World Journal of Zoology 6 (2): 187-191, 2011
ISSN 1817-3098

Incidence of Aphid, *Aphis gossypii* Glover (Hemiptera: Aphidae) on Tomato Crop in the Agro Climatic Conditions of the Northern Parts of West Bengal, India

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Abstract: Incidence of *Aphis gossypii* population in tomato crop field was assessed by randomized block design during four consecutive *kharif* crop seasons (2005-2008) at Alipurduar, Jalpaiguri, West Bengal. The population was initiated at about 48 standard meteorological weeks (SMW), improved at first slowly up to 52 SMW then steadily up to 6 SMW attaining the maximum at about 8 SMW which was maintained up to about 11 SMW. The population then subsumed at first slowly then abruptly. Abiotic conditions such as maximum temperature, minimum temperature, temperature gradient, average temperature, minimum relative humidity and sunshine hours had significant negative influence on *A. gossypii* population. In case of maximum relative humidity and relative humidity gradient a positive influence was observed. In addition, other factors such as average relative humidity, number of rainy days, rainfall expressed insignificant positive effect on population development. Based on the incidence and abundance pattern of *A. gossypii*, a package can be developed and accordingly time fitted precautionary measures may be highlighted in the northern parts of West Bengal. From the present observation it was thus evicted that a time-fitted early-season cultivation of tomato crop was economically prudent to minimize aphid menace.

Key words: Aphid incidence · Climatic factors · Tomato crop

INTRODUCTION

Although insect pests have been a problem in agriculture through the centuries, phenomenon of pest outbreaks have increased with the change of pest complexities, in the last four decades. Some insects have increased in severity, whereas others have declined in importance. There is evidence that 'specialized species' have been favoured by crop intensification. Intensification engrosses the changes in cultural practices such as (I) increase of crop-cycle per year, (ii) augmentation of agricultural chemicals (fertilizer and pesticides), (iii) improvement of irrigation facilities and (iv) enhancement of higher plant densities [1].

Aphids or plant lice are one of the most common polyphagous insect pests [2]. Detection of the field dynamics of tomato aphid population [*Aphis gossypii* Glover (Aphididae: Hemiptera)] in relation to crop phenology and climatic conditions is considered as a prime requisite for the execution of the subsequent crop protection package in view of modern IPM practices. The pest affects almost all the areal parts of the tomato plant from the early growth stages till to the fruit maturation stage [3,4]. Feeding often results in stunting, curling or yellowing of plant green foliage [2]. Severe infestations may exterminate the plant totally [5]. Loss incurred due to sucking to the growing tomato crop is insurmountable [6]. Sharma and Bhatnagar [5] have reported that aphid infestation on barley cultivars has affected adversely resulting severe loss. Way *et al.* [7] have documented that the damage done by aphids reduce seed viability and food value of bean. Severe infestation causes necrosis to the leaf chlorophillus tissue, suppresses tomato flowers to bloom and makes the mature fruit unfit to consume.

Among the northern parts of West Bengal, India, the district Jalpaiguri offers a congenial environment for tomato cultivation. Farmers do follow irregular planting

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dates disregarding the occurrence of aphid incidence. Considerable losses to tomato crop have been reported for this pest from the district of Cooch Behar, West Bengal [8]. Therefore understanding the recent trends of seasonal abundance of *A. gossypii* is the prerequisite to develop an integrated management system for this pest. Such time bound observation will help to envisage about the periodicity of the population and the extent of infestation. Observation on population dynamics of *A. gossypii* in consideration of pest management decision making is thus found crucial. Grossly, there are three specific objectives of this study: (i) to define the basic population system of *A. gossypii* in the *kharif* crop seasons at Alipurduar, Jalpaiguri, West Bengal. (ii) to consider the role of weather parameters on the incidence of the *A. gossypii*'s population. and (iii) to apply the generated information relating to aphid population dynamics in integrated pest management decision-making.

