RELATIVE RESISTANCE OF SOME COTTON VARIETIES AGAINST BOLLWORM COMPLEX AT DISTRICT SANGHAR, SINDH, PAKISTAN

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ABSTRACT: Cotton bollworms are an imperative insect pests of cotton which are not only responsible for yield reduction but also damages the lint quality by causing yellow spots on fibre that results in reduced market value of cotton. Therefore, this study with relative resistance of some cotton varieties against bollworm complex was designed. Nine cotton varieties were grown at farmers field Sanghar during 2014. The result showed that maximum pink bollworm population (0.92±0.20) was observed on CRIS-467 and minimum (0.52±0.15) on MNH-552. Maximum American bollworm population (0.92±0.20) was observed on IR-901 and minimum (0.48±0.15) on CRIS-467 variety. Maximum spotted bollworm population (0.80±0.19) found on CRIS-467 and minimum population (0.52±0.15) on MNH-552 per plant respectively. It was concluded from this study that MNH-552, IR-901 and MNH-552 were resistant varieties against bollworms as compared to other cotton varieties.

Keywords: Cotton, Varieties, Bollworm complex, Resistance.

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INTRODUCTION

Cotton (white gold) is a chief fiber crop of Pakistan. Cotton crop provides occupation to the millions of people occupied in its trade, ginning mills and textile industry. Pakistan is the fourth largest cotton producer in the world, the third largest exporter of raw cotton, the fourth largest consumer of cotton and the largest exporter of cotton yarn with 1.3 million farmers (FAO, 2015). Moreover, it is a major source of foreign exchange earnings, which not only provides raw substance for our local industry, but also stands at the top of exports and income (Atwal, 2005). Consequently, there is a dire need to produce maximum and best quality cotton in Pakistan. Cotton is attacked by many chewing and sucking insect pests. These pests are damaging the cotton production and its quality. Mostly in chewing pest pink bollworm, *Pectinophora gossypiella* (Saunders) (Gelechiidae: Lepidoptera), American bollworm, *Helicoverpa armigera* (Hubner) (Noctuidae: Lepidoptera) and spotted bollworms, *Earias* spp. (Arctiidae: Lepidoptera) causes reduction in cotton yield and quality in national and international market level (Ali, 2016). The losses of cotton production and its quality have been increased due to pesticides resistance against bollworms in cotton crop.

There are different insect pest management strategies, as varietal preferences plays crucial role in Integrated Pest Management techniques. Through highly resistance varieties can be managed attack of pests without applications of highly toxic pesticide (Ali and Ahmad, 1982; Bughio *et al.*, 1984). Insecticide has been generated resistance in lepidopterous pests reported by Jin *et al.* (1999); Hua and Hua, (2001). Highly usage of pesticides are injurious to human and animals health (Khan *et al.*, 2003). New Bt. genotypes which having *Bacillus thuringiensis* (Bt.) toxin and these genotypes can be more effective against lepidopteran pests (Torres and Ruberson, 2005). After the introduction new Bt. cotton genotypes which has decreased the uses of highly toxic insecticides at farmer's level in developed countries reported by Perlak *et al*. (2001) in USA, Ismael *et al.* (2001) in South Africa, Huang *et al.* (2002) China, Pray *et al.* (2002) and Qaim and Zilberman (2003) in India. Due to continue sowing of same varieties resistance has been developed in insects. Therefore, a depth research is further required to know the reasons of resistance evolved by pest on cotton verities. Some studies have been conducted previously in Sindh Pakistan. Therefore, present study was carried out to observe the population of bollworm complex on different varieties of cotton.

MATERIALS AND METHODS

The study was carried out on the relative resistance of some cotton varieties against bollworm complex at district Sanghar, Sindh, Pakistan. Nine varieties viz MNH-552, Shahbaz, MNH-886, FH-1000,

FH-142, FH-901, IR-901, CRIS-134 and CRIS-467 of cotton varieties were grown through Randomized Complete Block Design (RCBD) at farmer's field at district Sanghar during 2014. All the varieties were purchased from Central Cotton Research Institute (CCRIG) Ghotki, Central Cotton Research Institute Sakrand (CCRIS) and Agriculture Research Institute (ARI) Tandojam. Total land 1.5 acres were selected for grown of varieties. Each varieties was replicated four times. The total plot size was 16.5 ×20sq ft and had four separate rows. However the distance from row-to-row 30 inches and plant-to-plant was 10 inches. All the agronomic practices were made and no any pesticides were applied. The observations were recorded at fortnightly basis from June to November. The attack of pink bollworm *P. gossypiella*, american bollworm *H. armigera* and spotted bollworm *Earias spp.* were recorded from leaves, flowers, lint and bolls. Ten plants and five leaves/plants, five bolls and flowers were observed randomly at weekly intervals. The ANOVA of collected data was done and correlations with temperature and humidity. The data were subjected to analysis using analysis of variance (ANOVA) through SAS Statistics software.

