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Genotypic variability on the incidence of late wilt and grain yield losses in maize

G. KOTESWARA RAO, R. BENER RAJ, HASHMATHUNNISA BEGUM AND SHAIK MOHAMMAD

Maize Research Station, Amberpet, Hyderabad 500 013

Three maize (*Zea mays* L.) genotypes were evaluated for their response to the incidence of late wilt (*Cephalosporium maydis* Samra, Sabet & Hingorani) and losses in seed-yield in the monsoon season during 1986 and 1987 at the Maize Research Station, Amberpet, Hyderabad. Results indicated that the performance of hybrids DHM 103 and Ganga-5 was highly significant compared to the cultivar Warangal Local which was severely affected with maximum incidence of the disease and yielded low. Ganga-5 in turn was more sensitive with significantly lower yield and higher incidence than DHM 103. Seed yield of each genotype showed a highly significant and negative correlation with the disease incidence. The linear regression models showed that DHM 103 was more sensitive to yield loss per unit increase in the disease incidence followed by Ganga-5 and Warangal Local. However, the high yielding potential makes it a higher yielding genotype irrespective of the occurrence or absence of the late wilt incidence.

Seed dressing with Captaf at 2 g kg^{-1} followed by soil drenching with bleaching powder (1000 ppm chlorine) at 45 and 60 days caused a highly significant reduction in the incidence with a concomitant increase in yield of each genotype compared to the artificial inoculum infecting the crop.

The genotype x sub-treatment interactions were not significant. Genotype x year interaction on the basis of pooled analysis showed that the three genotypes yielded more in 1987 than in 1986 due to more favourable environment. Similarly, the yield levels due to sub-treatments showed a significant interaction with years, yielding more in the second than in the first year.

Key words : Genotype, Late wilt disease, Grain yield, Maize.

Among cereal crops in India, maize ranks fifth after rice, wheat, sorghum and pearl millet in total area, fourth in production and third in productivity, Three major crop seasons viz., monsoon, winter and spring are generally recognised in

which maize is grown. By and large over 80% of the cultivated area is rainfed depending on the natural precipitation in monsoon (Singh, 1986). Damp weather and water logged soils are very conducive for the occurrence of late wilt or the stalkrot incited by *Cephalosporium maydis* (Sarama Sabet and Hingorani) in the monsoon season. The disease is prevalent in the states of Rajasthan, Uttar Pradesh, Bihar and Andhra Pradesh (Payak and Sharma, 1985). Therefore, it is important to choose a genotype that is less susceptible to the disease and yields high. In an endeavour to evaluate the relative incidence of this stalk rot, Payak and Sharma (1978) observed a marked variation in 50 genotypes studied at Hyderabad. The percentage of the disease ranged from nil to a maximum of 70.7 with little to serve damage causing reductions upto 50.9%. Among the newly developed high-yielding hybrids DHM 103 and Ganga-5 are extensively grown in different parts of the country. However, their reaction to the incidence of this disease is not known. Therefore, field experiments were initiated to have an insight into the relative response of these hybrids and a local cultivar Warangal Local.

MATERIAL AND METHODS

Field experiments were conducted in the monsoon season during 1986 and 1987 at the Maize Research Station, Amberpet, Hyderabad. The crop was sown on 30th June and 4th July in the vertisols following the splitplot design. Three genotypes were assigned to the main plots each with two sub-treatments viz., artificial inoculation of the fungus and the chemical control. The genotypes comprised two promising hybrids DHM 103 and Ganga-5 in addition to a local cultivar Warangal Local. The treatments were run over four replications in each year. The fungus was artificially inoculated in the second internode of plants (Singh and Siradhana, 1986) at tasseling by the tooth pick method. The chemical treatment included seed dressing with Captaf at 2 g kg^{-1} at the time of sowing and drenching the soil with an aqueous solution of bleaching powder (1000 ppm chlorine) 45 and 60 days after sowing. The plot size included 6 rows, each 5 m long, spaced 60 cm apart and given an intra-row spacing of 25 cm. The crop was fertilized with 50 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare at the time of sowing Thirty days later additional dose of 50 kg N per hectare was applied.

At maturity, the crop was harvested from each plot after discarding the border rows all around. The stalks were split open and the incidence of disease spread was scored on a 1-10 scale proposed by Payak and Sharma (1983). The data on disease incidence and seed yield were statistically analysed. The pooled analysis for yield was attempted following the procedure described by Mc Intosh (1983). Correlation coefficients between seed yield and the disease incidence were worked out and the linear regression models were fitted to quantify the yield loss in each genotype.

RESULTS AND DISCUSSION

Maize genotypes showed marked variation in the incidence of late wilt both during 1986 and 1987 (Table 1). The hybrid Ganga-5 was superior with a lower incidence (4.46 and 4.57) of late wilt than the cultivated variety Warangal Local (4.85 and 5.00). The differences were highly significant in the first year and significant with P=0.05 in the second year. The hybrid DHM 103 was excellent with a least incidence of 3.35 and 3.62. It showed highly significant differences compared to either genotype in both the years.

