Advances in Agriculture & Botanics
International Journal of the Bioflux Society

OPEN ACCESS
Research Article

Seasonal occurrence of sucking insect pest in cotton ecosystem of Punjab, Pakistan

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Abstract. In order to understand the seasonal occurrence and activity of insect pest on cotton, studies were carried out at Cotton Research Institute, AARI, Faisalabad during 2009. On June 30, 2009, maximum thrips (31±1.15/leaf), mites population (35.33±2.72/leaf) was recorded and whitefly (21.33±2.85/leaf) was recorded during the whole month of August but abundant population of jassid (3.33±0.33/leaf) was during October. In general three months viz., May, June and July boosted Thrips and mites population beyond the economic threshold level (ETL). Jassid and whitefly population remained above ETL throughout observation period except during April when its activity was comparatively lower. It was concluded that last two weeks of June were the most favorable for thrips and mites population and whole month of august and September encouraged jassid, whitefly and mealybug population. It was further concluded that transgenic cotton had no impact against population build up of sucking insect pest of cotton.

Key Words: cotton, sucking insect pest, seasonal activity, abiotic factors.

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Introduction

Cotton occupies a unique position in Pakistan's agricultural economy. American and desi cotton are cultivated in Pakistan. American cotton (*Gossypium hirsutum*) is more vulnerable to the attack of sucking insect pest complex (Aslam *et al* 2004; Amjad & Aheer 2007) than desi cotton (*Gossypium arborium*) (Nath *et al* 2000). It is attacked by 145 dissimilar species of insect and mite pests (Huque 1994). The yield loss in *Gossypium hirsutum* cotton due to sucking pests, bollworms and both has been recorded up to 8.45, 16.55 and 17.35 quintal ha^{-1} respectively (Satpute *et al* 1988) whereas out of 14% losses in total agriculture due to insect pest of which 84% is in cotton (Oerke *et al* 1994). Jassid, whitefly, thrips and mites are major complication for escalating yield and productivity of the crop. Jassid is reported to cause 18.78 percent decline in cotton yield (Ali 1992). Similarly whitefly vector of CLCuV (Malik *et al* 1995) injure circuitously to cotton by secreting honeydew and transmitting cotton leaf curl viral diseases that caused normal yield loss in Pakistan up to 38.7% during 1993 (Khan & Khan 1995). Similarly in the absence of thrips 56% plants produced 40% more lint than infested plants and young seedlings of cotton were severely infested by thrips (David 1958); whereas mealybug invasion resulted huge losses to cotton crop both in Pakistan and India. According to latest report (Muhammad 2007) available by the Centre for Agro-Informatics Research (CAIR) Pakistan, affirmed that the mealybug had shattered 0.2 million bales (170 kg lint per bale) and 150,000 acres (out of the 8.0 million acres) of cotton area all across Pakistan, chiefly in Punjab and Sindh provinces. According to Goswami (2007), in India due to mealybug plague nearly 2000 acres of cotton crop were ruined.

The simple method being practiced in Pakistan for the control of insect pest, on which farmers frequently rely, is the chemical control (Arif *et al* 2007). Now apart from yield losses, the cost of insecticide application only for mealybug has been increased by 250-375 US$ per acre (Nagrare *et al* 2009). Use of chemical control is not only creating health hazards and ecological contamination but also growing the resistance in the insects and disturbing the balance between the forces of destruction (predators, parasitoids and pathogens) and forces of creation (biotic potential of pests) in agro-ecosystem (Ahmad & Khan 1991; Hamburg & Guest 1997; Sorejani 1998). The transgenic varieties possess toxic protein and they can effectively control specific lepidopterous species (Arshad *et al* 2009), but lack of

resistance against sucking insect pests (Hofs *et al* 2004; Sharma & Pampapathy 2006) and hence require continuous use of pesticides and other control tactics for effective management (Hilder & Boulter 1999). The reduced use of insecticides in Bt cotton can increase the population of sucking insect pests (Men *et al* 2005) and hence sucking pests have become a more significant part of insect pest complex in Bt cotton (Wu *et al* 2002).

