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Kunal Bhattacharyya
Research Scholar, Department of Agricultural Entomology, BCKV, Mohanpur, Uttar Pradesh, India

Ayan Das
Research Scholar, Department of Agricultural Entomology, BCKV, Mohanpur, Uttar Pradesh, India

Bimal Mondal
Research Scholar, Department of Agricultural Entomology, BCKV, Mohanpur, Uttar Pradesh, India

Mainak Bhattacharyya
Research Scholar, Department of Agricultural Entomology, BCKV, Mohanpur, Uttar Pradesh, India

LN Mohapatra
Professor in Agricultural Entomology, OUAT, Bhubaneswar, Odisha, India

Correspondence
Kunal Bhattacharyya
Research Scholar,
Department of Agricultural Entomology, BCKV, Mohanpur, Uttar Pradesh, India

Seasonal incidences of some sucking pests in cotton and their correlation with abiotic factors at south costal districts of Odisha

Kunal Bhattacharyya, Ayan Das, Bimal Mondal, Mainak Bhattacharyya and LN Mohapatra

Abstract
Experiments on the seasonal incidence of some sucking pests in cotton and their correlation with abiotic factors was conducted at the Central Research Farm, Orissa University of Agriculture and Technology, Bhubaneswar during *kharif* 2016. Various sucking insects recorded on cotton during the period of study were leaf hopper, *Amrasca biguttula biguttula* Ishida., aphid, *Aphis gossypii* Glover., whitefly, *Bemisia tabaci* Gennadius. and mealybug, *Phenacoccus solenopsis* Tinsley. Among the sucking pests leaf hopper was found to be the dominant pest and its peak population (4.70 nos/leaf) was observed during 39th SW (Sep.24-30). Maximum activity of whitefly (4.50 nos/leaf) and aphid (11.58/leaf) was observed during 39th SW (Sep.24-30) and 34th SW (Aug. 20-26), respectively. Mealybug was active from the 30th SW (July 23-29) to 52nd SW (Dec. 24-31) with highest incidence during 47th SW (Nov.19-25) with 26.35 per cent branch infestation. Among the natural enemies, various predators viz., ladybird beetle, *Menochilus sexmaculata* Fabricius., green lacewing, *Chrysoperla carnea* Stephens and one species of spider were recorded during the period of study. Peak activity of ladybird beetle (2.75/plant) and spider (2.68/plant) was recorded during 39th SW (Sept. 24-30). The other predator green lacewing was active throughout the crop growth period with its peak occurrence 1.30/plant during 41st SW (Oct. 8-14). The abiotic factors such as maximum temperature, minimum temperature, evening relative humidity and rainfall had a positive effect on the leafhopper, whitefly and aphid population. Mealybug incidence showed negative correlation with minimum temperature, evening relative humidity and rainfall.

Keywords: Cotton, leafhopper, aphid, whitefly, mealybug, seasonal incidence

Introduction
Cotton is one of the world's oldest crop and has been in cultivation in India for more than five thousand years. India has the unique distinction of being the only country in the world to cultivate all four cultivable *Gossypium* species. Cotton in India has registered impressive growth both in productivity and production through advent of hybrid technology and transgenic contributing 36 per cent of world's cotton area and 26 per cent of world's cotton production. But the average national productivity is one of the lowest (560kg lint /ha) against the world's average of 788kg lint /ha and is much below other countries viz., Australia (1781kg lint/ha), China (1719 lint/ha) and Brazil (1522kg lint/ha) [2]. In the current scenario, with Indian exports gaining importance, there is a need to reorient research efforts to enhance the production from the current 340.5-lakh bales to 1000 lakh bales by 2030 in a sustainable manner through precision strategic planning in order to meet the market demand [2]. In India, majority of the cotton production comes from nine major cotton-growing states. Besides this, significantly production of cotton also achieved from in the state of Orissa in eastern India.
Insect pest are one of the major limiting factors in the cotton production. About, 1300 species of insects had been reported on cotton worldwide [7]. In India 162 insects and acarine species have been reported to infest cotton resulting in 50-60 per cent yield loss [5]. Among the arthropod pests, sucking insect viz., jassids, *Amrasca biguttula biguttula* (Ishida); whiteflies, *Bemisia tabaci* (Genn.); aphids, *Aphis gossypii* (Glover) and thrips, *Thrips tabaci* (Linn.) are the serious pests and cause losses in tune of 21.20 to 22.86 per cent [4, 10]. Adoption of Bt cotton has not only changed the cultivation profile, but also the pest scenario. While there is a decline in the pest status of bollworms; the sap feeders, viz. aphids, jassids, mirids and mealy bugs are emerging as serious pests. While the direct effects of sucking pest during early

season are visualized in terms of the poor crop stand and yield reduction, their late season attack especially aphids and white flies indirectly decreases cotton fiber quality due to deposits of honey dew on lint. In addition to lint contamination, whitefly transmits leaf curl disease.

