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Short Research Article

Seasonal Incidence of Insect-pests in Tomato (*Lycopersicon esculantum* M.) on Different Planting Dates and its Correlation with Abiotic Factors

Waluniba and M. Alemla Ao

Department of Entomology, SASRD, Nagaland University, Medziphema campus, Medziphema (797 106), Nagaland, India

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Correspondence to

E-mail: waluaj@gmail.com

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Abstract

Experiment conducted in the year 2010-2011 at experimental cum research farm, School of Agriculture Sciences and Rural Development, Nagaland University, showed that the incidence of aphids (*Aphis gossypii*) was observed at 52nd, 2nd and 4th, whitefly (*Bemisia tabaci*) at 4th, 7th and 9th, Serpentine leaf miner (*Liriomyza trifolii*) at 4th, 7th and 9th and fruit borer (*Helicoverpa armigera*) at 9th, 11th and 13th standard week on D_1, D_2 and D_3 respectively. The incidence of aphid correlating with abiotic factors showed negative significant influence by maximum temperature at 4th December planting date, whitefly showed negative significant influence on 4th December planting date, leaf miner showed positive significant effect with maximum and minimum temperature in all the planting dates and also minimum relative humidity on 19th December planting showed positive significant effect and in case of tomato fruit borer it showed a positive significant effect with maximum temperature and minimum relative humidity at 19th November and 19th December planting respectively.

1. Introduction

Tomato is an important vegetable grown World wide and it is also an important ingredient in our daily cuisine, but to produce healthy and good tomatoes and make it available to the consumers is a difficult task, as it undergoes a lot of pest attack from different angles. Jayraj et al. (1994) stated that the monetary losses due to pests in India have been estimated over rupees one thousand crores per year. So, to have clear proven idea on the incidence of insect pests and to find the population build-up of the pests attacking tomatoes and their relation with abiotic factors like temperature, rainfall and relative humidity, the following experiment was conducted for further understanding of the role played by the abiotic factors in the incidence of different pests which is harmful to tomato growers which ultimately will help tomato growers for better return in terms of yield as well as income generation.

2. Materials and Methods

The trial was carried out at experimental cum research farm, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, in the year 2010-2011 which is situated at 25°45'53" N latitude and 93°53'04" E longitudes at an elevation of 310 masl. The experiment was laid out in split plot design with three replications keeping sowing dates in the main plots and treatments in the sub-plots. Tomato variety Pusa Ruby was used for the experiment. The data was collected every standard week (as per meteorological data from ICAR) from the date of incidence of the pests in all the three different planting dates represented as D_1 (19th November, 2010), D_2 (4th December, 2010) and D_3 (19th December, 2010) till the crop was harvested. The collected data was later correlated with abiotic factors like maximum and minimum temperature (°C), maximum and minimum relative humidity (%) and rainfall (mm). Five numbers of plants were randomly selected from each plot where the population of aphid was counted from three leaves (top, middle and bottom), total number of white flies from five (5) randomly selected plants in each plot, the infestation of serpentine leaf miner was counted from the whole plant by observing the mined leaves from five randomly selected plants in each plot and the damage caused by tomato fruit borer has been represented in percentage (%) on number basis, where total number of damaged fruit and total number of fruits 5 plants^{-1} has been counted. Mean population of the pest was worked out and correlation coefficient of the population with abiotic factors was evaluated.

3. Results and Discussion

The observation revealed that, among the insect pests recorded, four insect species viz. Aphid (*Aphis gossypii*), whitefly

(*Bemisia tabaci*), Serpentine leaf miner (*Liriomyza trifolii*) and fruit borer (*Helicoverpa armigera*) were of concern pests of tomato crop.

