Middle-East Journal of Scientific Research 7 (5): 669-673, 2011
ISSN 1990-9233

Role of Temperature and Relative Humidity on the Development of *Amrasca devastans* (Homoptera; Cicadellidae) under Unsprayed Conditions in Faisalabad, Pakistan

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Abstract: Six advanced varieties of stub cotton *(Gossypium hirsutum)* were evaluated against cotton Jassid (A*mrasca devastans*) under natural environment to investigate the impact of temperature and relative humidity in the experimental area of NIAB, Faisalabad. Data were recorded from April 1st to July 30th 2005 taking two leaves each from top, middle and bottom of five randomly selected plants. Correlation analysis of jassid population and weather factors depicted that the temperature was positively correlated with the Jassid population while the relative humidity negatively correlated. NIAB-Karishma found high positively correlated (r=0.2702) with the maximum temperature and high negatively correlated (r=-0.5658) with relative humidity (50.37=8.994%) at 8:00 am. While maximum and minimum per leaf population of Jassid were 0.080=0.075/leaf and 0.018=0.02/leaf on FH-901 and IR-441 during the months of April and June respectively.

Key words: Abiotic factors · *Amrasca devastans* · Stub cotton · Faisalabad · Pakistan

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important non-food cash crop of Pakistan. It accounts for 10.5% of the values added in agriculture and about 2.4% to the GDP. In addition to providing raw materials to the local textile industry, the surplus lint cotton is exported. It contributes about 60% in export and 85% in domestic edible oil production. [1]. Cotton is vulnerable to the attack of large number of insect pests through out its growth period, which causes losses to the tune of 39.50% ….any data… [2]. The efforts of the Government, researchers and the cotton growers, during the last three years picked up the pace with a record production of 11.181 million bales. In 2005-2006 attributed mainly to the favorable weather conditions and low insect pest pressure [3]. Incidence of insect pests considerably reduces both the yield and quality of cotton [4]. "According to Bhat *et al.,* [5]" total losses of cotton due to *Amrasca devastans* and bollworm averaged 55%. The incidence and development of insect pests is dependent upon prevailing weather factors such as temperature, relative humidity and precipitation [6].

Of a number of factors, high population of piercing sucking insect pests and mites survive every year despite extensive and intensive insecticidal application on cotton and immense losses to crop as high as 45% in certain areas of country [7]. There is a great impact of prevailing weather factors especially of temperature, relative humidity and rainfall during the crop season on the incidence and development of sucking pest complex in cotton ecosystem. The pertinent influence of these environmental factors in fluctuating jassid population has been reported by different workers as [8, 9].

In contrast to the chemical control, the present study has been conducted to see the population fluctuation of jassid in relation to abiotic factors i.e. temperature and relative humidity on different varieties of stub cotton under unsprayed conditions and to devise a pest management strategy to control these insect pests. Akram [8] found a positive correlation between weather factors and jassid population with a correlation coefficient value of 0.867. Khaliq and Yousaf [10] reported that capture of *A. devastans* increased with increasing temperature and relative humidity.

MATERIALS AND METHODS

The six varieties (NIBGE-I, IR-441, IR-443, NIAB-Karishma, FH-901 and FH-925) of stub cotton were sown in the last week of May 2004 according to a Randomized Complete Block Design (RCBD) with three replicates.

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The total area was 89.9 X13.7 meter. The plot size for each treatment was 7.6X 3.0 meter. The row-to-row and plant-to-plant distance was maintained by 0.8 meter and 0.5 meter respectively with five rows of each treatment in each replication. Trail was carried out from the 1st week of April to the last week of July 2005. The data regarding the cotton jassid (*Amrasca devastans*) was recorded on alternate day taking two leaves each from the top, middle and bottom (Total six leaves/plant) of five randomly selected plants in three replication of each treatment for counting their population (6x5x3=90). The number of jassid was counted from underside of the leaves. Population means of each pest on each observation dates as well as weather factors were arranged. Data were statistically analyzed by using analysis of variance (ANOVA), Duncan's new multiple ranges (DMRT) test (Steel & Torrie, 1996) and least significance difference test (LSD).

