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Influence of weather factors on the trapped population of pink bollworm (*Pectinophora gossypiella*) under Multan Agro-ecosystem

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Abstract
Studies were carried out to evaluate the impact of weather factors on the population dynamics of pink bollworm for three consecutive years from 2009 to 2011 at Entomological Research Sub-station, Multan. Pheromone traps charged with Gossyplure [(Z, Z) and (Z, E) 7, 11 hexadecadienyl acetate] were installed and data for moth catches was recorded regularly at fortnightly basis. Simple correlation and regression coefficients were also computed to know the relationship between weather factors and moth catches. The results indicated that highest peaks of pink bollworm appeared during April having 1.1 and 1.13 moths/trap at 37.78 and 36.78 ºC (maximum temperature), 22.00 and 20.12 ºC (minimum temperature), 29.89 and 28.46 ºC (average temperature) and 67% (RH) during 2009 and 2011 respectively whereas peak appeared in November and December during 2010. Out of weather factors, maximum temperature and rainfall showed positive response while minimum temperature, average temperature and relative humidity had a negative impact on the population fluctuation of pink bollworm. Regression coefficient showed 8.92% impact of weather factors in population fluctuation.

Keywords: Pink bollworm, Multan, Climatic changes, Regression analysis

1. Introduction
Cotton is one of the most sensitive crop to the pest attack and chemically intensive among all fields. In Pakistan, bollworms are considered as major pest of cotton. Apart from cotton they also cause serious damage to number of other crops particularly the summer vegetables such as okra, tomato, tori, chilies and different cucurbits etc. Ahmed [1] reported that cotton crop is the most susceptible to bollworm, which inflect heavy damage that may vary from year to year but generally cause 20-30% of yield reduction. Ghouri [8] reported about 20% loss of yield by different bollworm pest only. *Pectinophora gossypiella* is one of the major lepidopteron pests of this region and cause significant infestation throughout the world. It causes an enormous damage and loss of cotton yield when it neglected [7].
Hutchison *et al*. [12] reported that young larvae of *P. gossypiella* penetrate in to the young bolls and flowers two hours after the hatching. The pink bollworm larvae feed on flower buds, flowers, bolls and seeds, and the termination of growth results in boll rotting, premature or partial boll opening, reduction of staple length, strength, and increases trash content in the lint. Sex pheromones are being used to monitor emergences of over winter population of pink bollworm (a successful technique for monitoring and mating disruptions) [16, 18]. Hummel *et al.* [11] identified the sex pheromones for pink bollworm as 1:1 mixture of (Z, Z) and (Z, E) 7, 11 hexadecadienyl acetate, named gossyplure. Boguslawski [4] used sex pheromones and pesticides in different plots for control of *P. gossypiella*, and found sex pheromones more successful than pesticides. Being cold blooded organisms, the effect of temperature on insects largely overwhelms the influence of environmental aspects [3]. Temperature exerts great impact upon the total number of eggs and on the ovipositional behavior of insects [5]. More often rainfall may have a negative impact on the insect population because eggs and neonates of some insects may be dislocated or killed by rain [14]. Its population increases during rainy season and population drop with increase in temperature. Different stages of the insect prolonged developmental period during winter and coloration also changes with change in temperature and humidity [17]. Insects are capable of surviving only within certain environmental limits, so one can predict the occurrence of peak activities of a given pest

through better understanding of preferred environmental factors. Therefore, the current studies were conducted to monitor the population of *P. gossypiella* and its relationship with weather factors.

2. Materials and Methods

The experiment was conducted for three consecutive years (2009 to 2011) at Entomological Research Sub-Station, Multan to monitor the population fluctuation of *P. gossypiella* and impact of weather factors on its population. Six pheromone traps each charged with Gossyplure were installed. Each trap was installed with the help of bamboo stick at the height of 1.22-1.55 m from the ground level. The data for moth catches were recorded fortnightly. The lure was changed after 15 days interval regularly. To evaluate the effect of weather parameters on the population of *P. gossypiella*, weather data were obtained from the nearby observatory at Multan.