The finding presented in table 1(a), 1(b) and figure (1) explained that the Aphid (*Aphis gossypii*) started to appear in the crop at 52nd, 2nd and 4th standard weeks respectively on 19th November (D_1), 4th December (D_2) and 19th December (D_3) planting dates during which the period was from 24th December to 28th January (2010-2011). The pest incidence remained almost constant and were abundant during 52nd to 9th standard weeks (i.e. 24th December to 4th March) exhibiting highest population of 6.87, 7 and 5.87 aphids plant^{-1} respectively at D_1, D_2 and D_3 planting dates. The aphid population persisted in the crop till the time of harvest but showed a decreasing trend from 11th standard week (12th to18th March, 2011) as the plant proceed towards maturity. Hath and Das (2004) has reported the peak population of aphid (4.47 plant^{-1}) during first week of March and stated that as the season and the age of the plants progressed the intensity of damage also increased. It is also observed by some workers that aphid population was initiated at about 48th Standard Meteorological Weeks (SMW) which improve slowly up to 52nd SMW, then steadily to 6th SMW attaining maximum at about 8th SMW which was maintained up to 11th SMW, and then subsumed slowly. Maximum and minimum temperature had showed significantly negative influence over the aphid population on all the planting dates whereas both relative humidity (maximum and minimum) and rainfall had negatively non-significant effect on all planting dates except on 19th December planting where the minimum relative humidity had significant negative relation with the aphid population. The findings of Chakroborty (2011) was more or less similar with the experiment result, who reported a significant negative influence of abiotic factors such as temperature (Maximum and Minimum), Minimum relative humidity and sunshine hours where as rainfall expressed positive insignificant effect.

Whitefly (*Bemisia tabaci*) first appeared in the field at 2nd, 4th and 7th standard week from 8th of January to 28th January on the three different dates of planting as presented in the table 2 (a),2 (b) and figure (2). The whitefly infestation was very scanty and was available in the field only up to 7th and 9th standard weeks respectively on D_1 and D_3 planting dates while on D_2, the infestation was recorded up to 11th standard week but sporadically with very little infestation. The pest was completely absent till the harvest time thereafter. The period of whitefly incidence comes within the period of 8th January to 18th February. The report of Kharpuse and Bajpai (2005) support the findings who also recorded the whitefly (*Bemisia tabaci*) incidence during the 2nd and 3rd week of February. However, Arif et al. (2006) observed the peak of whitefly population during the 4th week of August and 1st week of September. The probable reason of this difference may be due to the deviation of the cropping season. A negative non-significant influence of the three abiotic factors was found over the whitefly population on almost all the planting dates except 4th December (D_2) planting where maximum temperature was negatively and significantly correlated, other workers had noticed a significant and positive correlation between temperature and whitefly population while no significant correlation with rainfall was recorded (Arif et al., 2006).

The incidence of Serpentine leaf miner (*Liriomyza trifolii*) appeared in the field at 4th, 7th and 9th standard meteorological weeks, i.e., 22 January to 4th March on D_1, D_2 and D_3 respectively as presented in table 3(a), 3(b) and figure 3. The pest infestation persisted in an increasing trend till the harvesting period. The highest number of mined leaves (16.80 plants^{-1}) was recorded on 19th standard week (9th April to 13th May) of 19th December planting while

the least infestation (1 plant^{-1}) was noticed on 4th standard week (22nd to 28th January) of 19th November planting. Between the three dates of planting, 19th November planting had harboured maximum (6.97) infestation while 19th November planting crop

Table 1 (a): Incidence of aphid, *Aphis gossypii* population and its correlation with abiotic factors on different planting dates

Standard week	Mean aphid population			Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	D_1	D_2	D_3	Max	Min	Max	Min.	
52	6.87	-	-	22.1	8.16	78.29	39.43	0
2	5.13	4.73	-	23.39	11.53	74	35.14	0
4	4.87	7.00	3.13	24.16	8.7	73.86	18.57	0
7	5.67	4.93	5.47	26.7	8.1	84	8	0.43
9	4.80	2.87	5.87	31.7	9.1	87	7	0
11	4.67	4.07	3.33	30.3	11.1	79	7	1.06
13	3.69	2.73	3.87	32.3	15.3	80	22	9.57
15	2.60	2.60	3.07	30.3	15.3	81	20	2.14
17	-	2.33	2.20	30.7	18.3	86	32	3.49
19	-	-	1.47	33.7	21.5	83	30	3.8
Mean	4.79	3.91	3.55	---	---	---	---	---

Table 1 (b): Correlation coefficient (r) of aphid population with abiotic factors on different planting dates

Dates of sowing	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Max.	Min.	Max	Min	
D_1	-0.706*	-0.853*	-0.114	0.307	-0.511
D_2	-0.844*	-0.714*	-0.680	-0.114	-0.517
D_3	-0.246	-0.798*	0.266	-0.817*	-0.297

