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Characteristics of some cotton varieties in relation to seasonal abundance of pests, predators and their impact on yield and quality

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Abstract: Seven cotton varieties viz. CB-3, CB-5, CB-8, CB-9, CB-10, SR-05 and SR-01 were studied to observe their characteristics, seasonal abundance of pests, predators, and their impact on yield and quality. Results indicated that the variety CB-5 attained highest plant height (120.0 cm) produced higher number of sympodia (13.0) and GOT (41.33%). But this variety had longest duration (55.0 day) for initiation of first flower and produced lowest number of bolls (17.67/plant). Boll production was highest (29.0/plant) to the variety SR-05 but the variety CB-9 resulted highest (4.0) picking frequency. The varieties having dense hairs and trichoms (CB-9 and CB-10) are more tolerant to sucking pests. The bollworm abundance showed positive co-relation with hairy varieties and the variety SR-05 showed lowest abundance of bollworm. The variety CB-5 possessed more tolerance of armyworm, and positive relationship of predators and preys were found. The variety CB-9 with desirable plant height (115.0 cm) and number of bolls per plant (27.67) produced highest amount of yield (1650Kg/ha).
Key words: Cotton, variety, pest, predator

Introduction

Cotton, a major agricultural crop, is growing more than 60 countries of the world. It is a very sensitive crop in terms of pest complex. There are 162 species of insects have been recorded as pest, among which only 15 species are major due to their serious occurrence (Bohmfalk *et al*., 1996). The destructive pests of cotton in Bangladesh are jassid (*Amrasca biguttulla*), aphid (*Aphis gossypii*), white fly (*Bemisia tabaci*), thrips (*Thrips tabaci*), american boll worm (*Heliothis armigera*), spotted boll worm (*Earias vitella*) and pink boll worm (*Pectinophora gossypiela*). Whereas, lady bird beetle (*Menochillus sexmaculatus*), spider mite (*Tetranychus* spp), syrphids, and spiders are the main predators. Jassid is commonly known as leaf hopper. The nymphs and adults of jassid suck sap from the leaves and cause phytotoxic symptoms known as hopper burn which results in complete desiccation of plants (Narayan and Singh, 1994). Cotton aphids are commonly found on the underside of leaves or feeding on the terminal and other parts of cotton plants. They feed by sucking sap from phloem tissue. The accumulation of honey dew causing the appearance of sticky and shiny leaf surfaces often indicates the presence of aphids. Severe infestations seriously stunt plants and reduce yields. Honey dew secretions on open bolls may result in lint staining or sticky cotton (Bohmfalk *et al*., 1996). White flies excrete honeydew like aphids. Infested leaves reduce vigor, wilt and turn yellow (Bohmfalk *et al*., 1996). Thrips are early season pests of cotton seedlings. Thrips suck sap from cotton leaves and terminal buds and rupture cells, which cause stunted growth. The infested leaves crinkled and curl upward. During severe infestation terminal buds may be destroyed and cause excessive branching of plants. Sometimes cotyledon of seedlings become silvery appearance and termed "bronzing" (Bohmfalk *et al*., 1996). American bollworm larvae reduce both yield and quality of cotton. Larvae damage squares, flowers, green bolls, tender shoots and reduce yield (Anon. 2003). Larvae of spotted bollworm usually attack the growing shoots, buds and developing bolls (Alam, 1969). They destroy a large number of squares, flowers, green bolls and tender shoots, and consequently decline in yield (Annonymous, 2003). Pink bollworm is a key pest of cotton and feeds on cotton bolls reducing both yield and quality of the lint. They cut through the lint fibre and move from seed to seed. Pink bollworms make holes in boll that may be infected with boll-rotting organisms. During severe infestation, many bolls are rendered unpick-able (Bohmfalk *et al*., 1996). Lady beetle populations are related to aphid numbers and are most abundant when aphid populations are high. They eat bollworm larvae under field conditions (Bohmfalk *et al*., 1996). Syrphids and spiders are also good predators in cotton field. Resistant varieties play a significant role in reducing crop damage. So, this study was carried out to investigate the characteristics of different varieties in relation to the abundance of pests and predators and their effect on the yield and quality of cotton.