Odisha basically is a nontraditional cotton growing states grows the crop mainly in the western and southern districts *viz.*, Kalahandi, Nuapada, Balangir, Rayagada, Koraput, Nawarngpur and Ganjam which account for 75 per cent of the total cotton area of the state. However, the productivity (375kg/ha) is far behind the national average which can be enhanced through adoption of sustainable production and protection technologies [2]. Although 23 arthropod pests including sucking pests had been recorded in cotton in Odisha [8], comprehensive knowledge on the sucking pest complex, their period of occurrence and peak incidence under prevailing weather conditions and biotic pressure on each of the sucking peats are inadequate.

Materials and methods

Field experiments were conducted during *kharif* season of 2016 at Central Research Farm of Orissa University of Agriculture and Technology, Bhubaneswar located at a latitude of 20^0 15' N and longitude of 85^0 52' E with an altitude of 25.9 m above the MSL. The soil of the experimental plot was sandy loam and acidic with a pH of 5.9. Bhubaneswar comes under subtropical climate. During the experimental period (July to December) mean maximum temperature, mean minimum temperature, morning relative humidity and evening relative humidity was 31.42^0C, 21.42^0C, 91.04 per cent and 63.43 per cent, respectively. Total precipitation received during the period of study was 711mm. The test variety selected for the study was Mallika (Non Bt) was sown in 8m x 20m size of an Observational strip with the spacing of 90cm x 60cm. Recommended agronomic practices were adopted for raising the crop except crop protection measures. To study the seasonal activity, twenty plants were randomly selected and tagged, weekly observations on the incidence of sucking pests were recorded from those tagged plants. For assessing the jassid, aphid, and whitefly the number of adults and nymphs present on the three leaves of each plant sample, (i.e. one from the top, one from the middle and other from the bottom) were counted. For mealybug incidence, percentage damage by mealybug was calculated by counting number of infested branches to the total number of branches.

Occurrence of various natural enemies in the experimental crop was also recorded in similar manner by counting their populations per those tagged plants.

The meteorological data such as maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall were collected from the Agro-meteorology Center, Orissa University of Agriculture and Technology, Bhubaneswar. The relationship between the abiotic factors and the incidence of various sucking pests of cotton were established using correlation analysis.

Results and Discussions

Seasonal incidence of sucking pests

Leafhopper (*Amrasca biguttula biguttula*): The data given in Table 1 revealed that its population ranged between 0.2-4.7 nos/leaf. It first appeared on 3rd week of July (30th SW) (0.78 nos/leaf) which gradually increased reaching a peak (4.70 nos/leaf) on the last week of September (39th SW). Then it declined (0.20 nos/leaf) at the 3rd week of November (47th SW) with no incidence observed during December.

Whiteflies (*Bemisia tabaci*): The incidence of whiteflies commenced from third week of July (30th SW) (1.89 nos/leaf) and gradually increased reaching a peak (4.50 nos/leaf) in the last week of September (39th SW) (Table 1.). Then it declined but remained active until boll opening stage (0.23Nos/leaf) on the 4th week of December (52nd SW).

Aphid (*Aphis gossypii*): Incidence of aphid was observed during the third week of July (30th SW) (5.05 nos/leaf) but declined gradually (4.32 nos/leaf) during 1st week of August (32nd SW) (Table 1). The incidence gradually had a rise and fall with the peak (11.58 nos/leaf) in the 3rd week of August (34th SW). Its activity declined but there after remained active till boll opening stage (0.90Nos/leaf) on the 4th week of December (52nd SW).

Mealybug (*Phenacoccus solenopsis)*: Data given in Table 1 indicated that the incidence ranged between 6.20-26.35 per cent branch infestations. It first appeared during 3rd week of July (30th SW) (6.20 % branch infestations) which gradually increased reaching peak (26.35 % branch infestations) during 3rd week of November (47th SW). Then it declined but remained active till boll opening stage (17.65 % branch infestations) during 4th week of December (52nd SW).

Table 1: Seasonal incidence of sucking pests of cotton under Bhubaneswar agro climatic condition during *kharif* 2016-17.