Statistical Analysis

The data obtained were graphed using MS-Excel-2010 along with weather parameters. The data was transformed using square root transformation for calculating correlation and regression coefficients to check the role of weather parameters on the population fluctuation of *P. gossypiella*.

$Y=\sqrt{0.5+x}$

Where x is the number of *P. gossypiella*.

3. Results

The results (fig. 1) showed relative influence of weather factors on the population fluctuation of *P. gossypiella*. It is evident from the figure that moth catches of *P. gossypiella* trapped were very low (almost zero) during Jan-March of first year. Maximum moth catches were observed on 30-04-2009 (1.10 moths/trap) at moderate weather conditions (29.89 ºC, 51.21% R.H.). Second and third highest peaks of *P. gossypiella* population were observed on 15-04-2009 (0.86 moths/trap) and 30-10-2009 (0.78 moths/trap) respectively. No moth catches were recorded for other months.

During second year of study (fig. 2), moth population was observed in two peaks i.e. mid-April to mid-May and mid-October to December. No population was noticed for remaining months. However, maximum population of 1.00 moth/trap was recorded on15-12-2010.

During 2011, 1.13 moths/trap were observed on 30-04-2011 followed by 0.40 moths/trap on 30-10-2011. Moth catches remained very low during other period of the year (Fig. 3).

Simple linear correlation was also carried out to know the relationship between moth population and weather factors as depicted in Table 1. All the weather factors showed non-significant correlation with the pest population. Therefore, no conclusion was drawn from these results.

Multiple linear regression analysis revealed that weather factors exhibited 15.37% role on population fluctuation during 2009 (Table 2). Table 2 depicted the regression coefficient values to check the impact of weather factors on moth population. It is evident from the results that weather factors exhibited 15.37% role on population fluctuation during 2009. Minimum impact on moth population was exerted by rainfall (0.31%) followed by maximum temperature (0.91%) while relative humidity had great impact (6.93%). During 2010, weather factors contributed 72.75% variation in population fluctuation of moth catches which is statistically significant. Rainfall had maximum role (25.57%) in defining population variation during this year. Weather factors had non-significant impact on population fluctuation during 2011 and exerted 12.64% role only. On cumulative basis, the impact of weather factors was very low (8.92%).