RESULTS

The attack of cotton bollworms *E. insulana, P. gossypiella* and *H. armigera* were found throughout the cotton season (Table-1). A maximum *P. gossypiella* population 4.91 observed in the month of October. However, maximum mean population 1.63 of *H. armigera* found in the month of August and 2.81 population of *E. insulana* in the month of September.

The results in Table-2 showed the population of cotton bollworm on different cotton varieties. The results revealed that the maximum population of 7.36±0.58 was found on FH-901 followed by FH-1000 (6.84±0.56), FH-142 (6.15±0.53), Shahbaz (6.06±0.52), CRIS-467 (6.05±0.52), MNH-552 (6.02±0.52), MNH-886 (5.37±0.49), CRIS-134 (4.54±0.45) and IR-901 (4.12±0.43). The population of *H. armigera* on different cotton varieties. Results revealed that maximum mean population of (0.92±0.20) recorded on CRIS-467 followed by CRIS-134 (0.78±0.19), FH-901 (0.76±0.19), FH-1000 (0.73±0.18), Shahbaz (0.72±0.81), MNH-886 (0.67±0.17), FH-142 (0.65±0.17), MNH-552 (0.50±0.15) and IR-901 (0.48±0.15). The population of *E. insulana* on different cotton varieties, results revealed that maximum mean population (0.80±0.19) was recorded on CRIS-467 followed by CRIS-134 (0.76±0.19), FH-901 and FH-1000 (0.71±0.18), MNH-886 and FH-142 (0.62±0.17) IR-901 (0.61±0.17), Shahbaz (0.56±0.16), and MNH-552 (0.52±0.15).

The linear regression between *P. gossypiella* population on different cotton varieties with mean temperature and relative humidity was not significantly different (P= 0.05) and further showed negative but week linear relationship of population with mean temperature (r^2=0.690) and relative humidity (r^2=0.059) in Fig 1 and 2. *H. armigera* population with mean temperature was observed not significantly different (r^2=0.023) and significantly different with relative humidity (r^2=0.145) in Fig 3 and 4. The linear regression between *E. insulana* population on different cotton varieties with temperature was significantly difference (r^2=0.042) and relative humidity was not significantly different (r^2=0.125) in Fig. 4 and 6.The results indicated that the maximum population 8.83±0.95 was recorded in FH 901 and minimum population 5.21±0.75 was recorded in IR 901 among all verities.

Table-1: monthly mean larval population of cotton bollworms during cotton season.

Months	Fortnights	Pink bollworm	American bollworm	Spotted bollworm	Temp ^{0}C	R.H%
June	1st	1.96	0.02	0.11	32.96	52.08
	2nd	1.99	1.05	0.33	33.09	57.15
July	3rd	2.37	1.06	0.90	32.25	62.15
	4th	2.66	0.06	0.93	29.73	66.46
Aug:	5th	3.08	1.54	1.26	30.24	75.15
	6th	3.38	1.63	1.55	30.20	67.46
Sept:	7th	3.66	1.00	2.69	29.84	66.92
	8th	4.22	1.29	2.81	30.20	62.00
Oct:	9th	4.61	0.98	2.51	30.13	60.62
	10th	4.91	1.02	2.85	29.11	60.54
Nov:	11th	3.24	1.02	2.11	23.67	55.85
	12th	3.35	1.05	1.33	22.96	49.08

Table-2: Overall larval population of bollworms on different cotton varieties.

