Indian Journal of Entomology Online published Ref. No. e24679 DoI. No.: 10.55446/IJE.2024.1679

POPULATION DYNAMICS OF MAJOR INSECT PESTS AND NATURAL ENEMIES IN TOMATO

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ABSTRACT

An experiment on major insect pests and natural enemies of tomato was conducted during rabi, 2022-23 at the experimental farm for PG research, Biswanath College of Agriculture, Sonitpur. Results revealed eleven insect pests; whitefly, *Bemisia tabaci* (Gennadius); aphid, *Aphis craccivora* Koch; leafminer, *Lyriomyza trifolii* (Burgess); fruitborer, *Helicoverpa armigera* (Hubner); jassid, *Amrasca biguttula biguttula* (Ishida); semilooper, *Trichoplusia ni* (Hubner) were found to be the most dominant species. Two coccinellid predators viz., *Micraspis discolor* (F) and *Cheilomenes sexmaculata* (F) and two spiders *Lycosa tista* Tikader, *Anyphaena accentuata* (Walckenaer) were recorded as natural enemies. It was observed that the incidence of *B. tabaci, A. craccivora* and *A. biguttula biguttula* showed significant negative correlation with both maximum and minimum temperature. *B. tabaci* population registered a positive significant correlation with morning relative humidity. Both *L. trifolii* and *H. armigera* exhibited significant negative correlation with bright sunshine hour. Furthermore, *T. ni* showed significant negative correlation with maximum temperature and bright sunshine hour. As regards coccinellids, a significant negative correlation existed with maximum and minimum temperature, and rainfall and significant positive correlation with morning relative humidity. A significant positive correlation of aphids was also observed with coccinellids.

Key words: Correlation, *Bemisia tabaci*, *Aphis craccivora*, *Amrasca biguttula biguttula*, *Lyriomyza trifolii*, *Helicoverpa armigera*, coccinellid, spider, temperature, relative humidity, rainfall, bright sunshine hour

The tomato, *Solanum lycopersicum* L, is a flowering plant and one of the most lucrative food crops. It is also referred to as "poor man's orange" and originated in the South American Andes (Singh et al., 2021). Several biotic, physiochemical and mesobiotic variables influence tomato production. The tomato crops have been ravaged by a variety of insect pests, including fruit borer, *Helicoverpa armigera* (Hubner) and other insect pests viz., whitefly, *Bemisia tabaci* (Genn); jassids, *Amrasca biguttula biguttula* (Ishida); thrips, *Thrips tabaci* (Linderman); serpentine leaf miner, *Liriomyza trifolli* (Burgess); tomato pinworm, *Tuta absoluta* (Meyrick); fruit flies, *Bactrocera tau* (Walker); hadda beetle, *Henosepilachna viginitioctopunctata* (F); and phytophagous mites, *Tetranychus urticeae* (Koch). Moreover, weather parameters play a major role in pest population multiplication and spread. Keeping in view the above facts regarding the infestation of major insect pests and influence of weather parameters on the incidence of insect pests and natural enemies, the present experiment was undertaken.

MATERIALS AND METHODS

Field experiment was conducted at the experimental farm for PG research, Biswanath College of Agriculture, Sonitpur during rabi 2022-23 using tomato variety Swaraksha. The experiment was conducted in Randomized block design (RBD) with three replications and eight treatments. There were 24 numbers of plots with individual size 3.0 m x 3.0 m and plant to plant spacing was 60 cm x 45 cm. All recommended agronomic practices were followed. The crop was regularly inspected from the transplanting till the harvesting of the crop for the population dynamics of the insect pests, and these were collected and brought to the laboratory for identification. Observations on their incidence were recorded at weekly intervals from randomly selected five plants/ plot; the populations of *A. craccivora*, *B. tabaci* and *A. biguttula biguttula* were recorded on five plants selected randomly in each plot, considering three leaves upper, middle and lower. The population of *L. trifolii*, *H. armigera*, *T. ni* coccinellid and spider were recorded by counting their numbers on five plants selected randomly in each plot. Weekly data on temperature, relative humidity, rainfall and bright sunshine hours were obtained from the meteorological department of Biswanath College of Agriculture. Correlation co-efficient (r) was worked out between incidence of insect pests and weather parameters during the period of investigation.

