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Genetics of Leaf Nectaries in Upland Cotton

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Abstract: One nectariless cotton variety (NIAB-Karishma) and three varieties with leaf nectaries (CIM-443, NIAB-78 and S-12) were compared for bollworm damage. The F_2 population of the cross between the nectariless variety (NIAB- Karishma) and variety with nectarines (CIM-443) along with the F_1 and the parents was also screened to study the genetics of leaf nectaries. The F_1 plants were with nectaries while in the F_2 population the ratio of nectariless and nectarines plants was 15:1. The studies suggested that two genes were involved for the development of nectaries. The results of correlations for nectariless and agronomic traits showed that nectariless trait segregated independently so breeding for nectariless 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 gossypiella*) infestation is less on nectariless cotton genotypes compared to the genotypes with nectaries on leaves. Wilson *et al.* (1991) also observed reduction in insecticide use against pink bollworm on nectariless cotton. Dong Guan *et al.* (1995) concluded that adult bollworms lay fewer eggs in the nectariless cotton because of food shortage as the adult moths feed on leaf nectaries. So damage of bollworm in nectariless cotton is lower compared to cotton with leaf nectaries. It has also been observed that nectariless trait has non-significant effect on earliness, yield components and fibre strength, however, the trait has significant effect on fibre length and fineness (Zhang *et al.*, 1991).

In the present studies one nectriless (NIAB-Karishma) and three nectarines varieties (CIM-443, NIAB-78 and S-12) were compared for bollworm damage. The F_2 population of the cross between the nectariless (NIAB-Karishma) and nectarines variety (CIM-443) along with the F_1 and the parents was studied to find out the genetics of nectariless trait. The relationship of nectariless 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 nectariless trait on bollworm infestation, one nectariless (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 nectariless trait on other useful characteristics, an F_2 population (seed of the cross NIAB-Karishma x 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 F_2 population and one row of each of the parents and F_1 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 F_2 population were randomly selected during September-November, 2000 to record number of total buds, number of bollworm infected buds, number of total flowers, number of bollworm infected flowers, number of total bolls and number of bollworm infected bolls. Data about leaf nectaries was also recorded in the parents, F_1 and F_2 population. Fifteen plants from each of parents and F_1 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 F_2 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 infected flowers, total number of buds, bollworm infected buds, total number of sympodial branches and total number of monopodial branches.

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

Correlation studies of nectariless traits: Correlation of morphological and fibre traits among themselves and with nectarines and nectariless traits were calculated using the data of F_2 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 nectariless 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 wt.), 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.) nectarliness trait (Trait (NL) and nectarines trait (Trait (N).

Parameters	F. MIC	F. STR	F. LEN	F. UNF	F. ELG	RD	+B	Lint. Wt.	100-seed wt.	T. bolls	Inf. bolls	T. flowers	Inf. flowers	T. buds	Inf. buds	Symp.	Monop.	Trait (NL)
F. STR	0.099																	
F. LEN	0.134	0.287																
F. UNF	-0.171	0.209	-0.571**															
F. ELG	-0.169	-0.025	0.177	-0.179														
RD	-0.333	-0.232	-0.548*	0.546*	0.120													
+B	0.311	0.277	-0.208	0.508*	-0.147	0.231												
Lint. Wt.	-0.230	0.143	-0.400	0.303	-0.150	0.357	0.057											
100-seed wt.	0.319	0.487*	0.428	-0.179	-0.143	-0.186	-0.067	0.155										
T. bolls	-0.146	-0.208	0.058	-0.255	-0.039	-0.153	-0.399	-0.192	-0.312									
Inf. bolls	-0.234	-0.199	0.053	-0.338	0.130	-0.149	-0.485*	-0.252	-0.307	0.913**								
T. flowers	0.010	-0.362	-0.280	0.121	0.008	-0.008	-0.116	-0.224	-0.366	0.428	0.454*							
Inf. flowers	-0.041	-0.256	-0.171	0.016	0.091	-0.247	-0.225	-0.435*	-0.362	0.498*	0.549**	0.889*						
T. buds	-0.234	-0.034	0.120	-0.475*	0.068	-0.171	-0.529*	-0.041	-0.194	0.746**	0.692**	0.138	0.183					
Inf. buds	-0.191	-0.076	0.009	-0.462*	-0.042	-0.193	-0.483*	0.017	-0.286	0.749**	0.712**	0.143	0.186	0.899**				
Symp.	-0.097	0.107	-0.298	0.124	-0.430	-0.008	-0.030	0.058	-0.159	0.602**	0.494	0.350	0.322	0.508*	0.599**			
Monop.	-0.031	-0.291	0.305	-0.063	0.003	-0.095	-0.237	-0.467*	-0.073	0.136	-0.013	-0.024	0.052	0.092	-0.062	-0.296		
Trait (NL)	-0.145	-0.48	-0.293	0.255	-0.096	-0.078	0.197	0.083	0.140	-0.235	-0.328	0.023	0.085	-0.169	-0.358	-0.049	0.220	
Trait (N)	0.145	0.048	0.293	-0.255	0.096	0.078	-0.197	-0.083	-0.140	0.235	0.328	0.023	-0.085	0.169	0.358	0.049	-0.220	-1.000

* 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 independent 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 nectaried 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 buds 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 buds/plant. Similarly lint weight/plant would have negative effect on infected flowers and monopodial 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 buds/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 buds would have positive affect on infected buds and sympodial branching. Similarly infected buds are positively related with sympodial branches.

Genetics of nectariless trait: The F_1 of the cross involving nectariless and nectarines varieties was with nectaries. However, the F_2 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 heave negative effect on the agronomic traits. The nectariless trail is simply inherited, hence breeding for the trait would not be difficult.

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