Varieties *	Bollworms			Total population
	P. gossypiella	*H. armigera*	*E. insulana*	
MNH 522	6.02±0.52[ab]	0.50±0.15[a]	0.52±0.15[a]	7.04±0.82
Shahbaz	6.06±0.52[abc]	0.72±0.81[a]	0.56±0.16[a]	7.34±0.96
MNH 886	5.37±0.49[abc]	0.67±0.17[a]	0.71±0.19[a]	6.66±0.83
FH 1000	6.84±0.56[a]	0.73±0.18[a]	0.62±0.18[a]	8.28±0.92
FH 142	6.15±0.53[ab]	0.65±0.17[a]	0.71±0.18[a]	7.42±0.87
FH 901	7.36±0.58[a]	0.76±0.19[a]	0.61±0.17[a]	8.83±0.95
IR 901	4.12±0.43[c]	0.48±0.15[a]	0.52±0.15[a]	5.21±0.75
CRIS 134	4.54±0.45[bc]	0.78±0.19[a]	0.76±0.19[a]	6.08±0.83
CRIS 467	6.02±0.52[ab]	0.50±0.15[a]	0.80±0.19[a]	7.77±0.91

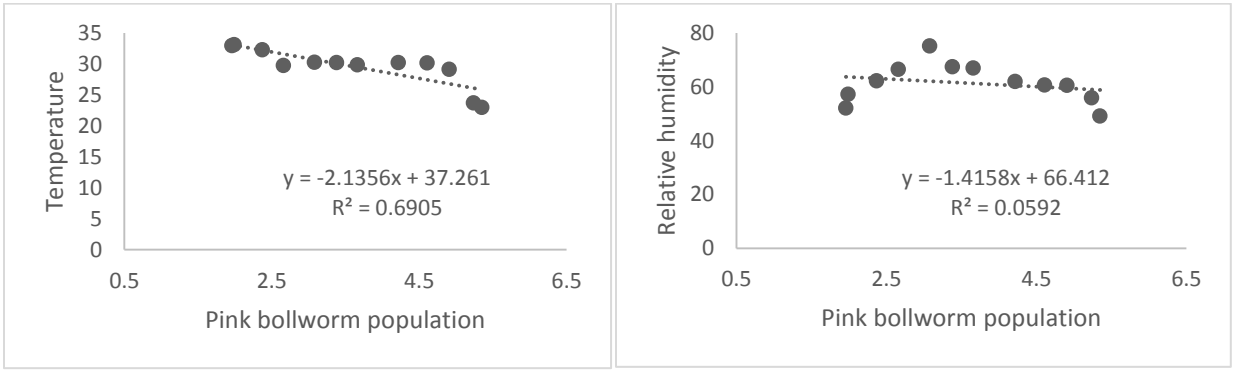

Figure-1: Linear regression between mean population of pink bollworm, field temperature and relative humidity

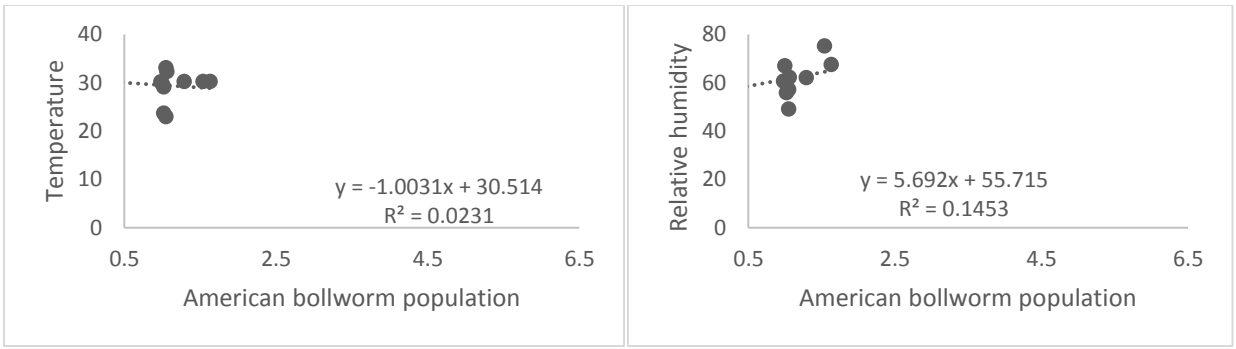

Figure-2: Linear regression between mean population of American bollworm, field temperature and relative humidity