Period	Standard week	Population of sucking pests			
		Leaf hopper (Nos/leaf)*	Aphid* (Nos/leaf)	Whitefly* (Nos/leaf)	Mealybug* (% branch infestation)
July'2016	30 (23-29)	0.78	5.05	1.89	6.20
July	31 (30-05)	0.90	5.21	2.10	6.60
Aug	32 (6-12)	1.21	4.32	2.13	8.30
Aug'16	33 (13-19)	1.60	5.45	3.05	12.50
Aug	34 (20-26)	4.40	11.58	3.65	11.10
Aug	35 (27-02)	2.02	7.70	3.98	10.00
Sept'16	36 (3-9)	2.13	8.45	4.23	8.33
Sept	37 (10-16)	4.28	10.12	4.32	7.14
Sept	38 (17-23)	2.68	6.21	4.42	6.66
Sept	39 (24-30)	4.70	8.56	4.50	12.50
Oct'16	40 (1-7)	2.61	6.45	3.90	8.36
Oct	41 (8-14)	3.31	6.20	2.56	10.22
Oct	42 (15-21)	2.35	5.42	2.31	9.36
Oct	43 (22-28)	2.00	6.30	2.36	14.56

Nov'16	44 (29-04)	1.30	5.35	2.54	16.65
Nov	45 (5-11)	0.80	5.20	2.11	22.56
Nov	46 (12-18)	0.50	4.20	2.08	24.86
Nov	47 (19-25)	0.20	3.23	1.89	26.35
Nov	48 (26-02)	0.0	2.12	1.60	24.65
Dec'16	49 (3-9)	0.0	2.00	1.45	22.48
Dec	50 (10-16)	0.0	1.11	1.32	20.32
Dec	51 (17-23)	0.0	1.05	0.53	18.23
Dec	52 (24-31)	0.0	0.90	0.23	17.65

*Mean of 20 plants observations.

Occurrence of natural enemies (predators)

Ladybird beetle *(Menochilus sexmaculata*): The beetles first appeared during 1st week of crop i.e., 3rd week of July (30th SW) with a population of (0.08 nos/plant) which gradually reached the maximum (2.75 nos/plant) during 4th week of September (39th SW) (Table 2.). There after it declined but remained until the end of crop (0.85 nos/plant) during 4th week of December (52nd SW).

Spider (Unidentified): The spiders first appeared during 1st week of crop i.e., 3rd week of July (30th SW) (0.06 nos/plant) which gradually increased but maintained a low incidence throughout but reaching a peak (2.68 nos/plant) during 4th week of September (39th SW) (Table 2.) Thereafter it declined but remained until boll opening stage (1.23 nos/plant) during 4th week of December (52nd SW).

Green lacewing (*Chrysoperla carnea*): Data in Table 2 revealed that the predator first appeared during 3rd week of July (30th SW) (0.12 nos/plant), then increased but maintained a low incidence throughout but reaching a peak during 2nd week of October (1.30 nos/plant) (41st SW). Then it declined but remained active until boll opening stage (0.16 nos/plant) during 4th week of December (52nd SW).

Table 2: Occurrence of natural enemies (predators) in cotton ecosystem under Bhubaneswar agro climatic condition during *kharif* 2016-17.

Period	Standard week	Population of predators		
		Ladybird beetle* (Nos/plant)	Spider* (Nos/ plant)	Green lacewing* (Nos/plant)
July	30 (23-29)	0.08	0.06	0.12
July	31 (30-05)	0.10	0.10	0.15
Aug	32 (6-12)	0.85	0.50	0.50
Aug	33 (13-19)	1.45	1.05	0.56
Aug	34 (20-26)	1.45	1.40	0.40
Aug	35 (27-02)	1.85	1.55	0.55
Sept	36 (3-9)	1.58	1.46	0.45
Sept	37 (10-16)	2.55	1.00	0.78
Sept	38 (17-23)	2.35	1.00	0.85
Sept	39 (24-30)	2.75	2.68	1.05
Oct	40 (1-7)	2.45	1.65	1.25
Oct	41 (8-14)	1.23	1.75	1.30
Oct	42 (15-21)	1.56	1.55	1.20
Oct	43 (22-28)	1.22	1.50	1.12
Nov	44 (29-04)	1.03	1.80	0.96
Nov	45 (5-11)	1.32	1.55	0.80
Nov	46 (12-18)	1.25	1.39	0.39
Nov	47 (19-25)	1.22	1.89	0.45
Nov	48 (26-02)	1.13	1.98	0.68
Dec	49 (3-9)	0.90	2.45	0.50
Dec	50 (10-16)	0.75	2.23	0.45
Dec	51 (17-23)	0.68	1.34	0.34
Dec	52 (24-31)	0.85	1.23	0.16

*Mean of 20 plants observations.

