Türk. Bit. Kor. Derg. (1982), 6 (1) : 3-14

Evaluation of some cotton varieties with known genetic markers for their resistance / tolerance against sucking and bollworm complex

A.A. Baloch* B.A. Soomro* G.H. Mallah*

Summary

Studies were carried out at the Cotton Research Institute, Sakrand to evaluate resistance/tolerance of cotton varieties against cotton pests and relative infestation of bollworms on these varieties.

It was observed that Glandless, Nectariless and Gossypol free varieties were susceptible and the hairy ones tolerent to jassid attack; but the hairy varieties were susceptible to thrips and whitefly.

The results indicate that Glandless, Nectariless, Glabrous Gossypol free, hairy and Okra leaf varieties were more susceptible to bollworm attack.

As the yield component is concerned, maximum yield was obtained from 6-1-3 (high gossypol) variety which was comparatively more resistant towards sucking as well as bollworm complex.

Introduction

About 1362 insect species are known to occur on the cotton crop in the world. In Pakistan, nearly 148 insect species have been recorded on this crop by different workers from time to time but only about 17 species can be considered as major pests of it. It is estimated that the insect pests, on an average, cause 5 to 10 % damage to cotton crop every year; in case of serious attack however, 30 to 40 % crop is lost and even total loss occurs in some cases (Huque, 1972).

* Cotton Research Institute, Sakrand, Pakistan.

Received (Alınış) : 24.11.1981

Srivastava (1976) considers that plant protection is often synonymous with the use of pesticides. In general, consumption of pesticides is often criterioned as the effective paiameter for judging achievements in plant protection with realizing that the choice and formulation of an insecticide, time and method of its application, crop potential and economic value form the basic principles of effective cotton insect control. Thus other avenues that help cotton insect control are worthwhile to be studied.

The use of insect resistant varieties is also one of the most important approach to aid insect control. Most phytophagous insects have a well defined host range and the varieties that are consistently less infested and damaged by a particular species of insect are called resistant. Painter (1951) defined plant resistance as the relative amount of heritable qualities, possessed by a plant, which influence the ultimate degree of damage done by the insect. In practical agriculture, it represents the ability of a particular variety to produce a large crop of good quality than do ordinary varieties at the same level of insect population. Although the causes of plant resistance are often complex, the mechanism has been classified into three broad categories (Painter, 1951 and 1958), viz., (i) non-preference possession of plant factors that render it unattractive to insect pests for oviposition, feeding or shelter, (ii) antibiosis-the host plant exertion of adverse effects on the survival, growth and multiplication of the insects, and (iii) tolerance-the ability of the host plant to suffer the least damage in the presence of an insect population large enough to damage the susceptible hosts severely. Presence of known genetic markers for certain desired characters in particular cotton cultivars renders them resistant/tolerent to insect pest attack and therefore such cultivars are preferably introduced in local breeding programmes. For example early maturity genes offer resistance to boll weevil, profusely hairy varieties are resistant to cotton jassid and presence of B_2 B_6 genes bring bacterial blight resistance, other characters like high gossypol, nectariless, freegobracts and okra leaf offer in one way or the other, resistance to bollworm complex.

Realizing the importance of such genetic stocks in the breeding programme, it was considered worthwhile to study the level of natural resistance of some introductions with defined gene markers in them before embarking upon a planned breeding programme. The results obtained, in terms of relative infestation by sucking and bollworm complex are presented in this paper. This information will help the breeders to evaluate their material if they are introsted in breeding for insect pest and disease resistance.

Material and Methods

An experiment was laid out with the object to evaluate the resistance/ tolerance of 20 cotton genetic stocks (Table 1) against jassids ([1]), thrips ([2],[3]) and whitefly ([4]) and also to findout the relative infestation of spotted ([5],[6]) and pink bollworms. ([7]) The desing of the experiment was randomised block with four repeats and plot size 16.7'x17.5'. The sowing and picking was done on 8.5.80 and 5.11.80, respectively.