RESULTS AND DISCUSSION

The results on the occurrence of insect pests are presented in Table 1 and revealed 11 insect pests from four orders and eight families were recorded as pests of tomato in the field. The present studies get support from the Singh et al. (2011) which recorded six species of insect pests from three orders and six families viz., *B. tabaci, A. craccivora, L. trifolii, H. armigera* and *A. devastans, S. litura, A. ipsilon* from eastern region of Uttar Pradesh. Two coccinellid predators and two spider species were also found as natural enemies during the present investigation as shown in Table 1. Previously, three coccinellid predators, viz., *Coccinella transversalis* (Fabricius) *Coccinella septempunctata* (Fabricius) and *M. discolor* (Fabricius) were reported by Harshita et al. 2019 from Assam corroborating with the present study. Three species of Coccinellid, viz., *Scymnus* sp, *Chelomenes* sp and *Illeis* sp and ten families of spider were recorded by Hirur et al. 2020 according to whom araneid spiders were most commonly found spiders in the tomato crop. Seasonal incidence and correlation details are presented in Fig. 1 and Table 2, respectively.

B. tabaci : The incidence of *B. tabaci* was observed on newly transplanted crop from the fourth week of November' 2022 to second week of March' 2023. The incidence was higher vegetative stages with a peak of 11.93/ leaf during the fourth week of December. Previously, Kumar and Singh (2022) reported that peak period of activity of whitefly was recorded from first week of January which is corroborating with the present investigation. All the weather parameters showed direct or indirect impact on insect populations. Among all the weather parameters maximum and minimum temperature showed negative and significant correlation with the whiteflies population whereas, morning relative humidity showed positive and significant correlation with the population build-up of the pest species (Table 2; Fig. 1). The present findings were in accordance with Kotak et al. (2019), who also found significant negative impact of both maximum and minimum temperature with whitefly population. The present results also correspond with Jha and Kumar's (2017) findings, who reported that the whitefly population significantly negatively correlated with both the maximum and minimum temperature and significantly positively correlated with morning relative humidity.

A. craccivora: The activity of *A. craccivora,* was observed from the fourth week of November' 2022 to second week of March' 2023 in the present investigation. The population of insect was at higher level during the fourth week of December with a peak population of 18.11/ leaf. The present findings were in conformity with Dev and Bharpoda (2017), according to whom the peak population of aphids on tomato during the fourth week of December. The correlation studies of the insect with different weather parameters indicated that, both maximum and minimum temperature exhibited a negative but significant impact on aphid population (Table 2). The findings are in agreement with

Table 1. Insect pest and natural enemies associated with tomato crop during 2022-2023

Insect pests		
Common name	Scientific name	Order: Family
Whitefly	*Bemisia tabaci*	Hemiptera: Aleyrodidae
Aphid	*Aphis craccivora*	Hemiptera: Aphididae
Serpentine leaf miner	*Lyriomyza trifolii*	Diptera: Agromyzidae
Tomato fruit borer	*Helicoverpa armigera*	Lepidoptera: Noctuidae
Jassid	*Amrasca biguttula biguttula*	Hemiptera: Cicadelidae
Cutworm	*Agrotis ipsilon*	Lepidoptera: Noctuidae
Cabbage semilooper	*Trichoplusia ni*	Lepidoptera: Noctuidae
Tobacco cutworm	*Spodoptera litura*	Lepidoptera: Noctuidae
Green stink bug	*Nezara viridula*	Hemiptera: Pentatomidae
Flea Beetle	*Monolepta signata*	Coleoptera: Chrysomelidae
Epilachna beetle	*Henosepilachna vigintioctopunctata*	Coleoptera: Coccinellidae
Natural enemies		
Species	Order: Family	Prey
Micraspis discolor	Coleoptera: Coccinellidae	*Aphis craccivora*
Cheilomenes sexmaculata	Coleoptera: Coccinellidae	*Aphis craccivora*
Lycosa tista	Araneae: Lycosidae	*Aphis craccivora*
Anyphaena accentuata	Araneae: Anyphaenidae	*Aphis craccivora*

