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Population Dynamics of Predatory Phytoseiid Mite, *Neoseiulus longispinosus* (Evans) on Brinjal

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***Abstract*:** The peak incidence of *N. longispinosus* was observed on brinjal during second fortnight of April 2018 i.e. during 17th (2.375 active stages/leaf) and 18th (2.318 active stages/leaf) standard meteorological week (SMW). The incidence of egg stage was found to range from 0.00 to 0.42 per leaf. Phytoseiid mite population showed a decreasing trend when temperature increased or decreased than 37.0 °C. Temperature range from 15.5 to 26.1°C (mid-October to end of February) was not found favourable for the development of *N. longispinosus* under natural conditions. The population of eggs and active stages of *N. longispinosus* was found to have a positive correlation with maximum temperature while it showed a negative correlation with minimum temperature. A negative correlation of rainy days was also observed with the population of eggs and active stages of *N. longispinosus*.

Keywords: Brinjal, Predatory mite, *Neoseiulus longispinosus*, Population dynamics, Weather parameters

The phytophagous mites are key pests of many agricultural crops. Phytophagy in Acari is seen in families Tetranychidae, Tenuipalpidae, Tarsonemidae, Eriophyidae and Tuckerellidae. Mites were considered as minor pests of agricultural crops, but in present scenario they have become major pest due to the repeated use of synthetic pesticides and elimination of natural enemies (Hoy 2011, Dhooria 2016). Tetranychidae is a moderately large family comprising of more than 1200 described species (Krantz and Walter 2009). For the management of mite pests especially the polyphagous two-spotted spider mite *Tetranychus urticae* Koch, several new molecules of acaricides have been introduced. The repeated and injudicious use of these chemicals led to the development of acaricidal resistance in mites in different crops, mainly due to the shorter developmental period and higher fecundity of these mite pests (Leeuwen et al 2010). The development of resistance is proving to be a great obstacle in the effective integrated mite management programmes. In Punjab, higher levels of resistance in two-spotted spider mite, *Tetranychus urticae* Koch were detected for dicofol (195-fold) (Kaur and Bhullar 2011), propargite and spiromesifen (Kaur and Bhullar 2016) and fenazaquin (Sharma and Bhullar 2018). Therefore, there is a need to explore biocontrol agents for the suppression of the two-spotted spider mite population. There are many natural enemies of mites like predatory insects *viz.* coccinellid, *Stethorus* sp., *Oligota* sp., and predaceous mites which have been proven to be voracious feeders of phytophagous mites. Among the acarine mite predators, predatory mites belonging to family Phtyoseiidae mites are most promising, as they have shorter life cycle than other group of predators and they can also be mass produced fairly easily.

More than 2280 species of phytoseiids have been reported from world by Chant and McMurtry (2007) and many new species have been described since then as per the Phytoseiidae world database. From India 169 species were reported by Gupta (1985) which have been raised to 247 through the contribution of several workers (Gowda 2009, Karmakar and Gupta 2011, 2015, Bhowmik and Karmakar 2021). From Punjab, 13 species of phytoseiid mites were reported by Biswas et al (2022). Many species of family Phytoseiidae have been exploited for suppression of phytophagous mites and amongst them the species, *Neoseiulus longispinosus* (Evans) has been reported as a potential biocontrol agent against several spider mites. *N. longispinosus* was first described from Indonesia as *Amblyseius longispinosus* (Evans 1952) and is widely distributed in Taiwan, Philippines, Indonesia, India, Australia, China, Thailand, Malaysia, Pakistan, Papua New Guinea, Hawaii and New Zealand (Ho et al 1995, Ehara 2002a, 2002b). In India, it has been found as a widely distributed species and observed to feed on tetranychids on different crops (Karmakar and Gupta 2011, Haneef and Sadanandan 2013, Biswas et al 2022). Few studies on exploration of this species as biological control agent have been done in Punjab, India (Nag et al 2020, Bhullar et al 2021). But negligible studies are available pertaining to the natural

occurrence of this mite on brinjal. Therefore, the present study was planned to study the population dynamics or the seasonal incidence of phytoseiid predatory mite, *N. longispinosus* on brinjal.

MATERIAL AND METHODS

Brinjal, variety *Punjab Sada Bahar,* was raised at Entomological Research Farm, Punjab Agricultural University, Ludhiana as per the recommended Package of Practices for cultivation of Vegetable crops. Four crops of brinjal were transplanted in different seasons viz. first crop in 2nd fortnight of February (17.02.2017), second in 2nd fortnight of April (28.04.2017), third in 2nd fortnight of August (28.08.2017) and fourth in 2nd fortnight of November (28.11.2017). The population dynamics of *N. longispinosus* was studied throughout the year. The weekly observations on mite population were started after 45 days of transplanting. For recording the incidence or population of *N. longispinosus*, three leaves each from top, middle and bottom canopy were taken from ten randomly selected plants. The leaf samples were brought to the laboratory and observed under Magnus stereo zoom binocular microscope. The number of eggs and active stages of *N. longispinosus* were recorded separately. Maximum and minimum temperature, relative humidity, rainfall and rainy days were also recorded during the crop season at Ludhiana. Correlation analysis was worked out with the mite population and standard meteorological week (SMW) weather data. Partial correlations were worked out between mite population and weather parameters by using the SPSS software. Results were analysed at 1 and 5 per cent levels of significance.