The occurrence and progress of all the insect pests are much dependent upon the customary environmental factors such as temperature, relative humidity and precipitation (Aheer *et al* 1994). The activities of these insect pests are fluctuated under erratic environmental conditions. For instance, jassid and whitefly exhibit their activity under wet environmental conditions whereas thrips and mites under high temperature dry situations (Khan & Ullah 1994).

Keeping in view the present studies were carried out to investigate the seasonal incidence and peak activity of sucking insect pest of cotton throughout cotton growing season in order to manage insect pest prior to their economic injury.

Material and Method

The present study was carried out at Cotton Research institute (AARI) Faisalabad, during the cotton season 2009 in order to determine the seasonal occurrence of sucking insect pest on cotton. For this purpose observations regarding insect pest population were recorded from April to October on early sown cotton cultivar FH-113. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and the plot size was kept at 25 x 10 ft, the row-to-row and plant-to-plant distance was 2 ½ ft and 1 ¼ ft, respectively. Thrips, jassid, whitefly (adults & nymphs) and mite's population data on per leaf basis and of mealybug per 10cm terminal twig were recorded early in the morning at weekly intervals. No plant protection measures were applied throughout the season, but standard and recommended agronomic practices were carried out as and when required. The five plants were selected at random from each plot for recording pest population three upper middle and lower leaves from each plant were selected. Population means of sucking insect pests for whole growing seasons at ten days interval were calculated. The data were analyzed statistically to find the significance of the results and means were compared following DMR test at 5% probability (Steel & Torrie 1980).

Results and Discussion

Population density counts

Thrips population

The presented data (Table 1, column a) revealed that maximum thrips population (31±1.15) was recorded on June 30, 2009 on cotton. Thrips population in general was low and below ETL before end April and early August. This population was first recorded on early April that gradually increased till the highest peak on June 30. Three months viz. May, June and July boosted up thrips population beyond the economic threshold level. Thrips population declined thereafter and on end August suppression was up to (0.67±0.33). It was concluded that last two weeks of June were the most favorable resulting thrips population 25-35/leaf. Results showed (Table 2) that the population of thrips behaved positive response with temperature and negative response with relative humidity. The present research findings are confirmatory to the findings of Khan & Ullah (1994), who also observed a negative relationship between population build-up of *Thrips tabaci* and *Tetranychus urticae* and the mean relative humidity and rainfall.

Mites population

Similar to thrips, studies revealed that mites population (Table 1, column b) was maximum (35.33±2.72) on June 30, 2009. Mites population in general was low and below ETL before end April and early August. The starting population was recorded on early April that gradually increased till the highest peak on June 30 and second peak on next consecutive week of July (27±0.57). During the three months viz. May, June and July favored mite's population beyond the economic threshold level. Mite's population declined thereafter and on early September up to (2±0.57). It was concluded that last week of June was the most favorable resulting mites population 25-35/leaf when temperature was high up to 36.3˚C the present findings are supported by the findings of Linger *et al* (1998) who reported that cotton mite population was favored by higher temperature. The results described in Table 2 depicted that increasing temperature favored the mite population but relative humidity exerted negative correlation with mite population. These research findings are confirmatory to the findings of Khan & Ullah (1994), who also observed a negative relationship between population buildup of *Thrips tabaci* and *Tetranychus urticae* and the mean relative humidity and rainfall and crop growth reduction due to mite infestation was greater in early than in late infested crops Sadras & Wilson (1997).

Jassid population

Studies revealed that in October the jassid population was the highest. The peak population (3.33/leaf) of jassid was recorded on October 30. In general jassid population remained above ETL since the months of May to onward, after appearance population of jassid increased on subsequent dates of observation till the highest peaks population during October when temperature and humidity were 22.3˚C and respectively 54% humidity. The present studies depicted that relative humidity exerted positive effect on jassid population but temperature affected badly. The present findings were partially supported by the findings of Khan & Ullah (1994). However slight variations might be due to difference of materials and methods.

Whitefly population

Similar to jassid studies, investigation revealed that period of abundance for whitefly population (Table 1, column d) was the whole month of August. Peak population of whitefly was recorded on August 10 and second peaks (22.33±2.85, 21.33±2.85) on consecutive weeks before and after 10 August. In general whitefly population remained above ETL throughout observation period till end October except in April when its activity was comparatively less. However its population abruptly increased on subsequent dates of observation till the highest peaks population during August when temperature and humidity were 34.5 and 51% respectively. Correlation data (Table 2) depicted that both temperature and relative humidity favored the whitefly population. The present findings are absolutely supported by the findings of (Seif 1980) who also observed similar response.

