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Combining Ability for Shoot fly (*Atherigona approximata* Malloch) Resistance in Pearl Millet (*Pennisetum americanum* (L.) Leeke).

R. APPADURAI[1], U. S. NATARAJAN[2], T. S. RAVEENDRAN[3] and A. RAGUPATHY[4]

In a combining ability analysis for shootfly resistance in pearl millet, no genetic differences were observed between the female parents Tift. 23 D_2A and MS 5141.A. Among the 40 males that were tested eight were found to be high combiners for resistance. The interaction between males and females was significant. However, only one hybrid showed specific combining ability. The usefulness in a breeding programme, of male parents identified as high combiners for res tance is indicated.

Although pearl millet (*Pennisetum americanum* (L.) Leeke) is fairly free from insect pests, shootfly is a notable one among the few insects that cause damage in this crop. Apart from causing damage to the central shoots resulting in dead hearts, the maggots feed also on the young panicles (Natarajan *et al.*, 1973). Although reports on the incidence of this pest and extent of damage and grain loss caused are available in this crop, no attempt has so far been made to study the genetics of shootfly resistance. No genotype in pearl millet has so far been reported to be completely resistant to shootfly attack. However, as different degrees of damage have been observed in different genotypes, resistance is probably polygenic. With this assumption, an investigation was carried out to find out the combining ability of different inbreds for resistance.

MATERIAL AND METHODS

Forty inbreds of diverse origin as males were crossed to Tift. $23D_2A$ and MS. 5141 A as females to produce 80 F_1 hybrids. These F_1S were studied in a randomized block design with three replications during Kharif 1976. The entries were sown in single rows of 3 m length with a spacing of 45 cm between rows. The crop was thinned to leave about 20 seedlings per row so that the spacing between plants was 15 cm. The crop was neither protected against shootfly attack nor any adult flies released so that the infestation was under natural conditions. Seedling incidence causing dead hearts was negligible. However, attack on panicles was heavy because of cool and humid weather during panicle emergence (September — October). The panicles damaged by shootfly were counted and the percentage calculated. The percentage data were subjected

1 & 3: School of Genetics, Tamil Nadu Agricultural University, Coimbatore-3.
2 : Sugarcane Breeding Institute, Coimbatore-7.
4 : Department of Entomology, Tamil Nadu Agricultural University, Coimbatore-3.

to angular transformation and a line x tester analysis carried out for general and specific combining ability following the sire x dam mating design of Kempthorne (1957).

RESULTS AND DISCUSSION

The results of analysis of variance are given in Table 1. The variance due to hybrids, males and interaction between males and females were significant. The variance due to females was not significant. The SCA variance was predominant over GCA variance indicating that shootfly resistance in the material studied is more due to dominant gene action than due to additive gene action.

The mean percentage of shootfly incidence in various hybrids is given in Table 2. The percentage ranged from 4.4 to 63.2. Generally the incidence is high in Tamil Nadu when compared to other parts of the country. Jotwani *et al.*, (1969) studied shootfly incidence for three years from 1966 to 1968 at various centres in the country and reported no incidence at Delhi, but as high as 47 per cent in a plot at Coimbatore. Natarajan *et al.*, (1973) reported shootfly incidence of 30 to 67 per cent on panicles in various hybrids at Coimbatore causing an estimated grain loss of 26 to 59 per cent. Seshu Reddy and Davies (1977) observed only 1.4 per cent dead hearts as the maximum at Patancheru, Andhra Pradesh. In the present investigation, although seedling incidence was negligible, the attack on panicles was high (Table 2). Six hybrids (Tift. 23 D_2A x PT 1930, Tift. 23 D_2A x PT. 1886, MS. 5141 A x IP 241, MS 5141 A x PT 1930, MS 5141 A x PT 1939 and MS 5141 A x IP 863) showed very good resistance recording less than 10 per cent incidence. Five hybrids were found to be highly susceptible with more than 50 per cent incidence.

The general combiners for resistance as well as for susceptibility can be seen from Table 2. There was no difference in general combining ability effect between Tift. 23 D_2A and MS 5141 A. Among the males eight inbreds viz. IP 241, PT 1939, MS 6317, PT 1522, PT 1930, IP 863, PT 1886 and MS 6112 showed significant general combining ability effects for resistance (negative values). Of these, the first three inbreds were also general combiners for either yield or yield components whereas the latter five were not (Appadurai *et al.*, 1979). Hence these five inbreds cannot be used directly as parents in hybrid programmes. However, they can serve as source materials in a breeding programme to impart partial resistance against shootfly in developed inbreds.

Only one hybrid MS 5141 A x PT 1939 showed specific combining ability for shootfly resistance. The male parent in this hybrid is also a general combiner for resistance. Although the number of male parents showing high combining ability is large, specific combining ability was rarely observed in the hybrids. This is perhaps due to the absence of genetic differences for shootfly resistance between the females.

The foregoing discussion clearly indicates that there are genetic differences for shootfly resistance in the materials studied. A few pollen parents showing resistance have been identified. These can be directly used as parents for producing hybrids if the inbreds show combining ability for yield and/or yield components or can serve as source materials in imparting resistance in developed inbreds.