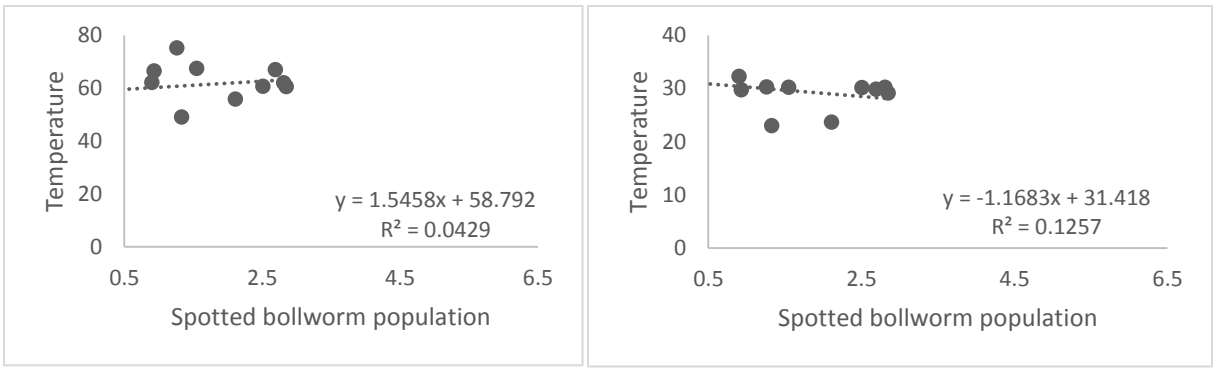

Figure-3: Linear regression between mean population of spotted bollworm, field temperature and relative humidity

DISCUSSION

The bollworms are one of the most destructive pests of cotton crop in the world. A significant attack has been indicated in local cotton varieties due to lose of their resistance against bollworm complex in Pakistan. Keeping in the mind, the present study was conducted to observe the resistance ability of cotton varieties against bollworms. The attack of cotton bollworms were found throughout the cotton season. A maximum *P. gossypiella* population found in the month of October. However, *H. armigera* found in August and *E. insulana* in September. The similar results was reported by Shah *et al.* (2011) he observed that maximum population of bollworms were in the months of August to and October. The present results indicated that the FH 901 variety was susceptible and IR 901 was resistance among all verities.

Present results are in accordance with Ahmad, (1999) who reported that Ahmad, (1999) reported that FH-901 variety is susceptible against *P. gossypiella*. Dhillon, (2009) they conducted experiment on attack of bollworms on different cotton varieties. research work conducted by various researchers such as Ali and Ahmad (1982); Ahmad *et al.* (1989); Wahla *et al.* (1998); Perlak *et al.* (2002); Khan *et al.* (2003); Prasad and Rao (2008); Jamshed *et al.* (2008); James, (2009) they worked on comparative resistance of cotton varieties against bollworm complex. Jin *et al.* (1999) reported that weather components as temperature and relative humidity significantly and non-significantly affect the cotton bollworm population. Pray *et al.* (2002) reported temperature are positively co-related to population of *H. armigera* while and relative humidity negatively co-related with it. (Shahid. 2014) reported that in varietal resistance in pests has been developing because of continuity sowing of same varieties. The susceptibility of variety particularly FH-901 against bollworms has also been previously reported by Jamshed *et al.* (2008) they worked on attacks of bollworms different cotton varieties. Present results are in accordance with Dhillon and Sharma (2009) who reported previously the infestations of bollworms on both Bt. and non-Bt. cotton varieties. Tabashnik *et al.* (2005) reported that resistance development in cotton bollworms due to continue grown of same varieties after nine years refutes the worst scenarios predicting pest resistance to crops in as little three years. Prasad and Rao (2008) also worked on varietal resistant against pink bollworm and reported low damage square and green bolls. (Ahmad, 2001; Ahmad *et al.*, 2008 and Jamshed *et al.*, 2008) worked on infestation of bollworm on flowers and bolls in different genotypes of cotton.

Conclusion: On the basis of present study on cotton bollworms, it has been concluded that MNH-552, IR-901 and MNH-552 showed better resistance against bollworms. So, these cotton varieties can be sown and used in cotton hybridization purpose in future.

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REFERENCES

Ahmad, G., M. J. Arif and S. M. I. Shah (2008). Resistance in cotton genotypes against bollworm complex. Int. J. Agri. Biol., 5 (2): 196–198.

Ahmad, M., A.R. Khan and S.M. Hussain, (1989). Some studies on the physio-chemical factors contributing towards resistance in different cultivars of cotton against insect pest complex of cotton. Pak. Entomol., 11: 23–8.

Ahmad, Z (2001). IPM strategies for cotton. The Pakistan Cotton Grower., 5: 4–9

Ali, A and M. Ahmad, (1982). Biophysical resistance in different varieties of cotton against insect pests". Pak. Entomol., 4: 27-32.

Ali, S., Z. Ahmad, A. A. Noor, 1999. Relative resistance of some cotton genotypes against bollworms, Int. J. Cotton Sci., pp: 5–20.