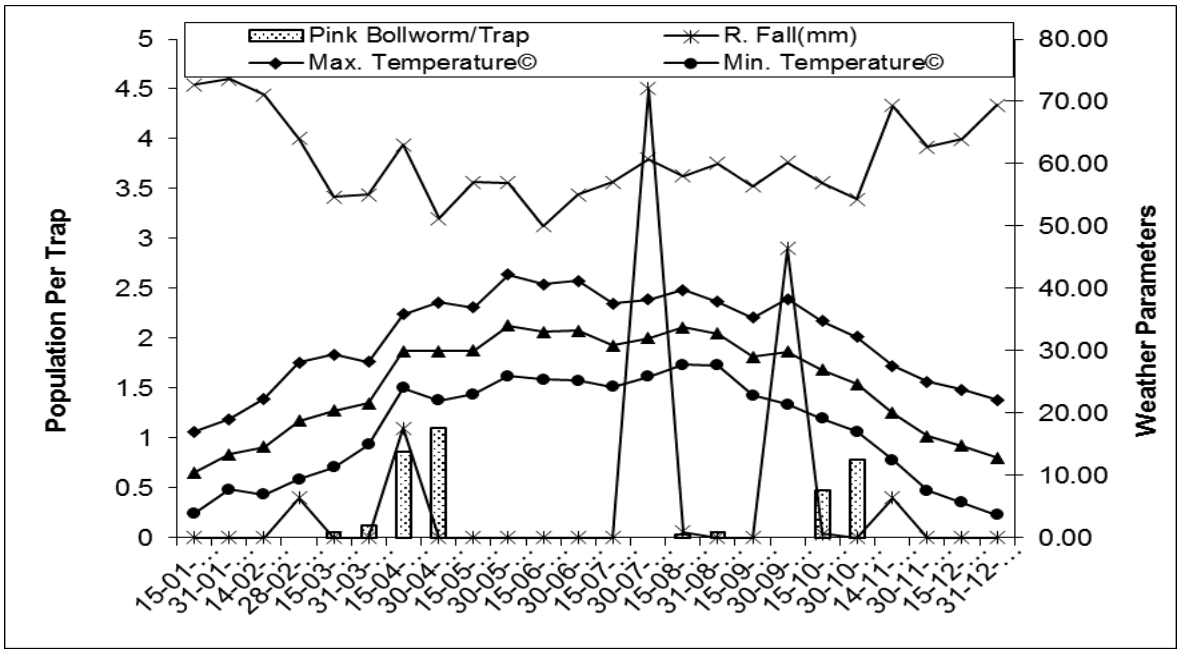

Fig.1: Moth catches of pink boll worm per trap versus weather factors during 2009 at Multan agro-ecosystem.

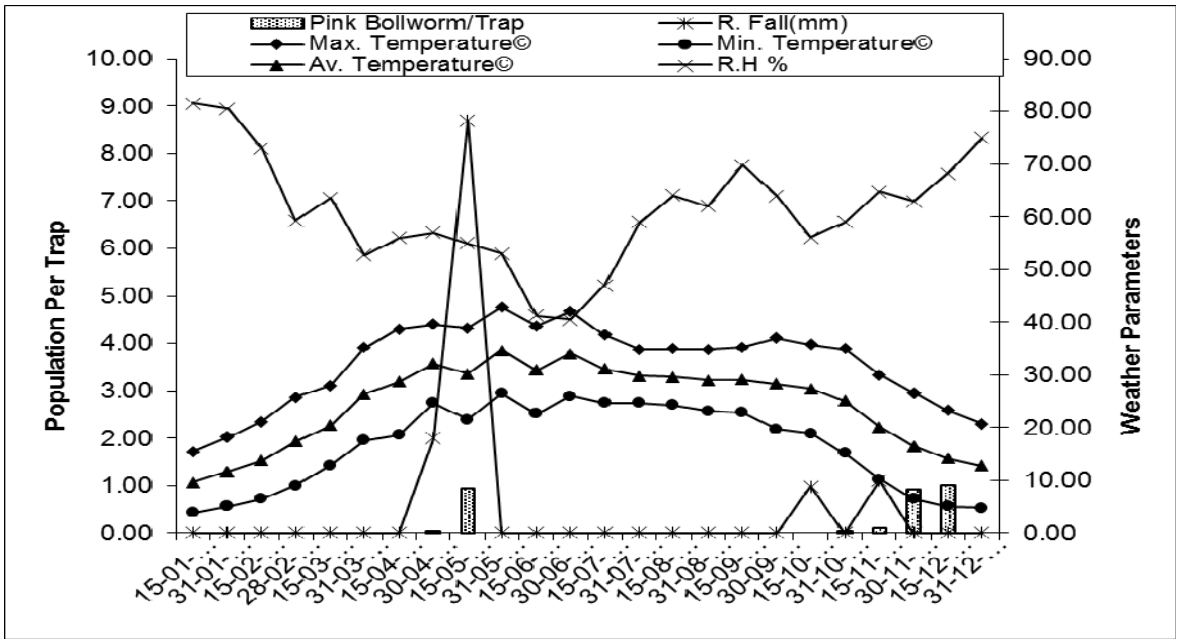

Fig.2: Moth catches of pink boll worm per trap versus weather factors during 2010 at Multan agro-ecosystem.