Weekly population were estimated from the number of jassid adults and nymphs, thrips adults and nymphs and whitefly adults which were counted on one apical, two middle and two bottom leaves of ten randomly selected plants per treatment each time. All the observations were based on the examination of both the lower and upper surface of the leaves which were examined by naked eye and some time glasses were also used. The relative infestation of bollworms was recorded by counting the total number of squares, green and open bolls per ten plants per treatment. The infested parts were then sorted out counted and infestation percentage determined. The picking of each variety was done repeat wise. The seed cotton yield was then expressed in terms of kgs/hectare.

Results and discussion

(a) Resistance to sucking complex

The pest population data of the experiment are summarised in Table 1. It could be seen from the data that in June, very low population of jassid/leaf was recorded on LA-17801 (nectariless), DP-SL-NCS-1 (glabrous), Acala-4-42 (glabrous), HG 6-1 N (nectariless with high gossypol), Gregg 25-V (Glandless) and Hsuchow (short stature and early maturing) varieties. Black thrips was also recorded at very low level on LA-17801, D2L-3-63 (glabrous), Acala-4-42, HG 6-1 N and NCM-2-65 (Nectariless). Yellow thrips was recorded in all the varieties (though the population was very low) except LA-17801 and Rajhans (hairy). The maximum population/leaf was recorded on RA-31-47 (hairy) and Gregg 25 V. Similarly very low populaton of whitefly was noted on all

---

[1]**Amrasca devastans** Dist. (Hom.: Cicadellidae)
[2]**Scirtothrips dorsalis** Hood (Thys.: Thripidae)
[3]**Thrips tabaci** Lind. (Thys.: Thripidae)
[4]**Bemisia tabaci** Genn. (Hom.: Aleyrodidae)
[5]**Earias insulana** Boisd. and [6]**E. vitella** Stoll. (Lep.: Noctuidae)
[7]**Pectinophora gossypiella** Saund. (Lep.: Gelechiidae)

the varieties and maximum population/leaf was noted on NCM-2-65. In this month highest population that occurred was of whitefly and lowest was of black thrips.

In July, the population of sucking complex remained below economic injury level on all the varieties. The highest population was that of yellow thrips on Acala 63-75 followed by jassid on Acala 63-75, black thrips on OK-86 (okra leaf) and whitefly on 6-1-3 (High gossypol) varieties, respectively.

In August, population of jassid crossed the economic injury level on all the varieties except Rajhans (hairy) and the maximum population/leaf was noted on Acala 63-75. Other pests remained below economic injury level on all the varieties. Anyhow the maximum population of black thrips, yellow thrips and whitefly was noted on LA2 x 6M-1 (okra leaf), Qalandri and RA-31-47 (hairy) respectively.

In September, the population of jassid remained above economic injury level only on nine varieties and the maximum population/leaf was noted on Acala-4-42, while, very low population of black thrips and whitefly was noted on Hsuchow and HG 6-1 N varieties, respectively, yellow thrips remained at very low level on all the varieties except Rajhans (hairy) where it was not found.

In October, very low population of jassid and whitefly was recorded on all the varieties and maximum one was noted on Acala 63-75 and Gregg 25V respectively. Black thrips (very low population) was noted only on D2L-9-68, 6-1-3, (1209x407-38) LA2-3 (okra leaf). Similarly, yellow thrips was also noted at some level on all the varieties except LA-17801.

In November, only jassid was noted on all the varieties, though its populaton level was very low, black thrips, yellow thrips and whitefly was noted on Stoneville 731-N (Nectariless), RA-31-47 and 6-1-3 varieties, respectively.

These results indicate that glandless, nectariless and gossypoll free varieties were susceptible and hairy ones tolerent to jassid attack. On the other hand, hairy varieties were susceptible to thrips and whiteflies. In August jassid population remained above economic injury level in all the varieties which indicates that none of the variety is resistant to this pest.

