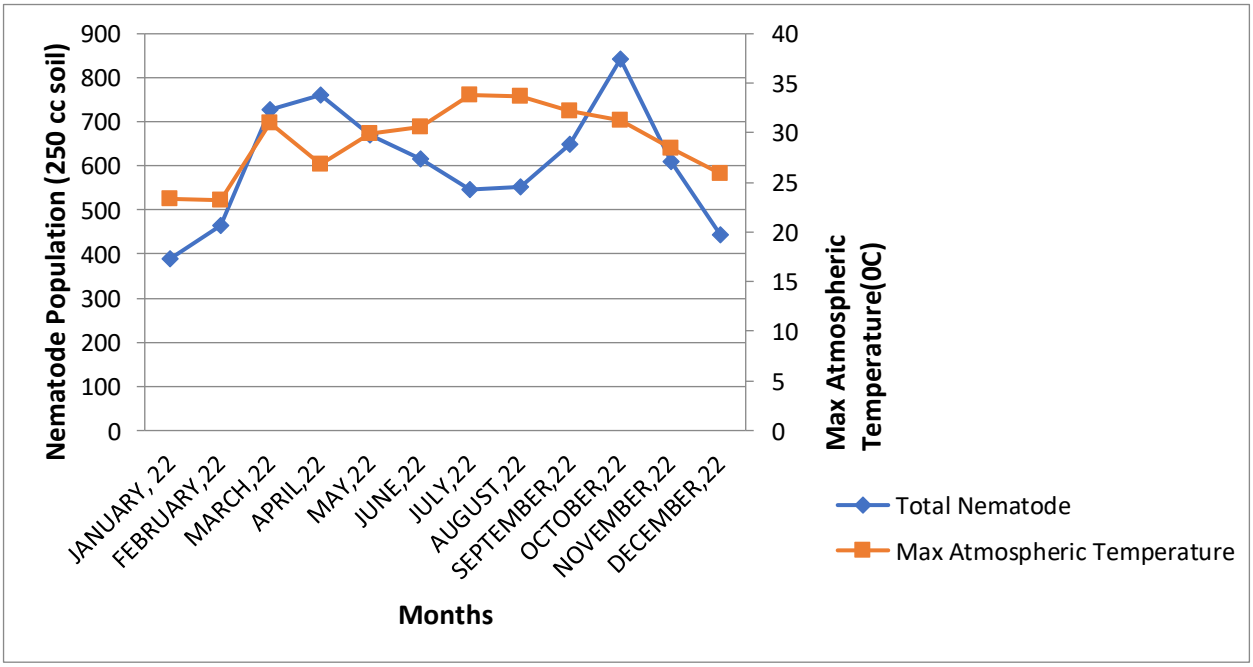

Fig. 3. Seasonal fluctuation of population of plant parasitic nematodes and influence of maximum atmospheric temperature.

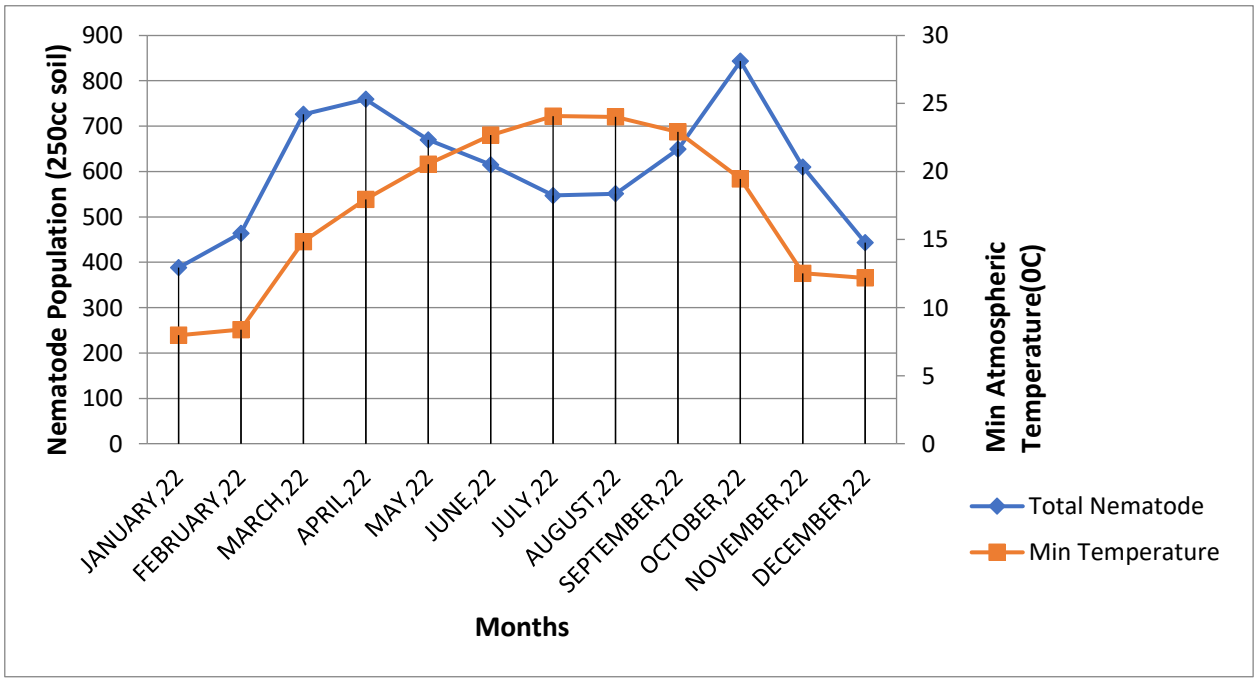

Fig. 4. Seasonal fluctuation of population of plant parasitic nematodes and influence of minimum atmospheric temperature.