Table 1. Fluctuation of sucking insect pest population on cotton during its growth period

Months	Mean temp.(C°)	RH%	Thrips	Mites	Jassid	Whitefly	Mealybug
Apr 1	23.5	57	0.67±0.33hi	0.33±0.33j	0±0a	0.33±0.33jk	0.3±0.2q
Apr 10	20.3	71	0.33±0.33hi	0±0j	0±0a	0.33±0.33jk	0.7±0.5pq
Apr 20	31.3	27	3±0.57ghi	4±0.57ghi	0±0a	0.67±0.33jk	1.3±1.1pq
Apr 30	31.8	29	4.67±0.67ghi	8.67±0.33fg	0±0a	0.00±0.00k	2.3±0.3opq
May 1	32	38	8±2.30fgh	7.33±0.88gh	0±0.57a	1.67±0.67ijk	3.3±o0.1pq
May 10	31	40	13±2.30ef	14.33±1.67ef	0.67±0.33ab	5.00±0.58ijk	5.3±0.3no
May 20	37.3	27	16.67±0.88de	16.33±1.76de	1±0b	5.33±0.33hijk	4.3±0.2nop
May 30	34.5	30	19.33±2.02abcde	18±1.15abcd	1.67±0.67b	6.33±0.88hij	7.3±0.5mn
June 1	32.3	32	20.67±2.33abcd	19.33±1.20abcd	1±0.57b	7.33±0.88ghi	11.0±l0.3m
June 10	33.3	30	24±3.6abc	21±3.21abc	1.67±0.33b	11.33±0.33fgh	12.7±0.7kl
June 20	31	43	25.33±1.4abc	22.66±2.72abc	1.0±0.33b	13.33±0.88defg	15.0±j1.1k
June 30	36.3	44	31±1.15abc	35.33±2.72abc	1.3±0.33b	12.67±0.88efg	17.7±0.5j
July 1	29.5	61	25±2.51abc	27±0.57abc	1.66±3.1b	14.00±0.58cdef	25.3±1.3i
July 10	34.5	55	22.67±0.88abcd	16.67±1.20bcd	1.67±0.67b	15.33±0.33bcdef	39.3±1.3h
July 20	35.5	52	19.67±0.88abcde	16.67±1.20bcd	1.33±0.33b	17.00±0.58abcdef	43.3±1.4g
July 30	28.3	72	17.67±1.45abcde	8.67±1.20fg	1.33±0.33b	17.67±1.45abcde	56.0±2.1ef
Aug 1	34	58	8.33±1.76fg	4.67±1.20ghi	1.33±0.88b	21.00±0.58ab	55.0±2f
Aug 10	34.5	51	5.67±2.18ghi	2.33±1.45ghi	1±0.57b	22.00±1.73a	59.0±2.2e
Aug 20	28.5	78	1.33±0.33hi	3±1.15ghi	2.33±0.33bc	21.33±2.85ab	70.7±4.3c
Aug 30	33.5	59	0.67±0.33hi	5±0.57ghi	2.33±0.88bc	20.33±0.88ab	75.0±4.5a
September 1	28	78	1±0.57hi	2±0.57ij	2.33±0.88bc	19.00±0.58abcd	75.7±4.5a
September 10	30	66	0±0i	0±0j	2.33±1.20bc	20.67±1.45ab	68.3±3.5cd
September 20	32	57	1.33±0.33hi	1.67±0.33ij	2.33±0.88bc	18.00±0.58abcde	75.0±4.5a
September 30	30.8	48	0.67±0.33hi	2±0.57ij	2.66±0.88bc	17.00±0.58abcdef	67.3±3.5cd
October 1	30.5	47	0±0i	0±0j	2.33±1.33bc	15.33±0.33bcdef	74.7±4.3ab
October 10	26.5	58	0±0i	0±0j	2.67±1.2bc	16.33±0.33abcdef	71.0±b4.1c
October 20	23.8	60	0±0i	0±0j	3±1.15c	20.00±2.52abc	70.0±4.1c
October 30	22.3	54	0±0i	0±0j	3.33±0.88c	18.00±2.08abcde	65.7±3.5d

