Genetics of Leaf Nectaries in Upland Cotton

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Abstract: One nectarless cotton variety (NIAB-Karishma) and three varieties with leaf nectaries (CIM-443, NIAB-78 and S-12) were compared for bollworm damage. The F1 population of the cross between the nectarless variety (NIAB-Karishma) and variety with nectaries (CIM-443) along with the F1 and the parents was also screened to study the genetics of leaf nectaries. The F1 plants were with nectaries while in the F1 population the ratio of nectarless and nectarine plants was 15:1. The studies suggested that two genes were involved for the development of nectaries. The results of correlations for nectarless and agronomic traits showed that nectarless trait segregated independently so breeding for nectarless trait would not affect agronomic traits in cotton.

Key words: Leaf nectaries, genetics, cotton

Introduction
Bollworms are important insect pests of cotton crop. Chu et al. (1991) and Flint et al. (1991) have reported that pink bollworm (Pectinophora gossypii) infestation is less on nectarless cotton genotypes compared to the genotypes with nectaries on leaves. Wilson et al. (1981) also observed reduction in insecticide use against pink bollworm on nectarless cotton. Dong Guan et al. (1995) concluded that adult bollworms lay fewer eggs in the nectarless cotton because of food shortage as the adult moths feed on leaf nectaries. So damage of bollworm in nectarless cotton is lower compared to cotton with leaf nectaries. It has also been observed that nectarless trait has non-significant effect on earliness, yield components and fibre strength, however, the trait has significant effect on fibre length and fineness (Cheng et al., 1991).

In the present studies one nectarless (NIAB-Karishma) and three nectarine varieties (CIM-443, NIAB-78 and S-12) were compared for bollworm damage. The F1 population of the cross between the nectarless (NIAB-Karishma) and nectarine varieties (CIM-443) along with the F1 and the parents was studied to find out the genetics of nectarless trait. The relationship of nectarless trait with agronomic traits was also studied.

Materials and Methods
The research work was conducted in the Department of Plant Breeding and Genetics, University of Agriculture Faisalabad, Pakistan. To study the effect of nectarless trait on bollworm infestation, one nectarless (NIAB-Karishma) and three nectarines (CIM-443, S-12 and NIAB-78) varieties were planted in Randomized Complete Block Design (RCBD) in the field area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during May to December, 2000. To study the effect of nectarless trait on other useful characteristics, an F1 population (seed of the cross NIAB-Karishma × CIM-443 and seed of the parents was received from the Department of Plant Breeding and Genetics, University of Agriculture) was also raised in Randomized Complete Block Design (RCBD) in the field.

For varietal trial, five rows of each variety (ten plants in each row) were planted in each replication. There were fifteen rows of F1 population and one row of each of the parents and F1 in each replication. Each row was 3 m long. Thirty centimeters plant to plant distance and 75 cm row to row distance was maintained. In varietal trial five plants from each replication were randomly selected, similarly 100 plants of F1 population were randomly selected during September-November, 2000 to record number of total buds, number of bollworm infested buds, number of total flowers, number of bollworm infected flowers, number of total bolls and number of bollworm infested bolls. Data about leaf nectaries was also recorded in the parents, F1 and F2 population.

Fifteen plants from each of parents and F1 were observed for nectaries (nectaries can be seen as black spots on the ribs of lower side of leaf lamina) and 300 plants were observed in the F2 population.

At maturity the data about number of sympodial branches, number of monopodial branches, staple length, fibre strength, fibre fineness, fibre uniformity, fibre whiteness, fibre yellowness, lint weight collected per plant and 100-seed weight were also recorded. Fibre characteristics of the samples were measured on computerized HVI apparatus in the Department of Fibre Technology, University of Agriculture, Faisalabad.

Results and Discussion
Analysis of variance revealed non-significant differences in the varietal trial except the infected buds trait under field conditions. There were non-significant differences between the varieties for total number of bolls, total number of flowers, bollworm infested flowers, total number of bolls, bollworm infested buds, total number of sympodial branches and total number of monopodial branches.

NIAB-Karishma is nectarless variety so, it was expected on the basis of earlier studies in the literature that it would have less infection of bollworms. There was non-significant differences between the nectarless and nectarine varieties except for the bud infection, which was even higher in NIAB-Karishma. Bollworms feed on leaf nectaries so logically the bollworm population should be lower in the plot of nectarless plants. As the plot size of varieties was small so the bollworms had chance to feed on the neighboring nectaries plants. So this might be the reason for non-significant difference of nectarless nectarine varieties for bollworm infestation. Dong Guan et al. (1995) compared the nectarless and nectarine varieties and found that the bollworm infestation was less in nectarless varieties in larger plot experiments, however, there was no difference of bollworm infestation between the nectarless and nectarine varieties in smaller plots. They suggested that in large plots of nectarless cotton, bollworms laid fewer eggs because of food shortage but in small plots bollworms can feed on the adjacent plots with nectaries varieties. Flint et al. (1991) and Wilson et al. (1991) have also reported similar findings.