*=significant

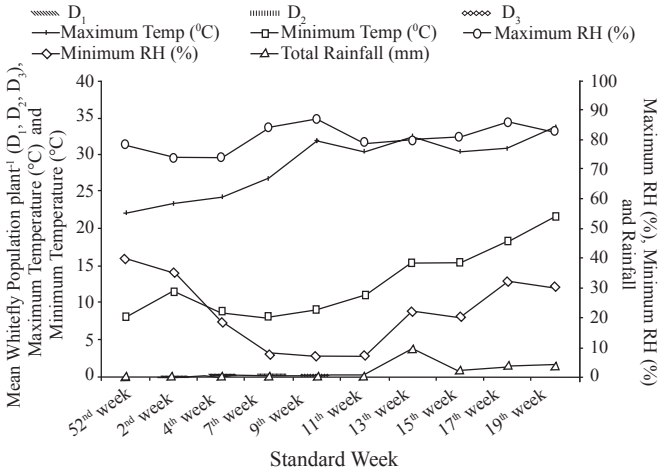

Figure 1: Incidence of *Aphis gossypii* population and its correlation with abiotic factors on different planting dates

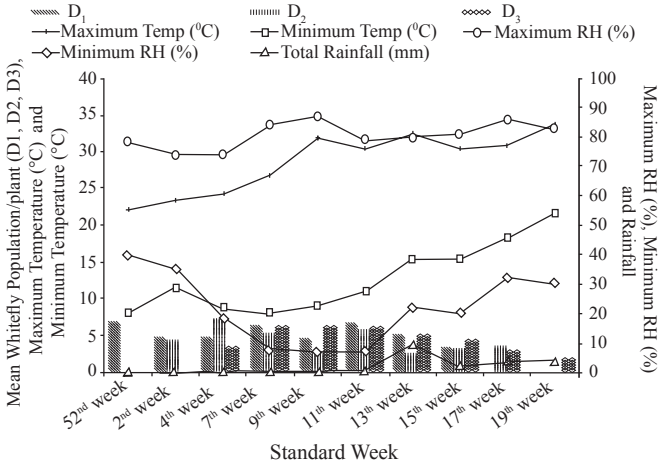

Figure 2: Incidence of *Bemisia tabaci* population and its correlation with abiotic factors on different planting dates

attracted the least (5.27). In partial agreement to the findings, Reddy and Kumar (2005) observed the peak incidence of Serpentine leaf miner during March-April and declined during November-December. The incidence of leaf miner evicted positively significant correlation with maximum and minimum temperature in all the planting dates and with minimum relative humidity on the third date of planting, maximum relative humidity did not show any influence with the incidence of serpentine leaf miner. Reddy and Kumar (2005) has reported that there was a high significant negative correlation between the seasonal abundance of the pest and rainfall. While a positive non-significance was observed with maximum and minimum temperature and relative humidity.

Tomato fruit borer (*Helicoverpa armigera*) appeared in the field at 9th, 11nd and 13th standard meteorological weeks from 2th of February to 12th April respectively on the three different dates of planting as shown in the table 4(a), 4(b) and figure 4. The highest fruit borer infestation (1.88 plant^{-1}) on number basis was observed on 19th November followed by 4th December (1.43 plant^{-1}) planting dates. The pest occurred during 9th to 13th standard week (26th February to 4th March) on the 19th November planting date while for 4th December planting date, the pest occurred during 11th to 15th standard week (12th March to 15th April) and between 13th to 15th standard week (26th March to 15th April) on D_2 planting date. The report of Hath and Das (2004) support the findings, who had also reported that the incidence of fruit borer occurred during the third week of March and second week of April. Others had also stated that *Helicoverpa armigera* was abundant from March-May (Kay, 1989). The correlation of the fruit borer with the abiotic factors such as maximum and minimum temperature, maximum and minimum relative humidity and rainfall showed that rainfall has positive influence on the incidence of fruit borer on all the