Since the insects damage the crop according to the type of their mouth parts (chewing, sucking or boring complex), the breeding for insect resistant varieties consequently involves transferance of those desirable characters in the cultivated commercial varieties which offer maximum obstruction to insect oviposition or handicap chewing, sucking or boring activity, as the

case may be. For example, jassid resistance is due to breeding for densely haired varieties especially having a coat of long dense hairs on the underside of their leaves. This, Sikka *et al.* (1966) concluded that the combination of hair length and high density of hairs on the lamina may be the best index of selection to breed for resistance to jassid attack. However, in breeding for jassid/aphid resistance, the hypothesis is, that the resistance is associated with completeness of the sclerenchymatous ring where by the entry of the insect's stylet into the vascular tissue is prevented (Martin, 1973).

(b) Resistance to bollworm complex

Table-2 indicates that the maximum bollworm infestation was noted on mature and open bolls in September and the infestation percentage crossed the economic injury level on DP-SL-NCS-1 (glabrous) and Acala 63-75 varieties. In October, immature bolls were more attacked where the infestation percentage reached economic injury level only in two varieties i.e., Qalandri and LA2 x 6M-1 (okra leaf).

Similarly in November, mostly the immature bolls of all the varieties were attacked but the percentage of infestation crossed economic injury level only in six varieties namely, Rajhans (hairy) followed by LA2 x 6M-1, OK-86 (early maturing), Acala 63-75, Gregg 25V (Gossypol free) and DP-SL-NCS-1, respectively. In mature and open bolls, infestation was noted in six varieties where maximum percentage of infestation (but below economic injury level) was recorded on RA-31-47 (hairy) followed by Acala 4-42 (Glandless), NCM-2-65 (Nectariless), D2L-9-68 (glabrous), Rajhans (hairy) and LA-17801 (Nectariless early maturing).

Thus the results indicate that Glandless, Nectariless, Glabrous, Hairy and Okra leaf varieties were more susceptible to bollworm attack.

Similarly, Lukefahr and Houghteling (1969) reported that smooth leaf nectariless (no extrafloral nectariless) and high gossypol content significantly reduce population of bollworm complex. There are evidences that varieties with increased gossypol content suffer less damage from bollworm attack particularly *Heliothis* species. Reduction in egg laying on glabrous and nectariless cottons was reported by Lukefahr *et al.* (1971) and consequently, these varieties were least succeptible to bollworm. Wilson and Wilson (1976) quantified that the nectariless trial gave 40 % reduction in population of pink bollworm while glabrous suppressed the population by 20 %. Smith *et al.* (1975) reported that high plant hair density is a promising mechanism offering resistance to pink bollworm. Similarly Shaver and Lukefahr (1969) found that the flavonoid compounds like, quercetin, isoquercitin and rutin

and gossypol and pigment glands all of them present in the cotton plant render it more toxic to pink bollworm.

(c) Yield of seedcotton results

It could be seen from Table 3 that the maximum yield was obtained from 6-1-3 (high gossypol) variety which was comparatively more resistant towards sucking as well as bollworm complex. Minimum yield was obtained from HG 6-1N variety, which may be due to the bollworm infestation as well as poor stand of the crop. Anyhow, the varieties which were more susceptible to bollworm infestation gave comparatively low yield.

Özet

Bazı pamuk varyetelerinin değişik böcek türlerine karşı dayanıklılığı ve toleransı üzerinde araştırmalar.

Bu araştırma, pamuk zararlılarına karşı pamuk varyetelerinin dayanıklılığını ve toleransını saptamak amacıyla Sakrand Pamuk Araştırma Enstitüsü (Pakistan)'nde yapılmıştır.