Table 1. Incidence of late wilt and seed yield (q ha-1) of maize genotype as influenced by artificial inoculation and chemical control treatment

Treatment	Late wilt Incidence 1986	1987	Seed yield (q ha-1) 1986	1987	Mean
Genotype					
DHM 103	3.35	3.62	43.30	51.00	47.15
Ganga-5	4.46	4.57	41.60	44.75	43.17
Warangal Local	4.85	5.00	29.40	31.00	30 20
SE ±	0.07	0.14	0.12	1.10	0.56
CD (P=0.05)	0.18	0.33	0.29	2.70	1.21
CD (P=0.01)	0.28	0.51	0.44	4.10	1.71
Sub-treatment					
Inoculated	5.60	5.85	34.00	37.33	35.67
Protected	2.83	2.95	42.20	47.16	44 68
SE ±	0.11	0.12	0.15	0.67	0.34
CD (P=0.05)	0.24	0.26	0.33	1.51	0.72
CD (P=0.01)	0.35	0.38	0.48	2.17	0.99
Genotype X Sub-treatment					
SE ±	0.09	0.20	0.26	1.16	0.59
CD (P=0 05)	0.20	0.46	0.58	NS	1.25
CD (P=0.01)	0.28	0.65	NS	NS	NS
Year					
SE ±	—	—	—	—	0.45
CD (P=0.05)	—	—	—	—	0.99
CD (P=0.01)	—	—	—	—	1.37
Genotype X year					
SE ±	—	—	—	—	0.79
CD (P=0.05)	—	—	—	—	1.71
CD (P=0.01)	—	—	—	—	2.40
Sub-treatment X year					
SE ±	—	—	—	—	0.48
CD (P=0.05)	—	—	—	—	1.02
CD (P=0.01)	—	—	—	—	NS
Genotype X sub-treatment X year					
SE ±	—	—	—	—	0.84
CD (P=0.05)	—	—	—	—	NS
CD (P=0.01)	—	—	—	—	NS

Artificial inoculation incited the late wilt incidence to 5.60 in 1986 and to 5.85 in 1987. The chemical treatment-seed dressing with Captaf at 2 g kg^{-1} and soil drenching with bleaching powder (1000 ppm chlorine) suppressed the incidence (2.83 and 2.95) by 49.5 and 49.6% during 1986 and 1987 respectively. Analysis of variance indicated that these differences were highly significant.

Interactions were highly significant in the two years. The chemical control treatment had a marked effect in reducing the late wilt incidence of each genotype. The cultivar-Warangal Local had a maximum incidence which was on per with Ganga-5 while DHM 103 had significantly lower incidence when the crop was artificially inoculated. But the chemical control treatment indicated that these genotypes responded significantly different from each other.

Seed yield of maize genotypes varied with highly significant differences in both the years. The hydrid DHM 103 out yielded Ganga-5 and Warangal Local. The yield of the cultivar was 32.10 and 39.21% less than the hybrid DHM 103 while it yielded 29.33 and 30.73% less than the hybrid Ganga-5 in 1986 and 1987 respectively. The pooled genotypic variance also indicated that DHM 103 was most outstanding hybrid yielding significantly more than Ganga-5 which in turn was significantly superior to Warangal Local.

The chemical control treatment significantly increased the seed yield (42.20 and 47.16 q ha^{-1}) by 24.12 and 26.33% over artificial inoculation (34.00 and 37.33 q ha^{-1}). The pooled analysis also showed a similar trend in that the crop yield increased from a mean of 35.67 q ha^{-1} with artificial inoculation to 44.68 q ha^{-1} when chemically treated.

The genotype x sub-treatment interactions were not significant. The pooled analysis showed highly significant variances with more seed yield in the second than in the first year. The genotype x year interactions were highly significant. This showed that the higher yields realised in the second year were consistent for the three genotypes. These differences might perhaps be attributed to a more favourable environment than in the first year. Obviously the sub-treatment x year interaction were also significant showing that the second year was more conducive for better growth. The higher order interactions were, however, not significant.

The correlation coefficients showed that the seed yield of maize genotypes varied with the late wilt incidence. Their relationship was negative and highly significant (Table 2). From the computed regression it is predictable that the hybrid DHM 103 would have yielded 57.60 and 65.15 q ha^{-1} in 1986 and 1987 with a mean of 58.84 q ha^{-1} against the corresponding expected yield of 54.16, 58.04 and 55.92 q ha^{-1} from the hybrid Ganga-5 in a disease free environment. The intercepts for Warangal Local were much less (40.99, 46.75 and 43.90 q ha^{-1}) and thus it has a very low yield potential. Slopes of the regrssion curves revealed that DHM

Table 2. Correlation and regression coefficients between seed yield and the incidence of late wilt in maize genotypes

Genotype	Year	Correlation coefficient	Regression equation (—y—a + bx)		Co-efficient of determination
			Intercept	Regression	
		(r)	(a)	(b)	(a^2)
DHM	1986	-0.986**	57.600	-4 269x	0.97
103	1987	-0.841**	65.155	-3.905x	0.71
Mean		-0 547**	58.838	-3.351x	0.30
Gang -5	1986	-0.991**	54.160	-2.815x	0.98
	1987	-0.897**	58.039	-2.905x	0.80
Mean		-0.881**	55.922	-2.821x	0.77
Warangal	1986	-0.989**	40.995	-2.391x	0.98
Local	1987	-0.975**	46.754	-3.151x	0.95
Mean		-0 953	43.897	-2.781x	0.91

103 is more sensitive to the late wilt incidence than Ganga-5 while Warangal Local is the least. The expected mean loss in seed yield of DHM 103 per unit increase in the incidence of the disease was 3.35 q ha^{-1} in contrast to a relatively lesser yield loss of 2.82 q ha^{-1} in Ganga-5 and 2.78 q ha^{-1} in Warangal Local.

The present investigations showed that DHM 103 outyielded the other genotypes in both the years despite the fact that the rate of loss in yield per unit increase in the incidence of late wilt was more. This may be explicable in view of the fact that this hybrid has a better yield potential and is more tolerant with a lower incidence that would overcompensate the rate of yield losses. It thus appears cogent to infer that DHM 103 may be preferred for raingrown situations while Ganga-5 may be an alternative if the farmer is not available.

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