MATERIALS AND METHODS

Geographic Location and Agro-Climatic Conditions: Alipurduar [26.50°N-89.52°E] is situated within the *tarai* zone covering the foot hills of the mountain *Himalaya*. The climate of this zone is sub-tropical humid in nature. The average annual rain fall varies from 2100 to 3000 mm, the maximum rainfall occurs during the rainy months of June to September amounting to more than 80% of the total rain fall. The annual average day night temperature ranges between 19.7and 29.9°C with the mercury soaring even as high as 33°C in April and cascading to a low of 3°C in January. The relative humidity at 8:30 hours is 58% and 88% in March and July respectively. The relative humidity in the afternoon at 17:30 hours is 48% and 84% in March and November respectively.

Experimental Layout: Field study was conducted by randomized block design (RBD) during three consecutive *kharif* crop years (2005-2008) in pesticide untreated field of tomato cultivar *pusa ruby*. Transplantation was done with 25-day old seedlings at 60 x75 cm spacing on 44-45 standard meteorological weeks (SMW). The soil of the experimental field was sandy loam with PH value 6.8 and EC value 0.28mmhs/cm. N, P_2O_5 and K_2O was 305, 69 and 347 kg/ha respectively. During land preparation, each plot received 150:60:60 NPK as basal dose. Field management was done following national protocol with befitting modifications.

Assessment on Aphid Population: Incidence and abundance of aphid population was recorded from 10 randomly selected tomato plants. For each plant 5 tender leaves were considered. Numerical abundance of aphid population was registered as individuals/leaf basis. There were three replications for each of the three experiment years.

Correlation and Matrix Analysis: Weekly noted aphid population were correlated with the prevailing climatic factors such as maximum temperature (Tmax), minimum temperature (Tmin), temperature gradient (Tgr), maximum humidity (RHmax), minimum humidity (RHmin), humidity gradient (RHgr), sunshine hour (Shr), rainfall (Rfall) and rainy days (Rdays).Further inter relationship of the climatic factors was also worked out and then tabulated in matrix pattern.

RESULTS

Incidence of *Aphis gossypii* population in tomato crop field was assessed by randomized block design during four consecutive *kharif* crop seasons (2005-2008) at Alipurduar, Jalpaiguri, West Bengal. The results are delineated below

Population Dynamics (Table1): During *kharif* season, initially very low number of aphid population at early months was gradually increased from about 48 to 49 SMW. The number then improved gradually up to 52 SMW then steadily up to about 6 SMW. The appearance of peak population was restricted to about 8 SMW. Persistent high population was noted from 8 to 11 SMW. The population then subsumed at first slowly then abruptly. Incessantly low number was counted from 14 SMW to 16 SMW. After 16 SMW very low detectable range of population was noted.

Correlation Study (Tables 2 and 3): In all the years except in 2007, the aphid population showed a significant negative relation with the Tmax. Tmin also had imparted a significant negative effect on the incidence of aphid in all the years except in 2007. Except in 2007, the incidence of aphid population showed significantly negative relation with Tgr. A significantly negative relation was also found with the Tavg in 2006, 2007 and 2008, but in 2005 relations were insignificantly positive. Persistent RHmax (85-94%) had exerted a significantly positive impact on the abundance of aphid p opulation in all

Table1: Average climatic parameters and the incidence of aphid population during the period of study