Table 2. Correlation coefficient and regression equation of various insect pests on tomato with weather parameter during 2022-23

Insect-Pest	Maximum temperature (ºC)	Minimum temperature (ºC)	Relative humidity (M) (%)	Relative humidity (E) (%)	Rainfall	Bright sunshine hr
Bemisia tabaci	-0.746** Y= -0.680x + 31.503	-0.757** Y= -0.789x + 18.776	0.671** Y= 0.537x – 87.00	0.116	-0.250	0.123
Aphis craccivora	-0.709** Y= -0.524x + 32.045	-0.511* Y= - 0.432x + 17.289	0.393	0.395	-0.203	-0.342
Amrasca biguttula biguttula	-0.782* Y= -0.1393x + 28.737	-0.520* Y= -1.031x + 14.319	0.272	0.183	-0.069	-0.477
Helicoverpa armigera	-0.464	-0.066	-0.143	0.184	0.244	-0.674** Y= -1.241x + 8.100
Lyriomyza trifolii	-0.407	-0.119	-0.301	0.043	0.191	-0.613* Y= - 0.721x + 8.025
Trichoplusia ni	-0.611* Y= -0.748x + 28.177	-0.221	0.065	0.114	0.114	-0.542* Y= -0.733x + 8.070
Coccinellid	-0.525* Y= - 1.692x + 29.039	-0.684** Y= -2.525x + 16.994	0.516* Y= 1.461x – 88.704	0.037	-0.528* Y= -0.640x + 1.578	0.017
Spider	-0.213	-0.057	0.085	0.321	0.143	-0.472

*Significant at p = 0.05; **Significant at p = 0.01

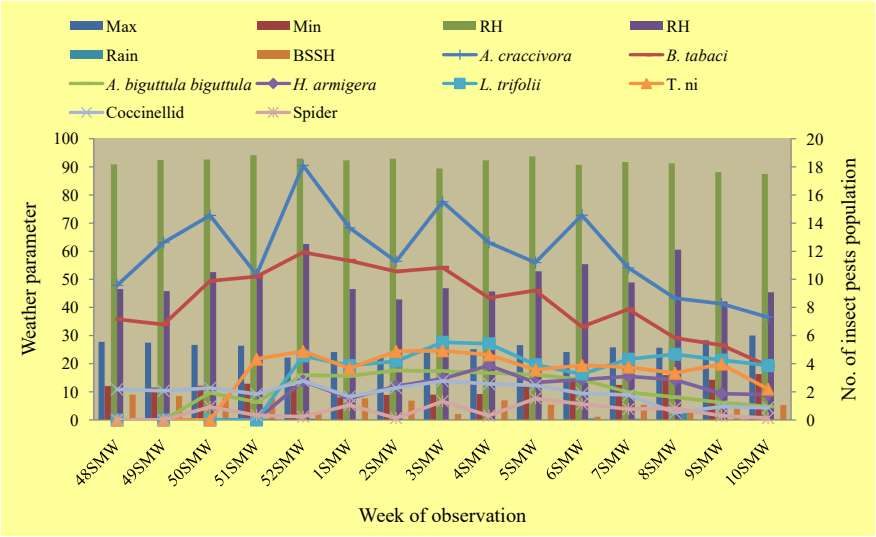

Fig. 1. Population dynamics of insect pests and natural enemies (2022-23)

Chakraborty (2011), according to whom both maximum and minimum temperature showed significant negative correlation with aphid population.

A. biguttula biguttula: The activity of *A. biguttula biguttula* was seen from the second week of December' 2022 to the second week of March' 2023. The peak period of activity of the insect was recorded during

third week of January' 2023. The present findings were in conformity with Patel and Radadia (2018), according to them pest population was initially observed during vegetative stage of the crop and remain active throughout the cropping season. From the correlation study it was observed that maximum and minimum temperature had a significant but negative impact on jassid population (Table 2). Previously, Kumar and Singh (2022) reported that both maximum and minimum temperature exhibited a significant negative correlation with jassid population, which corroborates with the present findings.