Influence of abiotic factors on incidence of sucking pests subsequently on natural enemies.

To find out the degree of association of incidence of various sucking pests viz., leaf hopper *Amrasca biguttula biguttula* Ishida, aphid *Aphis gossypii* Glover, whitefly *Bemisia tabaci* Gennadius. and mealybug *Phenacoccus solenopsis* Tinsley also some natural enemies viz., ladybird beetle *Menochilus sexmaculata* Fabricius., Green lacewing *Chrysoperla carnea* Stephens., Spider unidentified populations with the abiotic factors viz., mean maximum temperature (x_1), mean minimum temperature (x_2), average morning relative humidity (x_3), average evening relative humidity (x_4) and total rainfall (x_5), the data were subjected to statistical analysis. Simple and multiple correlations and regression co-efficient were computed (Table 3.).

***A. biguttula biguttula*:** Interaction between leafhopper incidence and weather factors revealed that their population had positive and significant correlation with maximum and minimum temperature, evening relative humidity and rainfall (r= 0.649, 0.721, 0.673 and 0.498, respectively), while morning relative humidity had positive but non-significant relation (Table 3.). The multiple regression analysis revealed that weather parameters contributed for 62.6 per cent of total variation in its incidence.

***A. gossyppi*:** Results presented in Table 3 indicated its incidence was positively and significantly correlated with

maximum and minimum temperature, evening relative humidity and rainfall (r= 0.581, 0.799, 0.753 and 0.518, respectively), while morning relative humidity had positive but non-significant relation. The multiple regression analysis revealed that the weather parameters contributed for 67.6 per cent of total variation in their population.

***B. tabaci*:** Temperature (maximum and minimum), relative humidity (evening) and rainfall had significantly positive correlation (r= 0.581, 0.807, 0.736 and 0.473, respectively), while morning relative humidity exhibited non-significant but positive interaction with whitefly population (Table 3.). The multiple regression analysis revealed that weather parameters contributed 68.6 per cent of total variation in the incidence of whitefly

***P. solenopsis*:** Temperature (minimum), relative humidity (evening) and rainfall had significantly negative correlation (r= -0.851, -0.859, and -0.695, respectively), whereas maximum temperature and morning relative humidity exhibited non-significant but negative interaction with mealybug incidence (percent branch infestation) (Table 3). The multiple regression analysis revealed that weather parameters contributed 75.6 per cent of total variation on the incidence of mealybug.

***M. sexmaculata*:** Temperature (maximum) had significantly positive correlation (r= 0.436) whereas minimum temperature. Relative humidity (morning and evening) and rainfall exhibited non-significant but positive interaction with ladybird population (Table 3.). The multiple regression analysis revealed that weather parameters contributed for 35.5 per cent of total variation in its incidence.

Spider: Results presented in Table 3 indicated its incidence was negatively and significantly correlated with relative humidity (morning and evening) (r= -0.452 and -0.423 respectively), while minimum temperature and rainfall had negative but non-significant relationship, maximum temperature had positive but non-significant relationship with spider population. The multiple regression analysis revealed that weather parameters contributed 33.7 per cent of total variation in the incidence of spider.

***C. carnea*:** Temperature (maximum) had significantly positive correlation (r= 0.433), while temperature (minimum), relative humidity (evening) and rainfall had non- significant but positive interaction with green lacewing population, in other hand relative humidity (morning) had negative non-significant interaction with green lacewing population (Table 3.). The multiple regression analysis revealed that weather parameters contributed 30.1 per cent of total variation in the incidence of green lacewing.

Table 3: Correlation coefficients/ regression equations – sucking pests, ladybird beetle, Spider, Green lacewing vs. weather factors (2016) - Bhubaneswar.