	Temperature				Relative humidity				Average	Rainfall	Number	
SMW	Tmax	Tmin	Tgr	Tavg	RHmax	RHmin	RHgr	RHavg	sunshine hour (hr/day)	(mm)	of rainy days	Individuals /leaf
48	21.21	12.24	8.97	10.61	96.00	67.70	28.30	81.85	5.74	0	0	0.17±0.02
49	23.11	12.01	11.10	11.56	98.12	47.25	50.87	72.69	5.78	0	0	0.20±0.04
50	23.65	9.81	13.84	11.83	95.47	46.38	49.09	70.93	1.84	9.87	1	0.26±0.07
51	23.61	10.11	13.50	11.81	94.83	47.14	47.69	70.99	5.17	0	0	0.29±0.05
52	20.89	9.56	11.33	10.45	96.53	78.00	18.53	87.27	8.47	0	0	0.37±0.04
1	18.42	9.21	9.21	9.21	96.22	65.01	31.21	80.62	2.29	0	0	0.58±0.11
2	17.82	9.65	8.17	8.91	95.53	56.27	39.26	75.90	2.04	0	0	0.98±0.13
3	20.72	9.13	11.59	10.36	95.00	44.53	50.47	69.77	3.48	0	0	2.33±0.51
4	22.72	9.35	13.37	11.36	95.84	46.12	49.72	70.98	6.47	0	0	3.21±0.47
5	23.31	9.25	14.06	11.66	94.25	40.12	54.13	67.19	6.94	0	0	4.09±1.03
6	24.35	9.79	14.56	12.18	94.76	41.79	52.97	68.28	8.69	1.02	1	5.37±1.08
7	26.23	12.05	14.18	13.12	94.28	48.41	45.87	71.35	7.35	2.11	1	5.45±1.61
8	26.81	13.34	13.47	13.41	96.01	41.59	54.42	68.80	8.51	1.42	1	6.78±1.75
9	27.15	12.72	14.43	13.58	84.12	39.25	44.87	61.69	5.61	6.13	2	6.14±0.97
10	27.69	13.92	13.77	13.85	85.01	47.41	37.60	66.21	8.53	2.17	1	5.93±0.21
11	25.97	14.39	11.58	12.99	87.89	53.53	34.36	70.71	8.73	1.09	1	4.97±0.19
12	27.48	16.39	11.09	13.74	88.00	57.10	30.90	72.55	6.12	65.32	3	4.51±0.13
13	25.98	15.83	10.15	12.99	86.71	53.21	33.50	69.96	4.08	47.32	2	3.37±0.12
14	29.94	15.68	14.26	14.97	90.89	57.10	33.79	74.00	6.27	11.98	2	1.22±0.08
15	28.73	15.39	13.34	14.37	92.79	69.78	23.01	81.29	6.45	56.87	3	0.54±0.02
16	27.65	17.03	10.62	13.83	95.73	57.58	38.15	76.66	3.48	62.12	3	0.12±0.01

Table 2: Correlation coefficient of incidence of the pests with the climatic factors indicating the level of significance

	Years of observation			
Climatic parameters	2005	2006	2007	2008
Maximum temperature (Tmax)	-0.602*	-0.645*	-0.411	-0.611*
Minimum temperature (Tmin)	-0.567*	-0.511*	0.425	-0.671*
Temperature gradient (Tgr)	-0.508*	-0.578*	-0.490	-0.701*
Average temperature (Tavg)	0.488	-0.578*	-0.675*	-0.587*
Maximum humidity(RHmax)	0.545*	0.535*	0.501*	0.564*
Minimum humidity (RHmin)	-0.765*	-0.821*	-0.768*	-0.675*
Humidity gradient (RHgr)	0.378	0.558*	0.653*	0.828*
Average humidity (RHavg)	0.211	0.476	0.487	0.219
Sunshine hours / day(Shr)	-0.413	-0.752*	-0.778*	-0.821*
Rainfall (Rfall)	0.346	0.365	0.287	0.445
Rainy days (Rdays)	0.423	0.467	0.334	0.312
Significant at 5% level				

Table 3: Matrix combination showing linear correlation coefficient (r) of important climatic factors in relation to aphid incidence