RESULTS AND DISCUSSION

Population dynamics of *N. longispinosus* on brinjal: The population of *N. longispinosus* was observed on brinjal throughout the crop season. The population started increasing in 12th and 13th (0.718 active stages/leaf) SMW (end of March), and showed peak incidence in April end in 2018 i.e. during 17th (2.375 active stages/leaf) and 18th (2.318 active stages/leaf) SMW, which further showed a decreasing trend in mid of May i.e. 19th (0.542 active stages/leaf) SMW. However, population of eggs during this period was in range of 0.00 to 0.419 per leaf. Population of *N. longispinosus* was maximum when the maximum temperature was recorded as 37.0°C. Population of mites decreased when temperature was observed to be less than or exceeded than 37.0°C. Thus, this temperature can be considered as optimum temperature for the growth of *N. longispinosus.* No population of *N. longispinosus* was found after mid-October to end of February, when temperature was in the range of 15.5 to 26.1°C (Table 1). Population of eggs and active stages of *N. longispinosus* was comparatively more in February and April grown crop as compared to August and November grown crop of brinjal (Table 2).

Partial correlation coefficients between mite populations and abiotic factors: The partial correlation coefficients between the abundance of predatory mite, *N. longispinosus* with the abiotic factors i.e. maximum and minimum temperature, maximum and minimum relative humidity, rainy days and precipitation (mm) was worked out. The population of egg and active stages of *N. longispinosus* was found positively correlated with maximum temperature and negatively correlated with minimum temperature, but the correlations were non-significant. The morning relative humidity showed a negative correlation with the population of eggs and active stages whereas, the evening relative humidity showed positive correlation with both the egg and active stages. Effect of rainy days was also negatively correlated with the population of active stages of *N. longispinosus* (Table 3).

Rachana et al (2009) recorded the population of *N. longispinosus* on *Tetranychus neocaledonicus* (André) in Shimoga region of Karnataka. Rajgopal and Srinivasa (2017) also reported greater predaceous activity of *N. longispinosus* during the summer season against *Tetranychus macfarlanei* (Baker and Pritchard) on okra. Rinkikumari *et al* (2017 recorded 0.13 mites per leaf during the 2nd SMW and reported gradual increase in population during 22nd SMW (last week of May) with 5.40 predatory mites/ leaf. Singh and Chauhan (2018) in Himachal Pradesh under polyhouse conditions recorded 8 species of predatory mites *viz*. *Euseius prasadi* (Chant & McMurty), *E. finlandicus* (Oudemans), *E. delhiensis* (Narayanan & Kaur), *E. alstoniae* (Gupta), *N. paspalivorus* (DeLeon), *N. longispinosus*, *P. roseus* (Gupta) and *Lasioseius sp*. and *E. prasadi* was dominant. Jasmine et al (2008) observed that that the predatory mite, *N. longispinosus* had positive correlation with the eggs and active stages of its prey i.e. *T. macferlanei* and *Oligonychus indicus* (Hirst) as well as with average temperature and average relative humidity. Singh and Singh (2014) recorded the seasonal incidence of *T. neocaledonicus* and *N. longispinosus* on brinjal and observed a significant positive correlation with maximum temperature, whereas negative correlation with minimum temperature, relative humidity and rainfall was observed. Shah (2014) reported that the incidence of predatory mite, *N. longispinosus* had significant positive correlation mean temperature while significant negative correlation existed with mean relative humidity. There was significantly positive relationship of population of *N. longispinosus* and *T. urticae* with maximum

Table 1. Population of phytoseiid predatory mite, *N. longispinosus* on brinjal and weather parameters