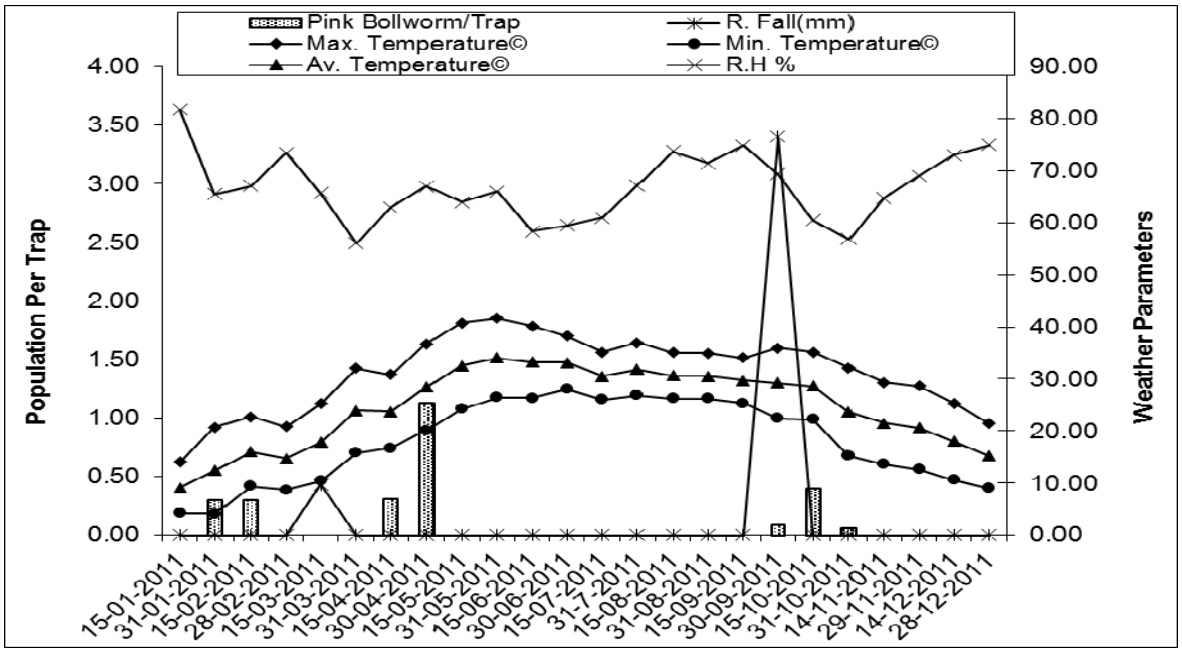

Fig.3: Moth catches of pink boll worm per trap versus weather factors during 2011 at Multan agro-ecosystem.

Table 1: Correlation coefficients (r) between trapped population of pink bollworm and weather factors during various study years

Weather Parameters	2009	2010	2011	Cumulative
Maximum Temperature (ºC)	0.206 (0.334)	0.022 (0.881)	0.017 (0.892)	0.106 (0.623)
Minimum Temperature (ºC)	0.225 (0.290)	-0.041 (0.783)	-0.065 (0.594)	-0.007 (0.972)
Average Temperature (ºC)	0.214 (0.314)	-0.008 (0.955)	-0.024 (0.844)	0.046 (0.829)
Relative Humidity (%)	-0.334 (0.111)	-0.081 (0.590)	-0.088 (0.466)	-0.133 (0.534)
Rainfall (mm)	-0.022 (0.918)	0.252 (0.087)	0.201 (0.094)	0.207 (0.331)

Table 2: Multiple Linear Regression showing impact of weather factors on trapped population of pink bollworm during 2009-2011

Year	Regression Equation, y	R^2 (%)	Impact (%)	P
2009	$Y=0.504 + 0.0497x_1$	4.25	4.25	0.334
	$Y=0.728 – 0.025\ x_1 + 0.049x_2$	5.16	0.91	0.573
	$Y=1.310 + 1.11\ x_1 + 0.726\ x_2 - 2.28x_3$	8.12	2.96	0.629
	$Y=3.07 + 0.35\ x_1 + 0.383\ x_2 - 1.02\ x_3 - 0.184x_4$	15.05	6.93	0.516
	$Y=3.27 + 0.26\ x_1 + 0.345\ x_2 - 0.88\ x_3 - 0.205\ x_4 + 0.029x_5$	15.37	0.32	0.663
2010	$**Y= 0.924 - 0.0262\ x_1$	1.31	1.31	0.003
	$Y=0.019 + 0.295\ *x_1 - 0.2296*x_2$	26.54	25.23	0.965