Means with same letter are not significantly different from each other according to Duncan's Multiple Range Test at P = 0.05

Table 2. Correlation studies regarding abiotic factors and sucking insect pest population on cotton

Factor	Jassid	Whitefly	Thrips	Mites	Mealybug
RH%	0.62	0.58	-0.38	-0.43	0.64
P values (5%)	0.0004	0.0011	0.0453	0.021	0.000
Temperature ◦C	-0.101	0.059	0.55	0.56	0.15
P values (5%)	0.609	0.762	0.0022	0.0018	0.44

Mealybug population/10cm twig

Studies revealed that abundant population period of mealybug (Table 1, column d) (>70/10cm twig) was recorded from August to October. However it remained active through out the year and peak population of mealybug was recorded during August and September when temperature ranged 28-33.5˚C and respectively 59-78% humidity. The current results observed that temperature and relative humidity exerted positive effects on mealybug population. The present studies are partially consistent as Aheer *et al* (2009) reported that CMB remained present throught study period on Chinese-rose.

Conclusion and Recommendations

The present studies showed that under hot dry conditions thrips and mites attacks more on cotton whereas during hot humid conditions whitefly, jassid and mealybug create problems. Similarly the peak population of jassid, whitefly and mealybug was recorded during the months of August and September but thrips and mite's peak population was recorded during May and June periods. These studies will warn the farmers about the population fluctuation and will be helpful for devising pre-planned management strategies against these pests.

References

Aheer, G. M., Ahmed, K. J., Ali, A., 1994. Role of weather in fluctuating aphid density in wheat crop. Journal of Agricultural Research 32:295–301.

Aheer, G. M., Zafarullah, S., Saeed M., 2009. Seasonal history and biology of cotton mealybug, *Phenacoccus solenopsis* Tinsley. Journal of Agricultural Research 47:423-431.

Ahmad, M., Khan, M. R., 1991. Insecticide resistance management strategies in cotton pests in Pakistan. Pakistan Entomology 13:1-4.

Ali, A., 1992. Physio-chemical factors affecting resistance in cotton against jassid, *Amrasca devastans* (Dist.) and thrips, *Thrips tabaci* (Lind.) in Punjab, Pakistan. Ph.D Thesis., Dept. Entomol., Univ Agric., Faisalabad. pp. 430.

Amjad, A., Aheer, G. M., 2007. Varietal resistance against sucking insect pests of cotton under Bahawalpur ecological conditions. Journal of Agricultural Research 45:205–208.

Arif, M. J., Abbas, G., Saeed, S., 2007. Cotton in danger, p: 4. Dawn, The Internet Edition (http://DAWN.com), March 24th, 2007.

Arshad, M., Suhail, A., Arif, M. J., Khan, M. A., 2009. Transgenic Bt and non-transgenic cotton effects on survival and growth of *Helicoverpa armigera*. International Journal of Agriculture and Biology 11:473–476.

Aslam, M., Razaq, M, Saeed, N. A., Ahmad, F., 2004. Comparative resistance of different cotton varieties against bollworm complex. International Journal of Agriculture and Biology 6:39-41.

David, W. A. L., 1958. Organic phosphorus insecticide for the control of field crop insects. Annual Review of Entomology 11:183-212.

Goswami, B., 2007. Bt cotton devastated by secondary pests. http://www.infochange india.org/features 441.jsp (posted on 1 September 2007).

Hamburg, H. V., Guest, P. J., 1997. The impact of insecticide arthropods in cotton agro-ecosystem in South Africa. Archives of Environmental Contamination and Toxicology 32(1):63-68.

Hilder, V. A., Boulter, D., 1999. Genetic engineering of crop plants for insect resistance-a critical review. Crop Protection 18:177–191.

Hofs, J. L., Schoeman, A., Vaissayre, M., 2004. Effect of Bt cotton on arthropod biodiversity in South African cotton fields. Communications in Agricultural and Applied Biological Sciences 69:191–194.

Huque, H., 1994. "Insect pests of fibre crops", In: Hashmi, A. A. (Ed.), Insect Pest Management, Cereal and Cash Crops. Vol. 1, Pakistan Agricultural Research Council, Islamabad, pp. 193-260.