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TABLE 1 *Analysis of variance for shootfly incidence*

Source	df	Mean sum of squares
Hybrids	79	291.21**
Males	39	451.39**
Females	1	152.48
Males x Females	39	134.57**
Error	158	72.68
GCA		2.62
SCA		21.48
GCA : SCA		1=10.8

** Significant at P=0.01

Table 2 Mean Percentage of shootfly incidence and combining ability effects

Inbreds 1	Tift 23 D_2 A 2	Sca effect 3	MS 5141 A 4	Sca effect 5	gca effect of male parents 6
J. 126 D_2B	40.5 (38.3)	(5.7)	30.5 (28.6)	(-5.7)	(0.4)
PT 1510	30.5 (38.9)	(3.1)	32.6 (34.4)	(-3.1)	(2.8)
PT 1522	23.2 (26 3)	(3.7)	13.5 (20.4)	(-3.7)	(-10,4)*
PT 1531	35.2 (35.6)	(-1.1)	40.5 (39.3)	(1.1)	(3.7)
PT 1577	29.9 (32.8)	(-1.1)	36.2 (36.6)	(1.1)	(0.9)
PT 1600	36.9 (38.0)	(-3.5)	52.5 (46.5)	(3.5)	(8.5)*
PT 1610	48.1 (43.9)	(7.9)	25.5 (29.6)	(-7.9)	(3.0)
PT 1921	22.4 (27.6)	(1.6)	22.7 (26.0)	(-1.6)	(-7.0)
PT 732/2	46.5 (43.0)	(-4.0)	63.2 (52.7)	(4.0)	(14.0)**
PT 734/4	32.7 (34.8)	(-4.2)	49.7 (44.8)	(4.2)	(6.0)
PT 734/5	41.6 (40.1)	(-0.8)	47.3 (43.3)	(0.8)	(7.9)
PT 1695	35.4 (36 5)	(2.4)	31.8 (33.3)	(-2.4)	(1.1)
IP 241	14.7 (20.9)	(5.5)	4.5 (11.4)	(-5.5)	(-17.6)**
PT 1722	42.0 (40.3)	(-3.5)	56.6 (48.9)	(3.5)	(10.8)**
PT 1922	34.8 (25.8)	(-2.1)	44.5 (41.5)	(2.1)	(4.9)*
PT 1923	43.7 (41.3)	(9.8)	18.3 (23.2)	(-9.8)	(-1.5)
PT 1924	30.5 (33.4)	(1.0)	32.4 (33.0)	(-1.0)	(-0.6)
PT 1925	46.8 (43.1)	(-2.9)	59.3 (50.4)	(2.9)	(13.0)**
PT 1926	33.3 (35.1)	(-3.6)	47.9 (43.8)	(3.6)	(5.7)
PT 1927	35.1 (36.2)	(-3.0)	46.9 (43.1)	(3.0)	(6.2)

2 contd......

Table 2 (contd...)

1	2	3	4	5	6
PT 1928	31.6 (34.1)	(-4.6)	49.7 (44.8)	(-4.6)	(5.7)
PT 1929	28.7 (31.9)	(0.5)	29.1 (32.6)	(-0.5)	(-1.6)
PT 1930	9.2 (16 5)	(1.1)	8.9 (15.8)	(-1.1)	(-17.6)**
PT 1931	28.6 (31.5)	(-3.5)	42.0 (40.1)	(3.5)	(2.0)
PT 1932	28.3 (31.7)	(-2.2)	37.7 (37.6)	(2.2)	(0.9)
PT 1933	26.1 (30.1)	(-0.1)	28.1 (31.8)	(0.1)	(-2.8)*
PT 1934	24.1 (28 4)	(-5.1)	30.6 (40.2)	(5.1)	(0.5)
PT 1935	48.2 (44.0)	(4.5)	36.0 (36.7)	(-4.5)	(6.5)
PT 1936	26.7 (31.1)	(-1.8)	37.1 (36.2)	(1.8)	(0.1)
PT 1937	20.6 (26 5)	(-7.8)	47.8 (43.7)	(7.8)	(1.3)
PT 1938	24.8 (27.8)	(-0.7)	24.0 (28.1)	(-0.7)	(-5.9)
PT 1939	36.1 (36 9)	(12.0)*	8.3 (14.4)	(-12.0)*	(-8.1)*
IP 863	13.6 (20.7)	(4.3)	6.5 (13.6)	(-4.3)	(-16.6)**
IP 897	48.9 (44.4)	(-8.1)	78.2 (62.3)	(8.1)	(+19.6)**
IP 1388	22.1 (26.8)	(-6.7)	44.4 (41.8)	(6.7)	(0.5)
IP 1509	26.6 (30.8)	(-2.9)	41.6 (38.1)	(2.9)	(0.7)
PT 1513	32.6 (34.5)	(-0.2)	35.5 (36.5)	(0.2)	(1.7)
PT 1886	4.4 (11.6)	(-3.5)	15.1 (20.3)	(3.5)	(17.9)**
MS 6112	30.7 (33.0)	(8.0)	11.5 (18.5)	(-8.0)	(-8.0)*
MS 6317	19.6 (25.0)	(3.8)	11.8 (19.1)	(-3.8)	(-11.8)**
gca effect of female parents	(-0.8)		(0.8)		

Figures in parenthesis — Mean of transformed values

** : Significant at P = 0.01

* : Significant at P = 0.05