	Tmax	Tmin	Tgr	Tavg	RHmax	RHmin	RHgr	RHavg	Shr	Rfall	Rdays
Tmax	1.0000	0.8031*	0.5739*	1.0000	-0.5729*	-0.1719	-0.0538	-0.3500	0.4318	0.5239*	0.8046*
Tmin	0.8031*	1.0000	-0.0270	0.8028*	-0.5354*	0.1908	-0.4002	-0.0196	0.1635	0.7528*	0.8549*
Tgr	0.5437*	-0.0270	1.0000	0.5743*	-0.2138	-0.5507*	0.4398	-0.5603*	0.4984*	-0.1556	0.1848
Tavg	1.0000	0.8080*	0.5743*	1.0000	-0.5726*	-0.1720	-0.0536	0.3500	0.4323	0.5235*	0.4043
RHmax	-0.5729*	-0.5394*	-0.2198	-0.5726*	1.0000	0.1745	0.2184	0.5007*	-0.2258	-0.2877	0.5215*
RHmin	-0.1719	0.1908	-0.5517*	-0.1720	0.1745	1.0000	-0.9228*	0.9357*	-0.0774	0.3036	0.1340
RHgr	-0.0538*	-0.4002	0.4598	-0.0536	0.2184	-0.9228*	1.0000	-0.7354*	-0.0117	-0.4134	-0.3171
RHavg	-0.3500	-0.0196	-0.5603*	-0.3500	0.5001*	0.9317*	-0.7354*	1.0000	-0.1464	0.1670	-0.0808
Shr	0.4818	0.1645	0.4984	0.4323	-0.2258	-0.0754	-0.0117	-0.1464	1.0000	-0.1517	0.0343
Rfall	0.5239*	0.7528*	-0.1556	0.5235*	-0.2877	0.3016	-0.4134	0.1620	-0.1817	1.0000	0.8652*
Rdays	0.8046*	0.8549*	-0.1748	0.8043*	-0.5215*	0.1140	-0.3171	-0.0808*	0.0343	0.8652*	1.0000

Each correlation coefficient (r) is calculated independently without considering other variables

the years, especially at the late tillering stage. A significantly negative relation between RHmin and the field aphid population was found in all the years. Significant positive relations existed between the RHgr and the field aphid population in all the years except in 2005 where the relation was insignificantly positive. Incidence was positively influenced by RHavg almost in all the years. But the values of relation differed among the years, particularly in 2006 and 2008. Bright sunshine hour for an average of 8.23 hrs/day had a significant negative effect on the aphid population with the exception of 2005 where the relation though negative, was non significant. Drizzling Rfall had an insignificant positive effect on the pest structure. But heavy shour within a short time had significant negative effect on pest appearance in all the years. Number of rainy days however showed insignificantly positive relation (Table 2).

Correlation matrix analysis of important climatic factors leads to determine the relative dynamic of the aphid population. As most of the climatic factors are interdependent, any change of single climatic factor will lead to multiple effects on pest structure. However impact of temperature was more profound (Table 3).

DISCUSSION

Tomato plantation should be done in such a way that the maximum crop growth stage and the maximum aphid abundance do not coincide. Highest level of aphid population was noted at about 8 SMW. If the crop passes the vulnerable growth stage before the pest peak emergence the crop can be well protected. In this consideration early transplantation of tomato seedlings is thus found prudent to minimize aphid menace. From the southern parts of India (Bangalore), Sredevi *et al.*[9] have reported that on pomegranate, the aphid population gradually developed attaining the maximum during February which is partly supported by present observation. Present study also corroborates to the findings of El-Nagar *et al.*[10] who have reported from Egypt that grossly temperature had a significant negative effect on population structure. Shaunak and Pitre [11] have identified two major flight periods for aphids in northeastern Mississippi in relation to climatic condition. Contrary to this, in the present observation only one peak was noted. Present observation disagrees with the observation of Oliviera [12] who have reported that rainfall imparts negative impact on population structure, but in the present observation it was insignificantly positive. He had also noted that ambient maximum temperature (>30°C) and minimum temperature (<12°C) have restricted population growth. Present study partially corroborates to the study of Zade *et al.*[13] who from Gujrat, India have reported nearly similar impact of climatic factors on the growth of aphid population on *Punica* sp. Sing [14] has reported that cloudy moist environment is conducive for aphid multiplication which supports the present observation. Similar to the present findings, Mall *et al.* [15] have noted that the survivability of the pest to be uppermost when Tmax and RHavg were between 20-25% and 50-72% respectively. Baral *et al.* [16] from the southern parts of Bengal have reported the maximum yield of paddy at early transplantation due to low aphid infestation. Yield loss of *faba* bean due to aphid attack can be controlled by judicious time fitted management [17].