RESULTS

Per Leaf Population of *A. devastans* on Different Varieties of Stub Cotton: Overall the mean populations of Jassid per leaf (average of 90 leaves) in different varieties of stub cotton were evaluated for three months (April, May and June). Results showed that replicates of jassid populations on different stub cotton genotypes were not differing significantly (P>0.01). Mean jassid populations on all stub cotton varieties, differed significantly. Similarly interactions between populations and months (VXM) revealed statistically significant (P<0.01) variations among them. NIBGE-I and FH-I did not show considerable difference (p>0.01) between them in the months of May and June while revealed remarkable differences in populations during the month of April (Table 1).

On NIBGE-I and IR-441, the jassid population increased as the mean maximum temp increased from 34.5-40.3 °C in whole the research period (April-June) while populations in remaining stub cotton cultivars decreased for the first two months and finally increased in the last month (Table 2). In the month of April maximum population (0.080/leaf) was observed on the FH-901 while minimum (0.058/leaf) found on the NIBGE-I and IR-447 at maximum 32.55 °C and 50.375% R.H. (8:00 am) and significant differences (p<0.001) were noted between them. Maximum population (0.036±0.054/leaf) was recorded on FH-925 while minimum (0.024±0.022/leaf) on NIABGE-I at mean maximum temperature 35.14±2.234°C and R.H. 45.5±14.318% in the month of May. During the month of June maximum number of jassid (0.058±0.039/leaf) were observed on FH-925 while minimum (0.020±0.010) on IR-447 at 40.30±2.625 °C and R.H. 47.16±13.448% and varied significantly (p<0.001). By comparing the ranges of jassid populations on all genotypes it was revealed that maximum ranges were observed in the cases of FH-901 and IR-441 while moderate seen on IR-447, NIBGE-I and NIAB-Karishma. Widest range of jassid populations was recorded on FH-901 (0.024±0.021-0.080±0.075/leaf) and narrowest on FH-925 (0.058±0.039-0.060±0.054/leaf) and significant variations were observed (p<0.001) (Table 2).

When we compared overall mean population of jassids in whole period of study maximum populations (0.080±0.075/leaf, 0.058±0.069/leaf and 0.058±0.067/leaf) were found for FH-901, NIBGE-I and IR-447 during the months of April and June respectively. The genotype IR-447 attracted least jassid (0.020±0.010/leaf) in the month of June at 40.30±2.625°C and 47.16±13.448 % R.H. (Table 2).

The pattern of population for NIBGE-I varied significantly (p<0.001) similar trend was seen for FH-1. Constant increasing trends were noted in the mean maximum and minimum temperatures whereas inconsistent patterns were seen in the R.H. at 8:00am. Progressive decreasing jassid populations for IR-447, NIBGE-I and NIAB-Karishma were recorded and significant variations (p<0.001) observed among them.

Strong positive correlation did not found between jassid populations on all varieties of stub cottons with maximum and minimum temperatures and R.H. at morning and evening sessions (8:00 am and 5:00 pm). Maximum positive correlation (r=0.2702) was observed between NIAB-Karishma and mean maximum temperature.

Table 1: Analysis of variance (ANOVA) for the data of jassid (*A. devastans*) population per leaf (mean+S.E.) on different genotypes of stub cotton during the months from April-June

SOV	df	SS	MSS	F Values
Replication	2	0.001	0.000	0.1864^{NS}
Variety	5	1.564	0.313	55.918^{**}
Months	2	0.429	0.215	38.346^{**}
VXM	10	1.133	0.113	20.251^{**}
Error	34	0.190	0.006	
Total	53	3.318	CV (%)	12.03

NS= Non-significant; **=Significant (P<0.01); V, variety; M, months; VXM, Interactions between varieties and months.