	Y= -2.77 - 3.66 x_1 - 2.825** x_2 + 8.34*x_3	46.79	20.25	0.018
	*Y= -3.14 - 3.64 8x_1 - 2.837 **x_2 + 8.36 *x_3 + 0.0275x_4	47.18	0.39	0.047
	*Y= -2.89 - 4.27 **x_1 - 3.133 **x_2 + 9.44 **x_3 - 0.0087 x_4 + 0.1758**x_5	72.75	25.57	0.016
2011	**Y=0.688 + 0.0143 x_1	0.70	0.7	0.690
	Y=0.273 + 0.186 x_1 - 0.1302x_2	11.96	11.26	0.246
	Y=0.247 + 0.15 x_1 - 0.158 x_2 + 0.09x_3	11.96	0	0.754
	Y=-0.11 + 0.19 x_1 - 0.168 x_2 + 0.07 x_3 + 0.0309x_4	12.39	0.43	0.936
	Y=-0.15 + 0.22 x_1 - 0.155 x_2 + 0.01 x_3 + 0.036 x_4 - 0.026x_5	12.64	0.25	0.921
Cum.	**Y=0.721 + 0.0098x_1	0.20	0.2	0.000
	Y=0.345 + 0.1459 x_1 - 0.0958x_2	5.32	5.12	0.163
	Y=0.302 + 0.077 x_1 - 0.140 x_2 + 0.14x_3	5.34	0.02	0.556
	Y=0.383 + 0.047 x_1 - 0.150 x_2 + 0.19 x_3 - 0.0074x_4	5.36	0.02	0.620
	Y=0.490 - 0.121 x_1 - 0.223 x_2 + 0.46 x_3 - 0.0212 x_4 + 0.0766x_5	8.92	3.56	0.523

Where:

x_1 = Maximum Temperature (°C) x_2= Minimum Temperature (°C)

x_3 = Average Temperature (°C) x_4 = Relative Humidity (%)

x_5 = Rainfall (mm) R^2= Coefficient of determination

4. Discussion

Weather factors are source of variation in population fluctuation of pink bollworm. In 1994, Jha and Bisen [13] recorded that seasonal incidence of pink bollworm was largely influenced by the weather factors. The results revealed high population of pink bollworm during April and October-November which are supported by Chaudhary and his co-workers[6] who reported that maximum population of Pink bollworm was observed during October, when the temperature ranges 25.0-35.0 °C and relative humidity ranges from 45.0-55.0% and there was no rain fall. These findings are in line with Kae *et al.* [15] who worked on the population of *P. gossypiella*, according to his observation maximum population took place from July-September. Our findings are also in accordance with Gupta *et al.* [9] who reported that peak populations of adult males were observed from the 2nd fortnight of August to the 1st week of November and peak larval populations were observed from the 2nd week of October to the 2nd week of December. The total rainfall (mm) reduced adult male populations and total rainfall and temperature reduced larval populations. These results are also at par with another study of Gupta *et al.* [10] who observed that pink bollworm peak population was noticed between third week of August and second week of November, indicating six peaks. Weather parameters *viz*., average temperature and average humidity had significant positive impact on the population build-up of pink bollworm male moths. The total rainfall, however, had significant but negative impact on its population build-up whereas our results indicated average temperature had non-significant negative impact during 2010 and 2011 but negative impact during 2009 and when computed on cumulative basis. This anomaly in results may be attributed to difference in weather conditions of both areas. The results of Balasubramanian *et al.* [2] also in conformity with our findings who reported that Significant positive correlations were found between the incidence of these pests and the maximum temperature and hours of sunshine. Significant negative correlations were found between pest incidence and minimum temperature, morning relative humidity, evening relative humidity, intensity of rainfall and number of rainy days.