Materials and Methods

The study was performed in the regional cotton research, training and seed multiplication farm, Sadarpur, Dinajpur. The site is situated approximately between $25^0$13' latitude north and between $88^0$23' longitudes east and about 37.5 m above the sea level. The soil was sandy loam with p^H 4.5 to 5.5. Previous crop of the plot was sunheamp as a green manure. Irrigation and drainage facilities were readily available in the farm. The Land was prepared at field condition by deep ploughing and harrowing followed by laddering. The field layout was done after final land preparation. The experiment was conducted in randomized complete block design with 7 varieties and each replicated 3 times. The plot size was 5.4 × 5 m. The spacing between block-to-block and plot-to-plot were 1.5 and 1m and respective footpath was 2m. Seeds were sown on 3rd August 2006, at the rate of 15

kg /ha in a North South row. The seeds were sown by hand keeping a distance of 45 cm from plant to plant and row-to-row distance was 90 cm. Varieties used for this experiment were CB-3, CB-5, CB-8, CB-9, CB-10, SR-05 and SR-01. Necessary intercultural operations such as mulching, weeding and irrigation were carried out properly. The plots were exposed to natural infestation. Chemical insecticides were applied to keep damage below economic injury level. To estimate the populations of pests and beneficial insects, sampling was carried out in the cotton field in the entire cotton growing season (August to November). It was done by weekly scouting taking 5 plants randomly from each replication. During examination of the plant, number of different beneficial insects such as lady beetle, spider and syrphids were recorded. A scouting form was used during estimation of the pests. Cotton was harvested from the inner rows of the plots excluding the border rows to measure the yield/ha. Data of the different parameters were analyzed statistically and means were separated by using "Duncan's Multiple Range Test" (DMRT).

Results and Discussion

Characteristics of varieties

Characteristics of the selected cotton varieties have presented in table 1. Results reveal that the variety CB-5 showed the highest plant height (120.0 cm), and the lowest height (75.0 cm) was found to the variety CB-8. Plant height of the variety CB-5 is equal to the world-class average height. Height of the variety CB-9 is almost touches the world average. Height is an important trait for the development of more fruiting points and sympodia. Significantly the highest (13.0) and lowest (10.0) number of sympodia were found to the varieties CB-5 and CB-3, respectively. CB-10 is a short duration variety and produced first flower significantly earlier (44.0 day), whereas the variety CB-5 required longest duration (55.0 day). The variety SR-05 produced significantly higher number (29.0/plant) of bolls, whereas the variety CB-5 produced the lowest number of bolls (17.67/plant). Among the seven varieties, CB-9 revealed significantly higher picking frequency (4.0) and it was lowest to the variety CB-10.

Table 1 Agronomic characteristic of the selected varieties of cotton

Variety	Characteristics				
	Height (cm)	Sympodia (no.)	1st flower (day)	Bolls/plant (no.)	Picking frequency
CB-3	88.33 e	10.00 c	48.00 b	20.67 e	3.33 ab
CB-5	120.00 a	13.00 a	55.00 a	17.67 f	3.33 ab
CB-8	75.00 f	11.75 ab	45.33 bc	26.33 bc	3.33 ab
CB-9	115.00 ab	12.50 ab	48.00 b	27.67 ab	4.00 a
CB-10	90.00 de	11.33 b	44.00 c	24.67 cd	3.00 b
SR-05	105.00 bc	10.67 bc	46.33 bc	29.00 a	3.33 ab
SR-01	95.00 cd	11.00 bc	48.00 b	23.67 d	3.67 ab

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$).