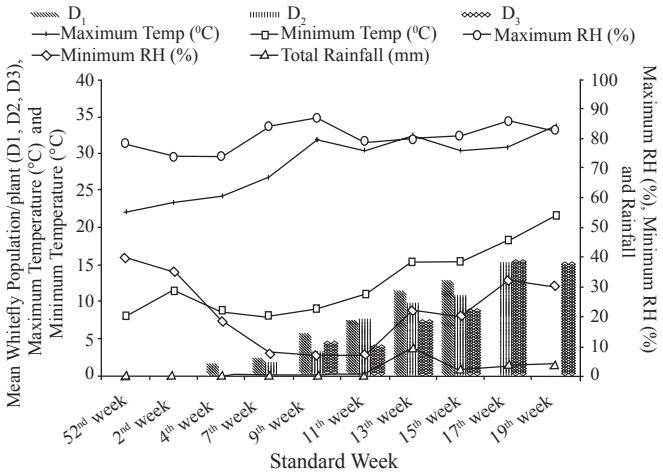

Figure 3: Incidence of *Liriomyza trifolii* population and its correlation with abiotic factors on different planting dates

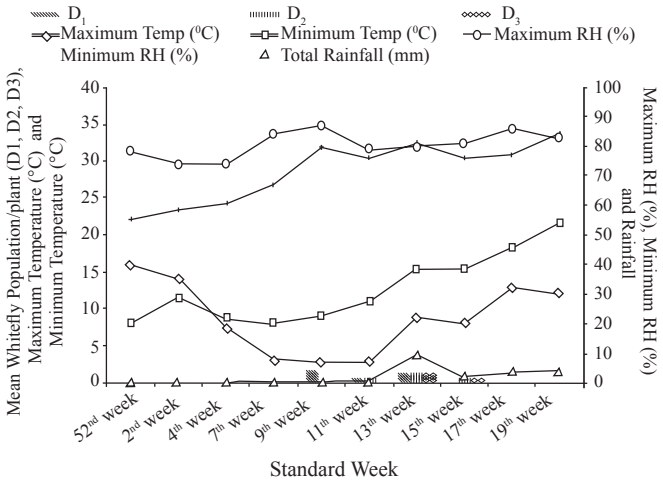

Figure 4: Incidence of *Helicoverpa armigera* population and its correlation with abiotic factors on different planting dates

Table 2 (a): Incidence of whitefly, Bemisia tabaci population and its correlation with abiotic factors on different planting dates

Standard week	Mean whitefly population			Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	D_1	D_2	D_3	Max	Min	Max	Min	
52	0	-	-	22.1	8.16	78.29	39.43	0
2	0.2	0.4		23.39	11.53	74	35.14	0
4	0.4	0.8	0	24.16	8.7	73.86	18.57	0
7	0.4	0.4	0.2	26.7	8.1	84	8	0.43
9	0	0	0.6	31.7	9.1	87	7	0
11	0	0	0	30.3	11.1	79	7	1.06
13	0	0.2	0	32.3	15.3	80	22	9.57
15	0	0	0	30.3	15.3	81	20	2.14
17	-	0	0	30.7	18.3	86	32	3.49
19	-	-	0	33.7	21.5	83	30	3.8
Mean	0.13	0.23	0.1	---	---	---	---	---

Table 2 (b): Correlation coefficient (r) of whitefly population with abiotic factors on different planting dates

Dates of sowing	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Max	Min	Max	Min	
D_1	-0.522	-0.053	-0.543	0.428	-0.279
D_2	-0.824*	-0.532	-0.669	0.125	-0.250
D_3	0.080	-0.494	0.569	-0.577	-0.410

*significant

Table 3 (a): Incidence of serpentine leaf miner, *Liriomyza trifolii* infestation and its correlation with abiotic factors on different planting dates

Standard week	Mined leaves by serpentine leaf miner			Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	D_1	D_2	D_3	Max	Min	Max	Min	
52	0	-	-	22.1	8.16	78.29	39.43	0
2	0	0	-	23.39	11.53	74	35.14	0
4	1	0	0	24.16	8.7	73.86	18.57	0
7	2.07	0.73	0	26.7	8.1	84	8	0.43
9	5.80	3.07	3.45	31.7	9.1	87	7	0
11	8.00	7.93	3.80	30.3	11.1	79	7	1.06
13	12.13	10.00	7.13	32.3	15.3	80	22	9.57
15	13.13	12.40	9.93	30.3	15.3	81	20	2.14
17	-	14.53	14.67	30.7	18.3	86	32	3.49
19	-	-	16.80	33.7	21.5	83	30	3.8
Mean	5.27	6.08	6.97					

three different dates of planting and minimum relative humidity exhibited a positive influence on third (19th December) date of planting. Maximum and minimum temperature and maximum relative humidity did not show any significant correlation. Wakil et al. (2010) has reported that temperature