Yapılan deneme ve gözlemlerden salgı bezi bulunmayan, nektarsız ve gossypol içermeyen varyetelerin **Amrasca devastans** Dist.'a karşı hassas, fakat tüylü olanların bu türe tolerans gösterdiği saptanmıştır. Buna karşılık tüylü pamuk varyetelerinin **Scirtothrips dorsalis** Hood, **Thrips tabaci** Lind. ve **Bemisia tabaci** Genn.'ye karşı hassas oldukları da ortaya konmuştur.

Salgı bezsiz, nektarsız, gossypolsüz (tüysüz), tüylü ve bamya yapraklı varyetelerin **Earias insulana** Boisd., **E. vitella** Stoll., **Pectinophora gossypiella** Saund. ve **Heliothis armigera** Hb.'ya karşı daha hassas olduğu deneme sonuçlarından anlaşılmıştır.

Ürün miktarı dikkate alındığında ise, en fazla ürün emici böceklerin yanısıra **E. insulana, E. vitella, P. gossypiella** ve **H. armigera**'dan oluşan kompleks de nispeten dayanıklılık gösteren yüksek gossypollü 6-1-3 varyetesinden elde edilmiştir.

References

Huque, H., 1972. Cotton Entomology. Cotton in Pakistan. Pakistan Central Cotton Committee, 305 pp.

Lukefahr, M.J. and J.E. Houghtaling, 1969. Resistance of cotton strains with high gossypol control to **Heliothis** sp. **J. Econ. Ent., 62** (3) : 588-591.

————,———— and H. M. Graham, 1971. Suppression of **Heliothis** populations with glabrous cotton strains. **Ibid., 64** (2) : 486-488.

Martin, H., 1973. The scientific principles of crop protection. Edward Arnold Ltd, 423 pp.

Painter, R. H., 1951. Insect resistance in crop plants. The McMillan Company, New York, 520 pp.

————————1953. Resistance of plants to insects. **Ann. Rev. entomol., 3**: 267-290.

Srivastava, S. K., 1976. Plant Protection in India. Problems and Prospects. **PANS, 22** (4): 467-473.

Shaver, T. N., and M. J. Lukefahr, 1969. Effect of flavonoid pigments and gossypol on growth and development of the bollworm, tobacco budworm, and pink bollworm. **J. Econ. Ent., 62** (3) : 643-646.

Sikka, S. M. et al., 1966. Studies on the jassid resistance in relation to hairyness of cotton leaves. **Euphytica, 15** (3): 383-388.

Smith, R. L., R. L. Wilson, and F. D. Wilson, 1975. Resistance of cotton plant hairs to mobility of first instars of the pink bollworm. **J. Econ. Ent., 68** (5): 679-683.

Wilson, R. L. and F. D. Wilson, 1976. Nectariless and glabrous cottons: Effect on pink bollworm in Arizona. **Ibid., 69** (5) : 623-624.

Table 1

Average population of **A. devastans, S. dorsalis, T. tabaci** and **B. tabaci** on 50 levels/treatment of different cotton varieties. Average population/leaf during the months.