Sucking pests/natural enemies	Temperature (0C)		Relative Humidity (%)		Total rainfall (mm)	R^2	Regression equation ($Y= A+Bx_1+Cx_2+Dx_3+Ex_4+Fx_5$)
	Max	Min	Morn.	Even.			
Jassid	0.649**	0.721**	0.268	0.673**	0.498*	62.6%	$Y= -22.28- 0.003x_1+ 0.575 x_2- 0.02 x_3+ 0.038 x_4+ 0.044 x_5$
Whitefly	0.581**	0.807**	0.278	0.736**	0.473*	68.6%	$Y= -9.08 - 0.007x_1+0.184 x_2+ 0.188 x_3+ 0.016 x_4+0.009 x_5$
Aphid	0.581**	0.799**	0.314	0.753**	0.518*	67.6%	$Y= -27.67- 0.014 x_1+.625 x_2+ 0.180 x_3 + 0.059 x_4+0.071 x_5$
Mealybug	-0.406	-0.851**	-0.358	-0.859**	-0.695**	75.6%	$Y= 13.78 - 0.026 x_1+ 0.351 x_2- 0.734 x_3+0.154 x_4- 0.129 x_5$
Ladybird beetle	0.436*	0.394	0.146	0.315	0.062	35.5%	$Y= -11.49 -0.11 x_1+0.254 x_2-0.006 x_3+ 0.045 x_4+ 0.018 x_5$
Spider	0.053	-0.404	-0.452*	-0.423*	-0.394	33.7%	$Y= - 0.19 - 0.003 x_1+ 0.212 x_2- 0.15 x_3- 0.034 x_4+ 0.023 x_5$
Green lacewing	0.433*	0.225	-0.123	0.197	0.002	30.1%	$Y= -4.02-0.005x_1+0.173 x_2-0.089 x_3-0.005 x_4+0.28 x_5$

(** Significant at 0.01%, *Significant at 0.05%)

Conclusion

Among the sucking pests leafhopper was the dominating pest. Maximum population of leafhopper and whitefly was observed at the end of September synchronizing with vegetative and early flowering stage of the crop. Activity of aphid reached peak during third week of August while the population remains at middle of September at similar trend. The activity of the pest was minimum during the month of December. Mealybug was active from throughout the crop growth period with highest branch infestation during end of November with more than one fourth of its branch infestation. Among the natural enemies one species of ladybird beetle, green lacewing and one species of unidentified spider were recorded during the period of study. Peak activity of ladybird beetle and spider was recorded synchronizing with peak activity period of major sucking pests. The other predator green lacewing was active throughout the crop growth period. The abiotic factors such as maximum temperature, minimum temperature, evening relative humidity and rainfall had a positive effect on the leafhopper, whitefly and aphid population. Mealybug incidence showed negative correlation with minimum temperature, evening relative humidity and rainfall.

References

1. Aggarwal, Naveen, Dulcha S Brar, Buttar GS. Evaluation of Bt and non Bt version of two cotton hybrids under different spacing against sucking insect pests and natural enemies, J. Cotton Res. Dev., 2007; 21(1):106-110.
2. Anonymous. Annual Report of ICAR- All India Co-ordinated Cotton Improvement Project, 2016-17. Published by CICR Regional Station, Coimbatore, India. 2016.
3. Bhute NK, Bhosle BB, Bhede BV, More DG. Seasonal

incidence of major sucking insect pests of Bt cotton and their natural enemies in Marathwada region, J. Cotton Res. Dev., 2012; 26(2):238-242.
4. Dhawan AK, Sidhu AS, Simwat GS. Assessment of avoidable loss in cotton (*Gossypium hirsutam and Gossypium arboretum*) due to sucking pests and bollworms. India J Agric. Sci. 1988; 58:290-292.
5. Jayaswal AP, Sundaramurlhy VT. Achievements in insect pest management in cotton. In: A. K. Basu and S. S. Narayallan (Eds.). Achivements of All India Co-ordinate Cotton Improvement Project. Silver jubilee (1967- 1992) September 17-19, 1992, Nagpur. 1992, 117-151,
6. Kumar V, Sharma A. Incidence of sucking insect pests of transgenic Bt cotton in relation to abiotic factors, International journal of plant sciences. 2012; 7(2):240-243.
7. Mathews GA, Tunstall JP. (eds) Insect pests of cotton. CAB International, 1994, 393
8. Mohapatra LN, Patnaik RK. Validation of IPM technology for rainfed cotton in western Orissa. All India Corrdinated Cotton Improvement Project, Journal of Cotton Research and Development. 2006; 20**(**1):102-108 ref.10
9. Patel ML, Patel RK, Sheth DB, Patel PR. Influence of Abiotic Factors on Population Dynamics of Sucking Insect Pests in Transgenic Cotton, *Advances in Life Sciences.* 2016; 5(5):1871-1875.
10. Satpute US, Patil VN, Katole SR, Men UB, Bhagwat VR, Thakare AY. Avoidable losses due to sucking pests and bollworms in cotton. Journal of Applied Zoological Research. 1990; 1:67-72.