Table 2: Population (mean±S.E.) of *A. devastans* on different varieties of stub cotton at different temperatures (Maximum and Minimum) and relative humidity (R.H.) (8:00 am and 5:00 pm)

			Months		
Variety			April	May	June
NIBGE-I			0.058=0.069[b]	0.024=0.022[a]	0.022=0.011[a]
IR-441			0.064=0.065[c]	0.034=0.038[b]	0.081=0.020b
IR-443			0.058=0.067[b]	0.028=0.027[a]	0.020=0.010[a]
NIAB-Karishma			0.062=0.073[b]	0.028=0.022[a]	0.032=0.018[a]
FH-901			0.080=0.075[b]	0.026=0.026[a]	0.024=0.021[a]
FH-925			0.060=0.054[b]	0.036=0.053b	0.058=0.039[b]
C.V. (%)		12.03			
L.S.D.			0.008		
Temperature					
(°C)	(Max)		34.525=3.304[a]	35.14=2.934[a]	40.30=2.625[b]
	(Min)		16.200=3.321[a]	20.62=2.767[a]	25.04=2.574[b]
C.V. (%)		8.030			
L.S.D.			4.002		
R.H.	(8:00 am)		50.375=8.994[b]	45.50=14.318[a]	47.16=13.448[a]
(%)	(5:00 pm)		26.750=5.008[a]	30.88=12.197[a]	31.30=13.609[a]
C.V. (%)		9.030			
L.S.D.			5.020		

Statistical significant differences determined by analysis of variance (ANOVA); Numbers followed by the same letters in the same row are not significantly different, according to Duncan's Multiple Range Test.; Least significance difference (L.S.D.) values at p<0.01 level; C.V., Coefficient of variance; ±S.E., Standard Error; R.H., Relative Humidity (%); Max, maximum; Min, minimum

Table 3: Correlation coefficients of weather factors and population of *Amrasca devastans* on different genotypes of stub cotton under unsprayed conditions recorded from April 1, 2005 to June 30, 2005 at Faisalabad

Varieties	Temp Max (C)	Temp Min (C)	R.H. 8 am (%)	R.H. 5pm (%)
V1	-0.0413	-0.2354	-0.11169	-0.2359
V2	0.1145	-0.0715	-0.2460	-0.2611
V3	0.1014	-0.0590	-0.2217	-0.1640
V4	0.2702	0.1300	-0.5658	-0.1906
V5	0.1150	-0.0516	-0.2992	-0.2127
V6	0.1616	-0.0638	-0.1886	-0.1509

V1, NIBGE-I; V2, IR-441; V3, IR-443; V4, NIAB-Karishma; V5, FH-901; V6, FH-925; Max,maximum; Min, minimum; R.H., relative humidity(%).

On the other hand apparent linear correlation -0.0413 did not found between NIBGE-I and maximum mean temperature (Table 3). The effect of minimum temp on population of jassid was negatively correlated (r=-0.2354) with NIBGE-I. All genotypes showed negative correlation with mean of maximum temperature except NIAB-Karishma (r=0.1300) (Table 3).

Similarly negative correlations were found between all genotypes and R.H. at morning and evening times (8:00 am and 5:00 pm). Highest negative correlation (r=-0.5358) was recorded for NIAB-Karishma and R.H. at morning (8:00 am) while least (r=-0.1116) observed between NIBGE-I and morning R.H. (8:00 am). Relative humidity at evening (5:00 pm) had highest correlation (r=-0.2359) with FH-901 (r=-0.02127). Apparent linear correlation (r=0.0413) between NIBGE-I and maximum temperature did not exist. Likewise linear correlations did not (r=0.0715, r=0.0590, r=0.0516 and r=0.0638) recorded between IR-441, IR-443, FH-901, FH-925 and mean of minimum temperature respectively (Table 3).

DISCUSSION

Role of Temperature and Relative Humidity on Population Fluctuation of *A. Devastans:* In Pakistan about 150 different species of insects and mites pests have been found attacking and reducing the cotton yield and quality [11]. Among these insect pests including the white fly and jassids are the most dangerous and harmful to cotton crops. Environmental factors viz., temperature, relative humidity and precipitation play a very important role on the population dynamics of sucking insect pests of cotton [6, 12-15]. Significant (0.05, 0.01 and 0.001% levels) relationships between population buildup of whitefly and jassids with respect to temperature and relative humidity were studied by numerous researchers [16, 17, 18, 12]. In recent study peak population was recorded in the month of April on FH0-901 at 34.52=3.304°C and R.H. 50.37=8.994 %. These results were in disagreement with the findings of Gupta *et al.,* [15] who observed peak population of aphids, jassid and thrips at four week of cotton in 1989-90.