VARIETY	JUNE				JULY			
	Jassid	B. thrips	Y. thrips	W. fly	Jassid	B. thrips	Y. thrips	W. fly
1. Stone ville 731-N	0	0	0.06	0.03	0.04	0.09	0.90	0.03
2. Qalandri	0	0	0.04	0.06	0.04	0.10	0.90	0.04
3. LA-17801	0.01	0.01	0	0.08	0.09	0.03	0.14	0.02
4. RA-33-47	0	0	0.03	0.03	0.04	0.18	0.32	0.01
5. DP-SL-NCS-1	0.01	0	0.02	0.04	0.06	0.04	0.37	0.03
6. RA-31-47	0	0	0.12	0.08	0.14	0.02	0.80	0.05
8. Acala-4-42	0.04	0.02	0.03	0.09	0.10	0	0.37	0.03
7. D2L-9-68	0	0.02	0.08	0.08	0.08	0.01	0.61	0.01
9. HG 6-1N	0.03	0.01	0.08	0.10	0.15	0.16	0.18	0.02
10. Gregg 25V	0.02	0	0.12	0.07	0.16	0.08	0.54	0.05
11. 6-1-3	0	0	0.05	0.10	0.15	0.05	0.47	0.08
12. Hsuchow	0.02	0	0.08	0.10	0.20	0.09	0.37	0.01
13. Rajhans (hairy)	0	0	0	0.06	0.03	0.17	0.28	0
14. OK-86	0	0	0.20	0.06	0.11	0.27	0.51	0.02
15. M-64	0	0	0.08	0.07	0.11	0.01	0.24	0.01
16. (1209x407-38) LA2-3	0	0	0.03	0.06	0.11	0.06	0.22	0.04
17. NCS-1-P/1-1	0	0	0.05	0.06	0.24	0.04	0.32	0.03
18. LA2 x 6M-1	0	0	0.07	0.12	0.12	0.03	0.22	0.02
19. NCM-2-65	0	0.01	0.08	0.16	0.09	0	0.42	0.02
20. Acala 63-75	0	0	0.80	0.10	0.28	0.04	0.96	0.03

(Continued)

AUGUST				SEPTEMBER			
Jassid	B. thrips	Y. thrips	W. fly	Jassid	B. thrips	Y. thrips	W. fly
2.33	0.44	1.13	0.08	0.93	0.05	0.10	0
1.05	0.71	1.54	0.09	0.74	0.12	0.28	0
3.64	0.52	0.21	0.07	0.97	0	0.19	0
1.61	0.13	0.77	0.06	0.96	0	0.36	0.01
2.51	0.19	0.74	0.16	1.10	0.08	0.22	0
1.19	0.40	0.61	0.22	0.96	0	0.17	0
1.90	0.17	0.38	0.10	1.11	0	0.20	0
3.12	0.37	0.47	0.10	1.54	0.08	0.25	0
2.07	0.38	0.19	0.12	1.07	0	0.17	0
3.47	0.32	0.56	0.11	1.37	0	0.40	0
1.44	0.33	0.52	0.14	1.17	0.03	0.25	0.03
2.21	0.35	0.41	0.17	0.94	0.02	0.11	0
0.02	0.46	0.10	0.05	0.36	0	0	0
2.43	0.64	0.34	0.04	1.20	0	0.07	0.09
2.16	0.23	0.23	0.05	1.18	0.02	0.17	0.03
1.84	0.47	0.13	0.05	0.77	0.04	0.16	0.03
2.41	0.46	0.24	0.06	0.86	0.06	0.16	0.03
1.85	0.85	0.14	0.06	0.92	0.05	0.17	0.01
2.65	0.69	0.46	0.07	0.92	0.01	0.19	0.02
3.98	0.36	0.92	0.10	1.07	0.09	0.19	0.01

(Continued)

OCTOBER				NOVEMBER			
Jassid	B. thrips	Y. thrips	W. fly	Jassid	B. thrips	Y. thrips	W. fly
0.34	0	0.04	0.20	0.17	0	0.03	0.01
0.35	0	0.12	0.14	0.12	0	0.01	0
0.42	0	0	0.22	0.04	0	0	0
0.34	0	0.09	0.22	0.04	0	0.01	0
0.31	0	0.14	0.15	0.06	0	0	0
0.27	0.01	0.05	0.11	0.05	0	0	0.02
0.32	0	0.01	0.23	0.22	0	0	0.03
0.27	0	0.03	0.07	0.07	0	0	0.02
0.29	0	0.05	0.24	0.12	0	0	0
0.23	0.01	0.14	0.20	0.17	0.01	0	0.02
0.36	0	0.06	0.14	0.16	0	0	0
0.24	0	0.04	0.09	0.08	0	0	0.05
0.28	0	0.10	0.15	0.06	0	0	0
0.38	0	0.04	0.14	0.17	0	0	0
0.24	0.01	0.03	0.10	0.11	0	0.02	0.01
0.38	0	0.01	0.09	0.17	0	0	0.01
0.29	0	0.02	0.13	0.14	0	0	0.02
0.51	0	0.07	0.12	0.21	0	0.01	0.05
0.55	0	0.04	0.17	0.20	0	0.01	0.01