CONCLUSIONS

During the winter months population of all plant parasitic nematode was found to be declined as this period received very little amount of rainfall, which indirectly affects the moisture content of soil. Likewise both soil and atmospheric temperature were found to be decline during this period as low temperature is not favourable for nematode multiplication. Nematode populations were found to be increase significantly due to increase of temperature and rainfall, which is congenial for nematode multiplication. Again during the period of heavy rainfall nematode populations were found to be declined as excessive moisture in soil tends to inhibit the locomotion of nematodes and lack of oxygen in saturated soils also adversely affects nematode populations due to asphyxia. Thus it can be concluded that temperature and rainfall have pronounced effect on population fluctuation of plant parasitic nematodes.

FUTURE SCOPE

Further studies required to develop a model of abiotic factors and plant parasitic nematode population.

Acknowledgement. The author is grateful to the Department of Agrometeorology, Biswanath College of Agriculture, Biswanath Chariali, Assam for providing Meteorological data.
Conflict of Interest. None

REFERENCES

Anita and Chaubey, A. K. (2003). Influence of soil temperature and moisture on population dynamics of ectoparasitic nematodes infecting *Mangifera indica*. *Annals of Plant Protection Sciences, 11*(1), 181-183.

Askary, T. H., Waliullah, M. I. S. and Gupta, S. (2012). Population fluctuation of plant parasitic nematodes associated with pome, stone and nut fruit nurseries. *Annals of Plant Protection Sciences, 20*(1), 265-267.

Bajya, R., Patel, Y., Garg, V. K. and Kumar, N. (2022). Effect of weather factors on population dynamics of *Helicoverpa armigera* Hubner (Noctuidae: Lepidoptera) in chickpea. *Biological Forum- An International Journal*, *14*(4a), 242-245.

Bali, R., Singh, A. K., Kumawat, P. K., Hussain, T., Singh, M., Sharma, R. N., Bajiya, S. and Kakraliya, S. S. (2022). Seasonal incidence and eco-friendly management of jassids in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]. *Biological Forum- An International Journal*, *14*(1), 1316-1320.

Jones, R. K. (1980). Population dynamics of *Helicotylenchus multicinctus* and other nematodes on banana from a subtropical environment. *Nematologica*, *26*, 27-33.

Kamra, A. and Sharma, S. B. (2000). Soil temperature regimes and nematode distribution in India. *Indian Journal of Nematol*ogy, *30*, 219-224.

Khan, A. M., Adhami, A and Saxena, S. K. (1971) Population change of some stylet bearing nematodes associated with mango (*Mangifera indica* L.). *Indian Journal of Nematology*, *1*, 99-105.

Koshy, P. K. and Bridge, J. (1990). Nematode parasites of spice, pp.557-582. In: M. Luc, A. Sikora and J. Bridge, eds., Plant parasitic nematodes in subtropical and tropical agriculture. CAB International, U.K.

Kumar, M., Balamohan, T. N., Jeyakumar, P. and Sreenivasan, N. (2014). Population dynamics of banana nematodes as influenced by weather parameters correlation studies for nematode population in banana. *Current Nematology*, *25*(1,2), 51-55.

Nambiar, K. K. N. and Sarma, Y. R. (1977). Wilt disease of black pepper. *J. Plant. Crops*, *5*, 92-103.

Nautiyal, A., Meena, R. S., Saini, R. and Nautiyal, A. (2022). Effect of abiotic factors on the population of thrips (*Scirtothrips dorsalis*) in chilli crops. *Biological Forum- An International Journal*, *14*(1), 491-494.

Pervez, R. and Eapen, S. J. (2015). Distribution of plant parasitic nematodes associated with black pepper in Idukki district, India *Annals of Plant Protection Sciences*, *23*(1), 192-194.

Queneherve, P. (1989). Population of nematodes in soils under banana, cv. Poyo, in the Ivory Coast.3. Seasonal dynamics of populations on mineral soil. *Revue Nematol*., *12*: 149-160.

Ramana, K. V. (1986). Slow wilt disease of black pepper and the role of plant parasitic nematodes in its etiology. *J. Coffee Res*., *16*, 17-21.

Ramana, K. V., Mohandas, C. and Balakrishnan, R. (1987). Role of plant parasitic nematodes in the slow wilt disease complex of black pepper (*Piper nigrum* L) in Kerala. *Indian Journal of Nematology*, *17*, 225-230.

Sivaprakash, M., Balasubramaniam, P. and Prabhu, S. (2009). Temporal pattern of phytonematodes associated with red sanders, *Pterocarpus santalinus*. *Annals of Plant Protection Sciences, 17*, 440-442.

Sundararaju, P., Koshy, P. K. and Sosamma, V. K. (1979). Plant parasitic nematodes associated with spice. *J. Plant. Crops, 7*, 15-26.

Venkitesan, T. S. and Setty, K. G. H. (1977). Pathogenicity of *Radopholus similis* to black pepper (*Piper nigrum* L.). *Indian Journal of Nematology, 7*, 17-26.

How to cite this article: Pranjal Pratim Neog (2023). Effect of some abiotic factors on population fluctuation of plant parasitic nematodes associated with rhizosphere of black pepper. *Biological Forum – An International Journal, 15*(8): 186-190.