They recorded peak populations of jassids and thrips during the last of July to mid September and second of October respectively. Joginder *et al.* [14] studied population buildup of cotton jassid on eleven varieties of cotton and revealed peak population of pest in late June and mid July. Maximum population build was correlated with mean temperature of 30°C and 5-8 hrs sunshine per day. Significant differences were found between two varieties viz., *G.hirsutum and G. arborium* while remaining exhibited same results. Similarly significant differences (p=0.01) among varieties were found in the present work.

Jassid populations during whole research work remained below the ETL (Economic Threshold Levels, 1-2jassid/leaf) as reported by many authors [14, 19]. Maximum jassid population (0.080±0.075/leaf) was found on FH-901 followed by NIBGE-1 (0.058±0.069/leaf), IR-447 (0.058±0.067) and FH-925 (0.058±0.039) in the months of April and June respectively. Least population was recorded on IR-441 at 40.3±2.625°C and 47.16±3.448% R.H. in the month of June. On the contrary Shad *et al.* [13] evaluated lower jassid population (0.13/leaf) on CIM-443 and on all other varieties close to ETL except BH-36 in the mid of august. Combined effect of relative humidity and temperatures found positively correlated with jassid population (nymphs and adults). Adult jassid population was negatively correlated with relative humidity and temperature [20]. All genotypes of cotton (NIBGE-I, IR-441, IR-442, NIAB-Karishma, FH-901 and FH-925) were the negatively correlated with R.H. (%) at the morning and evening (8:00 am and 5:00pm). Present results supported the findings of Ali [20]. Akram [8] conducted an experiment to report the correlations between weather factors and jassid population and found strong positive correlation coefficient value (r=0.867) but in the recent study maximum positive correlation (r=0.270) was observed between NIAB-Karishma and mean maximum temperature values while NIAB-Karishma negatively correlated r=-0.05658 with R.H% at morning (8:00 am). Weather factors viz., temperature, rainfall and R.H. were correlated with average population of *A. devastens* and thrips on cotton cultivers [9, 14, 16]. In the present research work similar parameters (temperature and relative humidity) were evaluated to observe the incidence of jassids on different genotypes of stub cotton. As positive correlation (r=0.2702) was observed between Niab-Karisma and mean values of maximum temperature. So the findings of present research work were consistent with the results (r=0.297) concluded by Ali *et al.* [9] for temperature and jassid density.

As relative humidity was concerned all genotypes of stub cotton were negatively correlated with R.H (%) at the morning and evening sessions (8:00 am and 5:00 pm). Highest negative correlation (r=-0.5658) was recorded of NIAB-Karishma with R.H. at the morning (8:00 am). These findings were not in conformity with previous results reported in literature [9] who described jassid population was strongly positive correlated (r=0.879) with R.H. (Table 3). By comparing the jassid populations on all genotypes these ranged from 0.018±0.02-0.58±0.039/leaf, 0.024±0.022-0.036±0.053/leaf and 0.058±0.067-0.080±0.075/leaf during the months of June, May and April respectively. It is concluded from recent results that maximum population (0.080±0.075/leaf) was observed on FH-901 and found most susceptible to jassid while IR-441 (0.018±0.02/leaf) found least susceptible in the months of April and June respectively (Table 2).

ACKNOWLEDGEMENTS

We thank the Chairpersons Zoology Department, GC University, Faisalabad for permission to work in the cotton fields. We are very much indebted to Dr. Saleem and Dr. Randhwa for generous support and help. Dr. M.S Mughal chairperson, zoology Department GC University Lahore gave valuable comments and suggestions for the preparation of the manuscript.