Table 3(b): Correlation coefficient (r) of serpentine leaf miner infestation with abiotic factors on different planting dates

Dates of sowing	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Max	Min	Max.	Min.	
D_1	0.870*	0.837*	0.371	-0.355	0.682
D_2	0.741*	0.901*	0.422	0.232	0.595
D_3	0.720*	0.978*	0.381	0.831*	0.460

*=significant

Table 4 (a): Incidence of tomato fruit borer, *Helicoverpa armigera* and its correlation with abiotic factors on different planting dates

Standard week	% damage fruit (number basis) by fruit borer			Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	D_1	D_2	D_3	Max	Min	Max	Min.	
52	0	--	--	22.1	8.16	78.29	39.43	0
2	0	0	--	23.39	11.53	74	35.14	0
4	0	0	0	24.16	8.7	7386	18.57	0
7	0	0	0	26.7	8.1	84	8	0.43
9	1.88	0	0	31.7	9.1	87	7	0
11	1.23	1.43	0	30.3	11.1	79	7	1.06
13	1.28	1.05	1.08	32.3	15.3	80	22	9.57
15	0	0.95	1.12	30.3	15.3	81	20	2.14
17	--	0	0	30.7	18.3	86	32	3.49
19	--	--	0	33.7	21.5	83	30	3.8
Mean	0.55	0.43	0.28					

Table 4 (b): Correlation coefficient (r) of tomato fruit borer infestation with abiotic factors on different planting dates

Dates of sowing	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Max	Min.	Max.	Min.	
D_1	0.767*	0.149	0.546	-0.530	0.350
D_2	0.517	0.288	-0.121	-0.258	0.463
D_3	0.258	0.229	-0.178	0.179*	0.622

*significant

was positively correlated. While, relative humidity showed negative interaction with the larval and fruit infestation.

4. Conclusion

Incidence of aphid (*Aphis gossypii*), serpentine leaf miner (*Liriomyza trifolli*), whitefly (*Bemisia tabaci*) and tomato fruit borer (*Helicoverpa armigera*) were observed and abiotic factors played an effective role in the incidence of the pest population.

5. References

Anonymous, 2012. National Horticulture Board and Ministry

of Agriculture, Government of India.

Hath, T.K., Das, B.R., 2004. Incidence of pest in late planting tomato under Terai agroecology of West Bengal. Environment and Ecology 22(1), 136-140.

Jayraj, S., Rose Victoria, D., Ravindra, R.J., 1994. Microbial control of *Heliothis armigera* on tomato. Journal of Biological Control 7(1), 44-46.

Chakraborty, K., 2011. Incidence of aphid*, Aphis gossypii* Glover (Hemiptera: Aphididae) on tomato crop in the agro climatic conditions of the northern parts of West Bengal, India. World journal of Zoology 6(2), 187-191.

Kay, I.R., 1989. Seasonal incidence of *Heliothis* spp. (Lepidopteran: Noctuidae) on tomato in North Queensland. Journal of the Australian Entomological society 28(3), 193-194.

Kharpuse, Y.K., Bajpai, R., 2006. Seasonal incidence of major insect pests of tomato (*Lycopersicon esculentum*) at JNKVV Research Farm Jabalpur. Indian Journal of Tropical Biodiversity 14(2), 156-157.

Arif, M.J., Gogi, M.D., Mirza, M., Zia, M., Hafeez, A., 2006. Impact of plant spacing and Abiotic factors on the population Dynamics of sucking insect pests of cotton. Pakistan Journal of Biological Science 9, 1364-1369.

Reddy, N.A., Kumar, C.T.A., 2005. Influence of weather factors on abundance and management of serpentine leaf miner, *Liriomyza trifolii* (Burgess) on tomato. Annals of Plant Protection Sciences 70(4), 613-624.

Wakil, W., Usman Ghazanfar, M., Kwon, J.I., Qayyum, M.Y.A, Nasir, F., 2010. Distribution of *Helicoverpa armigera* (Lepidoptera: Noctuidae) in tomato fields and its relationship to weather factors. Entomological Research 40(6), 290-297.