5. Conclusion

From the present investigation, it can be concluded that population of pink bollworm builds up during moderate environmental conditions i.e. April and November-December. So it is the best time to take preventive measures to keep its population in check. Also weather conditions greatly influence the population of pink bollworm so regular inspection of the pest is necessary.

6. References

1. Ahmed Z. Incidence of major cotton pests and diseases in Pakistan with special reference to pest management. Proceeding of First International Consultation on Cotton Production Research with focus on the Asian Region. Manila, Philippines. 17-21 November, 1980, 156-179.
2. Balasubramanian G, Balasubramanian M, Kulandaivelu R. Prediction of bollworms' damage to cotton in relation to weather factors. Madras Agric J. 1981; 68:657-659.
3. Baloch AA, Soomroo BA, Laghari MA, Sanjrani MW. Studies on economic injury levels of insect pests of cotton. Turkey Ent Dergisit, 1990; 14:131-148.
4. Boguslawski CV, Basedow T. Studies in cotton field I Egypt in the effect of pheromones mating disruption on *Pectinophoro gossypiella* (Saund.) Lepidoptera: Gelechiidae, on the occurrence of the arthropods. J Appl Entomol. 2000; 125:327-331.
5. Cammel ME, Knight JD. Effects of climatic change on the population dynamics of crop pests. Adv Ecol Res 1992; 22:117-162.
6. Chaudhari GB, Bharpoda TM, Patel JJ, Patel KI, Patel JR. Effect of weather on activity of cotton bollworms in middle Gujrat J Agro Meteor, 1999; 1(2):137-138.
7. El-Aswad AF, Aly MI. Screening of some insecticides against the cotton bollworms, *Pectinophora gossypiella* (Saund.) and Earias insulana (Boisd.). J Pest Contr Environ Sci. 2007; 15(2):63-74.
8. Ghouri ASK. Roll of DDT in pest control. Pak. Times Suppl 1980; 9:4-9.
9. Gupta GP, Katiyar KN, Vashisht AK. Behavior of male pink bollworm (*Pectinophora gossypiella*) toward gossyplure and its relationship with larval population and weather condition. Ind J Agric Sci. 1990a; 60:411-416.
10. Gupta GP, Kishore P, Vashisht AK. Monitoring of pink bollworm *Pectinophora gossypiella* (Saunders) males through pheromone traps and weather parameters affecting population build-up. J Ent Res. 1990b; 14:21-29.

11. Hummel HE, Gaston LK, Shorey HH, Kaae RS, Bryne JK, Silverstein RM. Clarification of chemical status of the pink bollworm sex pheromone. Science. 1973; 181:873-875.
12. Hutchison WD, Beasley CA, Henneberry TJ, Martin JM. Sampling pink bollworm (Lepidoptera: Gelechiidae) eggs: Potential for improved timing and reduced use of insecticides. J Econ Ent. 1988; 81:673-678.
13. Jha RC, Bisen RS. Effect of climatic factors on the seasonal incidence of the pink bollworm on cotton crop. Annuals of plant protection Science. 1994; 2:12-14.
14. Kadam JR, Khaire VM. Raining and relative humidity: key factors to suppress *Earias vittella* (Fabricius) infestation on 'okra' crop. J Ent Res. 1995; 19:201-205.
15. Kae RS, Shorg HH, Gaston LK, Sheller D. Sex pheromones of Lepidoptera: Seasonal distribution of male *Pectinophora gossypiella* in a cotton field. Environ Ent, 1977; 6:264-286.
16. Relofs WL. Chemical control of insects by pheromones. In biochemistry of Insects. Ed. by Rockstein, M. New York, NY: Academic Press, 1978, 419-464.
17. Schmutterer H. Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*. Annual Rev. Entomol 1990; 35:271-297.
18. Wene GP, Sheets LW, Woodruff HE. Emergence of overwintered pink bollworm in Arizona. J Econ Ent. 1961; 54:192.