SMW	Mean population/leaf		Temperature (°C)		Relative humidity (%)		Rainfall	
	Eggs	Active stages	Maximum	Minimum	Morning	Evening	Precipitation (mm)	Rainy days
1	0.000	0.000	15.9	5.4	96.0	66.0	0.0	0.0
2	0.000	0.000	20.8	5.3	94.0	43.0	0.0	0.0
3	0.000	0.000	22.0	6.1	92.0	40.0	0.0	0.0
4	0.000	0.000	15.5	7.6	93.0	76.0	18.4	1.0
5	0.000	0.000	21.2	7.6	91.0	46.0	0.0	0.0
6	0.000	0.000	21.1	5.6	89.0	38.0	2.4	0.0
7	0.000	0.000	21.1	9.3	89.0	53.0	21.4	1.0
8	0.011	0.000	25.5	11.7	88.0	48.0	3.2	0.0
9	0.011	0.000	25.8	13.1	89.0	51.0	0.0	0.0
10	0.154	0.220	27.2	12.2	88.0	42.0	0.0	0.0
11	0.088	0.242	29.9	14.1	85.0	30.0	0.0	0.0
12	0.286	0.705	29.2	14.2	86.0	44.0	0.0	0.0
13	0.321	0.718	33.1	16.5	74.0	29.0	0.0	0.0
14	0.264	0.353	34.8	20.3	69.0	33.0	0.0	0.0
15	0.000	0.090	36.6	15.1	56.0	13.0	0.0	0.0
16	0.011	0.676	41.7	23.6	51.0	23.0	0.0	0.0
17	0.000	2.375	36.9	21.5	54.0	23.0	8.6	1.0
18	0.011	2.318	37.0	22.2	46.0	22.0	0.0	0.0
19	0.354	0.542	40.9	26.1	48.0	21.0	0.0	0.0
20	0.110	0.154	39.2	25.7	50.0	24.0	0.0	0.0
21	0.419	0.132	39.0	26.4	51.0	32.0	10.0	1.0
22	0.264	0.055	37.5	24.5	59.0	34.0	21.6	1.0
23	0.110	0.088	38.9	27.3	58.0	35.0	26.6	1.0
24	0.022	0.054	38.5	25.9	53.0	30.0	5.0	1.0
25	0.022	0.055	34.5	25.5	75.0	53.0	18.8	2.0
26	0.033	0.088	33.7	27.7	75.0	61.0	77.2	3.0
27	0.066	0.165	35.4	25.7	80.0	59.0	39.6	4.0
28	0.055	0.143	35.1	28.3	74.0	59.0	9.8	2.0
29	0.022	0.032	34.5	28.5	79.0	61.0	25.0	1.0
30	0.110	0.012	34.1	27.7	79.0	62.0	37.4	1.0
31	0.000	0.022	32.6	27.2	85.0	72.0	20.6	2.0
32	0.011	0.033	35.0	28.0	82.0	66.0	0.0	0.0
33	0.000	0.044	35.0	27.6	80.0	61.0	15.0	1.0
34	0.000	0.033	33.3	25.8	85.0	65.0	11.6	1.0
35	0.000	0.033	32.0	25.7	84.0	74.0	100.0	3.0
36	0.000	0.044	33.7	24.7	81.0	61.0	24.0	1.0
37	0.000	0.022	33.9	24.5	85.0	55.0	0.0	0.0
38	0.000	0.022	33.9	23.1	85.0	49.0	7.4	1.0
39	0.022	0.033	34.6	23.3	88.0	49.0	0.0	0.0
40	0.000	0.011	34.9	21.0	85.7	37.7	0.0	0.0
41	0.000	0.022	34.4	21.1	91.0	43.0	0.0	0.0
42	0.000	0.000	34.3	17.3	90.0	32.0	0.0	0.0
43	0.000	0.000	31.3	16.2	87.0	36.0	0.0	0.0
44	0.000	0.033	28.0	15.3	91.0	53.0	0.0	0.0
45	0.000	0.000	26.1	14.1	96.0	57.0	0.0	0.0
46	0.000	0.000	22.3	12.9	90.0	60.0	7.0	1.0
47	0.000	0.000	23.9	7.4	94.0	29.0	0.0	0.0
48	0.000	0.000	25.4	7.9	94.0	31.0	0.0	0.0
49	0.000	0.000	22.7	7.3	87.0	30.0	0.0	0.0
50	0.000	0.000	17.1	9.3	90.0	70.0	24.0	1.0
51	0.000	0.000	21.9	7.4	91.0	47.0	0.0	0.0
52	0.000	0.000	20.7	6.3	96.0	49.0	0.0	0.0

Table 2. Population of phytoseiid predatory mite, *N. longispinosus* in different seasons on brinjal

Life stage	April-July	August-October	February-April	November-January
	Mean population/leaf			
Egg	0.100	0.002	0.110	0.000
Active stages	0.430	0.024	0.540	0.001

Table 3. Partial correlation coefficients between mite population and abiotic factor on brinjal

Life stage	Temperature (°C)		Relative humidity (%)		Rainfall	
	Maximum	Minimum	Morning	Evening	Rainy days	Precipitation (mm)
Egg	0.191	-0.195	-0.172	0.096	0.001	-0.020
Active stages	0.264	-0.258	-0.218	0.167	-0.011	0.033

and minimum temperature (Rinkikumari et al 2017). Rao et al (2018) reported that maximum temperature and minimum temperature had positive relationship with the incidence of *T. urticae* and *N. longispinosus*. Thus, the difference in results in the present findings might be due to the crop and growing conditions.

CONCLUSION

The population of *N. longispinosus* was observed on brinjal throughout the crop season with maximum incidence during end of April at a temperature of 37.0°C. The phytoseiid mite population decreased when temperature was more or less than 37.0 °C. Thus, this temperature can be considered as optimum temperature for the growth of *N. longispinosus.* Temperature in the range of 15.5 to 26.1°C (mid-October to end of February) was not favourable for the development of *N. longispinosus* as no mites were observed in this period. Population of *N. longispinosus* was comparatively more in February and April grown crop. The abiotic factors *viz*., maximum temperature and evening relative humidity had positive correlation while morning relative humidity had negative correlation with the population of *N. Longispinosus* on brinjal.

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