REFERENCES

1. Anonymous, 2005. Economic survey Govt. of Pakistan Fin. Div. Adv. Wing, Islamabad, pp: 11-118.
2. Naqvi, K.M. 1975. Crop protection to boost up cotton production. Paper presented at Cotton Seminar on April 13-14, 1975 at Lyallpur.
3. Anonymous, 2006. Economic Survey Govt. of Pakistan, Fin. Div. Econ. Adv. Wing, Islamabad, pp: 12-130.
4. Arshad, M., N. Illahi, M. Rashid and Z.U. Qamar, 2001. Estimation of useful hetrosis in intraspecific F1 cotton hybrids. J. Agric. Res., 39: 101-106.
5. Bhat, M.G., A.B. Josh and S. Munshi, 1986. Relative cotton yield by jassid and pink bollworm in some cotton genotypes. Ind. Jour. Entomol., 46: 169-173.
6. Aheer, G.M.., K.J. Ahmad and A. Ali, 1994. Role of weather factors in fluctuating aphid density in wheat crop. J. Agric. Res., 32: 295-301.
7. Ahmad, S.A., 1991. Bollworm and sucking pests on cotton in Punjab province of Pakistan. Quarterly newsletter Asia and Pecific. Pl. Prod. Commission, 34: 10-11.

8. Akram, M., 1984. Studies in varietal resistance in cotton to insect pests. M.Sc. Thesis, Dept. Agri. Entomol., Univ. Agri.., Faisalabad, Pakistan.
9. Ali, A., M.A. Bhatti and K.J. Ahmad, 1993. Role of weather in fluctuating the population of *A. denastans* (Dist.) and *T. Tabvaci* (Lind.) Proc. Pakistan Cong. Zool., 13: 133-139.
10. Khaliq, A. and M. Yousaf, 1986. Effect of weather on light trap capture of some insect pests of cotton. J. Agric. Res., 24: 313-319.
11. Attique, M.R. and A. Rashid, 1983. Efficacy of *pyrethroid pesticides* for the control of cotton pests. J. Agri. Res., 4: 65-67.
12. Otoidobiga, L.C., C. Vincent and R.K. Steward, 2004. Relative abundance of *Bemisia tabaci* (Genn) and its parasitoids and the impact of augmentative release of Erenmocerus spp (Hymenoptera: Aphelinidae) of the population dynamics of the pest in Burkina Faso (West Africa. Int. J. Pest. Manag.
13. Shad, S.A., W. Akram and R. Akbar, 2001. Relative response of different cultivars of cotton to sucking insect pests at Faisalabad. Pak. Entomol., 23: 79-81.
14. Joginder, S.B., Sekhin and J. Singh, 1995. Population buildup of cotton jassid, *Amrasca devastans*, on different varieties of cotton. J. Insec. Sci., 11: 53-55.
15. Gupta, M.P., S. Sandeep, S.K. Shrivastava and S. Sharma, 1997. Population buildup of some sap-sucking insects on cotton in Madhya Pardesh. J. Insc. Sci., 10: 153-156.
16. Berlinger, M.J., N. Lehmannsigura and R.A.J. Taylor, 1996. Survival of *Bemisia tabaci* adults under different climatic conditions. Entomol. Expt. App., 80: 511-519.
17. Bishnol, O.P., M. Singh, V.U.M. Rao, R. Nivas and P.D. Sharma, 1996. Population dynamics of cotton pests in relation to weather parameters. Indian J. Entomol., 58: 103-107.
18. Whala, M.A., J. Arif and M. Afzal, 1996. The impact of physical factors on the population dynamics of sucking pest complex of "FH-87" cotton variety. Pak. Entomol., 18: 81-83.
19. Anonymous, 2000. Agriculture Statistics of Pakistan. Govt. Pak., Min. of food, Agri. and Livestock, Islamabad.
20. Ali, A., 1981. Future studies in bio-physical resistance in different varieties of cotton against insect pests. M.Sc. Thesis, Univ. Agri, Faisalabad, Faisalabad, Pakistan.