L. trifolli: Incidence of *L. trifolli* was noticed from the fourth week of December' 2022 to second week of March' 2023. The maximum population was recorded during the third week of January'2023 with a population of 5.53 mines/ leaf. The present findings were more or less similar with the Ravipati et al. (2020), according to which peak period of activity was recorded during first week of January. The correlation study revealed that, bright sunshine hour had a negative but significant correlation with leaf miner population (Table 2). The present findings are in agreement with Chakraborty (2011), according to whom leaf miner population registered a significant negative correlation with bright sunshine hour.

H. armigera: The infestation of *H. armigera* was recorded from second week of January' 2023 to second week of March' 2023. The peak infestation of pests was recorded during fourth week of January' 2023 when the crop is at maturity stage. The results are in accordance with Mondal et al. (2019), according to them the pest population increased with availability of the fruits and presence of favourable weather condition. A negative but significant correlation of bright sunshine hour was observed with that of fruit borer population (Table 2). The present findings are in agreement with that of Singh et al. (2021) who also recorded a negative but significant correlation of Bright sunshine hour with fruit borer population.

T. ni: In the present investigation, it was found that the activity of the pests commenced from fourth week of December' 2022 to second week of March' 2023. The peak period of activity was recorded during the third week of January with a fluctuating population density of 4.93 larvae per plant. The present findings were in conformity with Jat et al. (2017), according to them the peak population of semilooper on cabbage was during the fourth week of January. The correlation studies of semilooper revealed a significant negative impact of maximum temperature and bright sunshine hour with the population of the pest species (Table 2). The present findings are contradictory to the result obtained by Purti and Rolania (2022).

Coccinellid predators: The coccinellid predators were observed in the field from fourth week of November' 2022 to second week of March' 2023 and it reached its peak (2.78 predators/ plant) during the fourth week of December' 2022. The present findings on population buildup of coccinellids were analogous with the findings of Borkakati and Saikia (2020), they reported that maximum population of coccinellids appeared during second week of November in brinjal crop. The correlation study revealed that maximum temperature, minimum temperature and rainfall had a negative but significant correlation with coccinellid predators. There was a positive and significant correlation between morning relative humidity and coccinellid population (Table 2). The present findings are in agreement with Kedar et al. (2018), who reported that maximum and minimum temperature and morning relative humidity had negative significant and positive significant correlation, respectively with coccinellid population in cotton crop. Borah and Saikia (2017) reported that rainfall exhibited a significant negative correlation with the coccinellid predators population, which corroborates with the present study. Coccinellid predators exhibited a highly significant and positive correlation with aphid population (Table 2). The present findings were in conformity with Harshita et al. (2019) and Borah and Saikia (2017), according to whom Coccinellid predators exhibited a significant positive correlation with aphid population.

Spiders: Spiders were observed in the field from second week of December' 2022 to second week of March' 2023. Previously Mondal et al. (2019) also found that spiders were present in the field from the vegetative to the last harvesting stage of the tomato crop. In the present investigation the peak period of activity of spider was recorded during the first week of February' 2023 which was contradictory to Hirur et al. (2020), according to them the peak period of appearance of spider was recorded during first week of January. The correlation studies indicated that all the weather parameters were found to be non-significant in the population buildup of the spider sp. The present findings were in conformity with Hirur et al. (2020), according to them morning relative humidity, evening relative humidity and bright sunshine hour had non-significant

correlation with spider population, which is in support with the present findings.

ACKNOWLEDGEMENTS

The researchers would like to express their gratitude to the Department of Entomology, Biswanath College of Agriculture, Assam Agricultural University for providing all facilities to carry out the experiment. The authors extend their special thanks to the department of plant pathology, department of nematology, department of agricultural statistics and department of meteorology for their immense help, constant support and valuable suggestions throughout the course of study.

AUTHOR CONTRIBUTION STATEMENT

N B conceived and designed the experiment. M B conducted the experiment, analyzed the data and wrote the manuscript with support from N B, B K B and P R. B K B helped in identification of insect pests and supervised the findings of this experiment. All authors discussed the results and contributed to the final manuscript.

FINANCIAL SUPPORT

No financial support has been received during the present experiment.

CONFLICT OF INTEREST

No conflict of interest.

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(Manuscript Received: September, 2023; Revised: May, 2024;
Accepted: June, 2024; Online Published: August, 2024)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e24679