Abundance of sucking pests

It is evident that jassid, aphid, white fly and thrips are the major sucking pests of cotton (Bohlen 1984). Table 2 showed that jassids abundance were highest (2.15/plant) to the variety CB-10 and statistically identical results (2.13 and 2.02/plant) were found to the varieties CB-3 and SR-01. Statistically lowest abundance (1.53/plant) of jassid was observed to the variety CB-9. Aphids were higher abundant (1.45/plant) to the varieties CB-3, CB-8 and CB-10. White fly abundances were highest (4.50/plant) to the variety CB-9, and this variety showed the lowest abundance (3.41/plant) of thrips. The morphological characteristics of the individual variety play a vital role in reduction of pest attack. Ibrahim and Rawshan (1991) reported that hairy genotypes of cotton are more resistance to jassid than sparsely hairy and smooth genotypes. Number of jassids, aphids and thrips are substantially higher in smooth variety of CB-3, CB-10, CB-8, SR-01 than the hairy variety of CB-5 and CB-9. But reverse picture of whitefly was found in sparsely and dense hairy variety of CB-5 and CB-9. The canopy volume of SR-05 is less than the varieties of CB-3, CB-8, CB-10 and SR-01 and the leaves are serrated enough which provides much ventilation. As a result the abundance of pest population was lower.

Abundance of chewing pests

Abundance of chewing pests on different varieties of cotton have presented in table 3. Results stated that the variety CB-9 showed higher number of spotted bollworm (0.26/plant) and american bollworm (0.27/plant) abundance. The lowest number spotted bollworm (0.20/plant) and american bollworm (0.21/plant) were found to the variety SR-05. Whereas the varieties CB-3 and SR-01 showed higher abundance (0.40/plant) of armyworm, and it was lowest (0.27/plant) to the variety CB-5. These results were in agreement with Ali and Shvetsova (1988) who reported plant characteristics to resistance against american bollworm. They expressed that the varieties have less hairs, nectaries and branches are more resistance to *H. armigera*. According to Tang (1987) *H. armigera* is less harmful to the cotton varieties having less nectary. He also found that *H. armigera* prefers pubescent variety rather glabrous variety. Probably trichomes and hairs help the eggs and larvae of *H. armigera* for attachment and clinging to the plant parts that increase survival rate. Et-zik and Thaxton (1989) reported that the cottons exhibiting a reduce number of trichomes discourages egg laying activity of bollworm. In this study, the abundance of bollworm in the

varieties CB-5 and CB-9 are predominantly higher than CB-3, CB-8, CB-10 and SR-01. On the other hand, the forked leaf variety, SR-05 is very much keen to protect itself, due to its architectural advantages.

Table 2 Seasonal abundances of sucking pests on selected varieties of cotton

Cotton variety	Number/plant			
	Jassid	Aphid	White fly	Thrips
CB-3	2.13 a	1.45 a	3.83 ab	4.50 a
CB-5	1.62 bc	1.30 c	3.90 ab	4.00 b
CB-8	1.99 ab	1.45 a	3.65 b	4.50 a
CB-9	1.53 c	1.25 c	4.50 a	3.41 c
CB-10	2.15 a	1.45 a	3.33 b	4.23 ab
SR-05	1.95 ab	1.32 bc	3.57 b	3.75 bc
SR-01	2.02 a	1.40 ab	3.50 b	4.23 ab

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$).

Table 3 Seasonal abundance of chewing pests on selected varieties of cotton

Cotton variety	Number/plant		
	Spotted bollworm	American bollworm	Armyworm
CB-3	0.22 ab	0.25 ab	0.40 a
CB-5	0.25 a	0.26 ab	0.27 c
CB-8	0.23 ab	0.23 bc	0.30 bc
CB-9	0.26 a	0.27 a	0.36 abc
CB-10	0.24 ab	0.24 abc	0.30 bc
SR-05	0.20 b	0.21 c	0.37 ab
SR-01	0.24 ab	0.23 bc	0.40 a

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$).