From this study, it was thus concluded that an early season cultivation of tomato crop was found economic to avoid aphid infestation in the northern parts of West Bengal.

REFERENCES

1. Cuperus, C.W., E.B. Radcliffe, D.K. Barnes and C.C. Marten, 1982. Economic-Injury Levels and Economic Thresholds for pea aphid, *Acyrthosiphon pisum* (Harris) on *alfalfa*. Crop. Prot., 1(4): 453-463.
2. Berlandier, F.A. and M.W. Sweetingham, 2003. Aphid feeding damage causes large losses in susceptible lupine cultivars. Australian J. Exp. Agric., 43(11): 1357-1362.
3. Cruz, Y.P. and E.N. Bernardo, 1971. The biology and feeding of the melon aphid, *Aphis gossypii* Glover (Aphididae:Hemiptera) on four host plants. Philippine Entomologist. 2(2): 156-166.
4. Contagelo, C.S. T.L. Mc Fadden and R.B. Cuthbert, 1971. Control of caterpillars on tomatoes with chemical pathogens. J. Econ. Ent., 64: 737-739.
5. Sharma, H.C. and A. Bhatnagar, 2004. Estimation of yield losses caused by the maize aphid, *Rhopalosiphum maidis* (Fitch) in different varieties of barley. Pest Management and Economic Zool., 12(1): 65-70.
6. Bergman, E.C., S.D.L. Imens, H. Hojo, T.B. Campos and A.P. Takemasta, 1984. Study on the aphid fauna in automaton crop. Resumes. IX. Congresso brasileiro de Entomologica, London, pp: 9.
7. Way, M.J., P.M. Smith and C. Potter, 1954. Studies on the bean aphid Aphis fabae Scop. and its control on field beans. Ann. Appl. Biol., 41: 117-131.

8. Choudhury, 2000. Insect pest constrains of tomato (*Lycopersicon esculentum* Mill) and their management under *terai* region of West Bengal. Thesis submitted to the University of North Bengal, West Bengal, India.
9. Sreedevi, K. and A. Verghese, 2007. Seasonal incidence of aphid *Aphis punicae* Passerini (Homoptera:Aphididae) and its relationship with abiotic factors. Pest Manage. Hort. Ecos., 13(2): 65-171.
10. El-Nagar, S., L.L. Ismail and A.A. Attaia, 1982. Aspect of seasonal occurrence and life cycle of Aphis punicae Pass.in Egypt. Bull. Soc. Entomol. Egypt, 64: 155-159.
11. Shaunak, K.K. and H.N. Pitre, 1971. Seasonal alate aphid collections in yellow pan traps in Northeastern Mississippi: possible relationship to maize dwarf mosaic virus. J. Econ. Entomol., 64: 1105-1109.
12. Olivera, A.M., 1971. Observation on the influences of climatic factors of aphid on potato. Pesquisa Agropecuoria Brasilera Agronoicea, 68: P163-172.
13. Zade, P.N. B.R. Patel and K. Pareek, 2010. Population dynamics of aphid, *Aphis punicae* Passerini (homoptera: aphididae) on pomegranbate in relation to abiotic Factors. 34(8): 27-29.
14. Singh, H., 1984. House hold and kitchen garden pest: principles and practices. Kalyani publishers. India, pp: 198-210.
15. Mall, N.P., R.S. Pandey, S.V Singh and S.K. Singh, 1992. Seasonal incidence of insect pests and estimation of losses caused by shoot and fruit borer on bringal, Indian. J. Ent., 54(3): 241-247.
16. Baral, K. and A.K. Mohapatra, 1998. Effect of dates of sowing and varieties on incidence of aphid, *Lipaphis erysima* (Kalt.) on rapeseed and mustard. Environment and Ecol., 16(3): 713-715.
17. Bishara, S.I., E.Z. Fam, A.A. Attia and M.A. El-Hariry, 1984. Yield losses of *faba* bean due to aphid attack. *Faba* bean Information Services News letter, pp: 10.