Table 2

Infestation percentage of boll worms in fruiting parts i.e. Squars, Flowers, Immature bolls and mature and open bolls on different cotton varieties sown at C. R. I. Sakrand.

VARIETY	Mean infestation percentage during the months : SEPTEMBER				OCTOBER				NOVEMBER			
	Squars	Flowers	Immature bolls	Mature and Open bolls	Squars	Flowers	Immature bolls	Mature and Open bolls	Squars	Flowers	Immature bolls	Mature and Open bolls
1. Stone ville 731-N	0	0	0.11	0	0	0	2.27	0	0	0	3.87	0
2. Qalandri	0	0	0	0	0.14	0	4.99	0	0	0	2.54	0
3. LA-17801	0	0	0	0	0	0	1.07	0.53	0	0	2.70	2.63
4. RA-33-47	0	0	0.12	0	0.37	0	0	0	3.13	0	4.55	0
5. DP-SL-NCS-1	0	0	2.22	7.54	0.35	0	0	0	4.47	0	6.25	0
6. RA-31-47	0	0	0.48	0	0.89	0	1.04	0	0	0	0	25.0
7. D2L-9-68	0	0	0.18	0	0.39	0	0.78	0	0	0	0	6.25
8. Acala-4-42	0	0	0	0	0	0	0.96	0	0	0	0	12.5
9. HG 6-1N	0	0	0	0	0	0	0	0	0	0	0	0
10. Gregg 25V	0	0	0	0	0	0	2.34	0	0	0	6.38	0
11. 6-1-3	0	0	0	0	0	0	2.06	0	1.47	0	3.10	0
12. Hsuchow	0	0	0.29	0	0	0	0	0.29	0	0	1.19	0
13. Rajhans (hairy)	0	0	0	0	0	0	1.99	0	0	0	16.40	6.25
14. Ok-86	0	0	0	0	0.83	0	0	0	0	0	10.80	0
15. M-64	0	0	0	0	0	0	0.62	0	0	0	2.93	0
16. (1209x407-38) LA2 3	0	0	0	0	0.27	0	0	0	0.76	0	0	0
17. NCS-1-P/1-1	0	0	0	0.9	0	0	0.89	0.24	0	0	1.93	0
18. LA2 x 6M-1	0	0	0	0	0	0	5.59	0	0	0	15.54	0
19. NCM-2-65	0	0	0.88	0	0	0	2.25	0.54	0	0	4.81	7.15
20. Acala 63-75	0	0	0	5.0	0.13	1.56	1.73	0.38	0	0	10.46	0

Table 3

Average yield in kgs of different varieties of cotton.

Sr. No.	Variety	Average yield in kgs/ hectare
1.	Stoneville 731-N	1030.21
2.	Qalandri	1371.33
3.	LA-17801	826.79
4.	RA-33-47	1056.49
5.	DP-SL-NCS-1	1582.10
6.	RA-31-47	938.22
7.	D2L-9-68	1222.70
8.	Acala-4-42	1022.85
9.	HG 6-1 N	509.85
10.	Gregg 25V	718.17
11.	6-1-3	1838.03
12.	Hsuchow	1587.36
13.	Rajhans (hairy)	833.10
14.	OK-86	1061.74
15.	M-64	777.91
16.	(1209x407-38) LA2-3	929.60
17.	NCS-1-P/1-1	946.11
18.	LA2 x 6M-1	850.45
19.	NCM-2-65	1051.23
20.	Acala 63-75	798.94