Atwal, A. S, (2005). Agricultural pests of South Asia and their management". Kalyani. Publ.,. Ludhiana,. India.,pp 221.

Bughio, A. R., A. Rahman, A.Q. Zafar, T. Hussain and Q.H. Siddiqui, (1984). Field evaluation of cotton mutants for pink and spotted bollworms resistance". Nucl. Pak., 21: 47-49.

Dhillon, M. K and H. C. Sharma (2009). Impact of Bt. engineered cotton on target and non-target arthropods toxin flow through different trophic level and seed cotton yield. Karnat. J. Agri. Sci, 22: 462-466.

Dhillon, M.K and H.C. Sharma, (2009). Impact of Bt. engineered cotton on target and non-target arthropods toxin flow through different trophic level and seed cotton yield. Karnat. J. Agri. Sci., 22 (3): 462-466.

FAO. 2015. FAOSTAT data 2015. http://www.fao.org.[accessed on 28 August 2015].

Hua, M. L and L.C. Hua, (2001). A study on the bollworm resistance of CRI-29 and the target to control the F3 bollworms. J. Ch. Cot., 27: 20-22.

Huang, J., R.Hu, S. Rozelle, F. Qiao, and C. Pray, (2002). Transgenic varieties and productivity of smallholder cotton farmers in China. J. Agric. Res., 46(3): 367-387.

Ismael, Y., R. Bennett and S. Morse, (2001). Farm level impact of Bt. cotton in South Africa. Biotech. Develop. Monit., 48: 15-19.

James, C, (2009). Global status of commercialized biotech/GM crops". ISAAA, Ithaca, New York, USA.

Jamshed, K., A. Suhail, M. Arshad, M. Asghar and M. M. Majeed (2008). Comparative infestation of bollworms on transgenic Bt. and conventional cotton cultivars. Entomol., 30 (2): 193-198.

Jamshed, K.A., M, Arshad, M. Asghar and M.M. Majeed, (2008). Comparative infestation of bollworms on transgenic Bt. and conventional cotton cultivars". Entomol. Soc., 30 (2): 193-198.

Jin, Z. Q., G.D. Cao, S.S. Luo, J.M. Hong and Y.Q. Hung, (1999). Insect resistance and yield of different insect resistant hybrid cotton cultivars. Zhejiang-. Nongye-. Kexue., 12 (3): 142-144.

Khan, M.T., M. Naeem and M. Akram, (2003). Studies on the varietal resistance of cotton against insect pest complex of cotton". S. J. Agric., 19: 93-96.

Perlak, F., M. Oppenhuizen, K. Gustafson, R.Voth, S. Sivasupramanian and D. Heering, (2001). Development and commercial use of Bollgard® cotton in the USA early promises versus today's reality. Pl. Sci. J., 27:489-502.

Prasad, N. V. V. S. D and N. H. Rao (2008). Field evaluation of Bt. cotton hybrids against insect pest complex under rain fed conditions. Ind. J. Entomol., 70 (4): 330-336.

Prasad, N. V.V and N.H. Rao, (2008). Field evaluation of some cotton hybrids against insect pest complex under rainfed conditions". Ind. J. Entomol., 70 (4): 330-336.

Pray, C., J. Huang, R. Hu and S. Rozelle, (2002). Five years of Bt. cotton in China the benefit continue. Pl. Sci. J., 31(4): 423-430.

Qaim and M. Zilberman, (2002). Yield effects of genetically modified crops in developing countries". J. Sci., 299: 900-902.

Shah, A.M., N. Memon and A. A. Baloch (2011). Use of sex pheromones and light traps for monitoring the population of adult moths of cotton bollworms in Hyderabad, Sindh, Pakistan. S. J. Agric. 27(3): 435-442.

Shahid. J (2014) Bollworms develop resistance against cotton crop. http://www.dawn.com. /news/1119078.

Tabashnik, B.E., T. J. Denneley and Y. Carriere, (2005). Delayed resistance to transgenic cotton in pink bollworm. Pro. Natle. Acad. Sci. 102: 15389-15393.

Wahla, M. A., M. Tufail, M. Afzal and M.N. Tariq, (1998). The comparative resistance of some recent releases of cotton cultivars to the insect pest complex. Pakistan. Entomol., 20: 92–4.

Yein, B. R, (1983). Relative susceptibility of some cotton cultivars to insect pests. J Res. As. Agric. Uni., 4: 141–147.