Abundance of predators

The abundance of predators varied significantly among the varieties of cotton (Table 4). Among the cotton varieties, CB-10 showed higher number (4.50/plant) of lady beetle abundance and the lowest number (3.17/plant) of lady beetle abundance was found to the variety CB-9. Spider abundance was highest (5.55/plant) to variety CB-3 and the variety CB-5 showed the lowest number (3.90/plant) of spider abundance. Syrphids were highly abundant (4.75/plant) in the varieties CB-3 and SR-01, and their abundant were lowest (3.25/plant) to the variety CB-9. In all cases, the abundance of predators is higher in smooth variety rather hairy varieties. The presence of more pests in smooth varieties invited more predators than hairy varieties like CB-5 and CB-9. In the variety SR-05, both the predators and prey feel uncomfortable for its less canopy volume and high degree of ventilation.

Table 4 Seasonal abundance of predators on selected varieties of cotton

Treatments	Name of insect		
	Lady beetle	Spider	Syrphids
CB-3	4.08 ab	5.55 a	4.75 a
CB-5	3.67 bc	3.90 c	3.68 cd
CB-8	4.08 ab	4.95 b	4.25 b
CB-9	3.17 c	3.42 d	3.25 d
CB-10	4.50 a	4.95 b	4.50 ab
SR-05	3.75 bc	4.02 c	3.75 c
SR-01	3.98 ab	4.67 b	4.75 a

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$).

Yield performance

Table 5 showed that the variety CB-9 produced significantly higher amount of yield (1650 Kg/ha), and the variety CB-5 produced significantly lowest amount of yield (1150 Kg/ha). Results of the seed index demonstrated that higher index (12.50 gm) was revealed to the variety CB-9 and the variety CB-8 resulted lowest (8.50 gm) index. Among the cultivated varieties ginning out tern (GOT) was highest (41.33%) to the variety CB-5 followed by CB-3, and all other varieties were statistically identical. The yield performances of other varieties are moderate. Boll size of CB-5 is too small hence fails to produce more yield. On the other hand, boll size of CB-9 is comparatively larger and produced highest yield. Though the number of bolls of SR-05 is significantly higher but did not produce higher yield than CB-9. Because the boll size of SR-05 is medium. The picking frequency of CB-10 showed significantly lower than other varieties. From the table 5, the seed index of the variety CB-9 is

significantly higher than other varieties. This is due to bigger size of individual seed weight. But GOT of CB-5 is higher than all the varieties were cultivated. GOT of CB-5 is followed by CB-3. Others have moderate GOT value.

Table 5 Yield and quality characteristics of selected cotton varieties

Variety	Characteristics		
	Yield (Kg/ha)	Seed index (gm)	GOT (%)
CB-3	1200 cd	10.67 b	39.00 b
CB-5	1150 d	10.00 b	41.33 a
CB- 8	1400 bc	8.50 c	35.33 c
CB-9	1650 a	12.50 a	35.83 c
CB-10	1350 cd	10.00 b	35.85 c
SR-05	1600 ab	10.00 b	34.83 c
SR-01	1300 cd	10.50 b	34.83 c

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$).

The present study was undertaken to determine the pest tolerant and competent variety of cotton for profitable cultivation and quality product. Findings of the study indicated that the variety CB-9 contains dense hairs and trichomes than CB-5, and found more tolerant to sucking insects. Smooth or glabrous verities are vulnerable to sucking pests. The serrated leaf variety, SR-05 is well ventilated, potential and prudent enough to protect themselves from insect attacks. On the other hand, *H. armigera* and *B. tabaci* prefers pubescent or hairy variety compared to glabrous one. The abundance of predator was higher on smooth varieties and found positively correlated with the abundance of prey. The morphological characteristics of SR-05 reduced the presence of predators.

From the viewpoint of earliness, CB-10 is looking hopeful and significantly earlier than other varieties of the cotton. It is surprisingly true that the yield contributing characters such as plant height, boll size, boll weight and number of bolls are enthusiastic in the varieties CB-9 and SR-05. These varieties hold an outstanding performance for commercial production of cotton.

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