Correlation studies of nectarless traits: Correlation of morphological and fibre traits among themselves and with nectarine and nectarless traits were calculated using the data of F2 population from the cross of CIM-443 and NIAB-Karishma. Correlations matrix of the traits is given in the Table 1. Knowledge of correlation is required to obtain the expected response of other characters when selection is applied to the character of interest in a breeding programme. So, correlations were carried out to find any linkage of the nectarless genes with
Table 1: Correlation studies among fibre fineness (F MIC), strength (F STR), length (F LEN), uniformity (F UNF) and fiber elongation (F ELG), whiteness (RD), yellowness (+B), lint weight per plant (Lint Wt.), 100-seed weight per plant (100-seed wtr.), total bolls per plant (T bolls), infected bolls per plant (Inf. bolls) total buds per plant (T buds), infected buds per plant (Inf. buds), sympodial branches per plant (Symp.), monopodial branches per plant (Monop.) nectariness trait (Trait NL) and nectariness trait (Trait N).

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<th>F MIC</th>
<th>F STR</th>
<th>F LEN</th>
<th>F UNF</th>
<th>F ELG</th>
<th>RD</th>
<th>+B</th>
<th>Lint Wt.</th>
<th>100-seed wtr.</th>
<th>T bolls</th>
<th>Inf. bolls</th>
<th>T flowers</th>
<th>Inf. flowers</th>
<th>T buds</th>
<th>Inf. buds</th>
<th>Symp.</th>
<th>Monop.</th>
<th>Trait NL</th>
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<td>+B</td>
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<td>0.608*</td>
<td>0.199**</td>
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<td>Monop.</td>
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<td>0.291</td>
<td>0.395</td>
<td>0.066</td>
<td>0.039</td>
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<td>-0.237</td>
<td>-0.467*</td>
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<td>Trait (NL)</td>
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<td>-0.48</td>
<td>-0.293</td>
<td>0.286</td>
<td>-0.086</td>
<td>-0.078</td>
<td>0.157</td>
<td>0.063</td>
<td>0.140</td>
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<td>-0.328</td>
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<td>-0.169</td>
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<td>-0.049</td>
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<td>0.449</td>
<td>0.397</td>
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<td>0.268</td>
<td>0.049</td>
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* P < 0.05
** P < 0.01
morphological and fibre characteristics or their association among themselves. Nectariless character was not correlated with morphological or fibre traits which suggest that the genes for nectariless trait segregate independently of the traits of agronomic importance. So, the breeding for nectariless trait would not affect other economic traits of cotton plant. Similar results have been reported by Zhang et al. (1991). However Meredith et al. (1996) have concluded from his studies that nectariless genotypes had larger bolls and seed and stronger fibres compared to nectariless genotypes. Similarly fibre fineness was also not correlated with any other traits studied. So breeding for higher fineness would not affect other traits. Fibre strength was positively correlated with hundred seed weight, which suggests that genes for fibre strength are strongly linked with gene controlling seed weight so increase with seed weight would also improve fibre strength in a genotype. Fibre length was negatively correlated with fibre uniformity and fibre whiteness which shows that the improvement in fibre strength would have negative effect on fibre uniformity and whiteness. Positive correlation of fibre uniformity with fibre whiteness and yellowness shows that breeding for any of these traits would also affect other traits in that direction. Whereas, fibre uniformity would have negative effect on total number of bolls and bud infestation by bollworms. The correlations shows that the genes for whiteness would not affect lint weight/plant, 100-seed weight, total flowers/buds/bolls or their infestation by bollworms and branching pattern. The genes for fibre yellowness would have negative effect on infected bolls/plant, total buds/plant and total infected bolls/plant. Similarly lint weight/plant would have negative effect on infected flowers and sympodial branches. The genes for 100-seed weight also would not affect total infected bolls/buds/flowers and branching pattern. Total bolls/plant would have positive effect on infected bolls/plant, infected flowers/plant, total and infected bolls/plant and sympodial branches/plant. Infected bolls would be positively affected by total or infected flowers and total or infected buds. Total flowers would be positively affected by infected flowers/plant. Total bolls would have positive affect on infected bolls and sympodial branching. Similarly infected bolls are positively related with sympodial branches.

Genetics of nectariless trait: The F₁ of the cross involving nectariless and nectarines varieties was with nectarines. However, the F₂ population showed a segregation ratio of 15:1 (nectarines: nectariless). This suggested that there are two genes controlling nectariless trait. Any of the gene present for nectarines would develop nectaries in plant and if both the genes are absent then the plant would show nectariless trait. So, the trait is simply inherited.

The studies conclude that nectariless trait in cotton segregate in department of important agronomic traits so selection for nectariless would not have negative effect on the agronomic traits. The nectariless trait is simply inherited, hence breeding for the trait would not be difficult.

References