Khan, S. M., Ullah, Z., 1994. Population dynamics of insect pests of cotton in Dera Ismail Khan. Sarhad Journal of Agriculture 10:285–290.

Khan, W. S., Khan, A. G., 1995. Cotton Situation in Punjab. An overview. Presented at National Seminar on Strategies for Increasng Cotton Production. Agri. House, 21-Agha Khan-III Road, Lahore. April 6-7.

Linger, M. S., Awaknavar, J. S., Lingapa, S., 1998. Seasonal occurrence of chilli mites and thrips. Karnataka Journal of Agricultural Research 11:380–385.

Malik, A. K., Mansoor, S., Saeed, N. A., Asad, S., Zafar, Y., Stanely, J., Markham, P., 1995. Development of CLCV resistance cotton varieties through genetic engineering. A monograph published by Director of Agricultural Information, Punjab, Pakistan, pp. 3.

Men, X., Ge, F., Edwards, C. A., Yardim, E. N., 2005. The influence of pesticide applications on *Helicoverpa armigera* Hubner and sucking pests in transgenic Bt cotton and non-transgenic cotton in China. Crop Protection 24:319–324.

Muhammad, A., 2007. Mealybug: cotton crop's worst catastrophe' published by the Centre for Agro-Informatics Research (CAIR), Pakistan in October 2007. Available at http://agroict.org/adss/MealyBug_Report.aspx.

Nagrare, V. S, Kranthi, S., Biradar, V. K., Zade, N. N., Sangode, V., Kakde, G., Shukla, R. M., Shivare, D., Khadi, B. M. Kranthi, K. R., 2009. Widespread infestation of the exotic mealybugspecies *Phenacoccus solenopsis* (Tinsley) (Hemiptera: Pseudococcidae) on cotton in India. Bulletin of Entomological Research 99:537-541.

Nath, P., Chaudhary, O. P., Sharma, P. D., Kaushik, H. D., 2000. The studies on the incidence of important insect pests of cotton with special reference to *Gossypium arborium* (Desi) cotton. Indian Journal of Entomology 62:391–395.

Oerke, E. C., Dehne, H. W., Schonbeck, F., Weber, A., 1994. Crop production and crop protection: Estimated losses in major food and cash crops. Elsevier, Amsterdam, The Netherlands, 808 pp.

Sadras, V. O., Wilson, L. J., 1997. Growth analysis of cotton crop infested with spider mites. Crop Science 37:481–491.

Satpute, U. S. Sarnaik, D. N., Bhalerao, P. D., 1988. Assessment of avoidable field losses in cotton yield due to sucking pests and bollworms. Indian Journal of Plant Protection 16:37-39.

Seif, A. A., 1980. Seasonal fluctuation of adult population of whitefly, *Bemisia tabaci* on cotton and its relationship with weather parameter. Journal of Cotton Research and Development 5:181–189.

Sharma, H. C., Pampapathy, G., 2006. Influence of transgenic cotton on the relative abundance and damage by target and non-target insect pests under different protection regimes in India. Crop Protection 25:800–813.

Sorejani, M., 1998. Current trend in pesticide usage in some Asian countries. Review of Applied Entomology 77:219-234.

Steel, R. G. D., Torrie, J. H., 1980. Principles and Procedures of Statistics: A Biometrical Approach, 2nd edition. McGraw Hill Book Co. Inc., New York.

Wu, K., Li, W., Feng, H., Guo, Y., 2002. Seasonal abundance of the mirids, *Lygus lucorum* and *Adelphocoris* spp. (Hemiptera: Miridae) on Bt cotton in northern China. Crop Protection 21(10):997-1002.

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Citation	Shahid, M. R., Farooq, J., Mahmood, A., Ilahi, F., Ria, M., Shakeel, A., Petrescu-Mag, I. V., Farooq, A., 2012. Seasonal occurrence of sucking insect pest in cotton ecosystem of Punjab, Pakistan. Advances in Agriculture & Botanics 4(1):26-30.
Editor	Miklos Botha
Received	27 February 2012
Accepted	30 May 2012
Published Online	30 June 2012
Funding	None Reported
Conflicts / Competing Interests	None Reported