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Stability Analysis for Oil and Other Characters in Maize

(*Zea mays* L.)

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ABSTRACT

Sixty four divergent genotypes of maize were evaluated for stability of performance for days to flowering, grain yield/plant, kernel oil content and embryo oil content in four environments during 1981-82. The analysis indicated that both linear and non-linear components of GXE interactions were responsible for the differences in the stability of genotypes. Genotype D 771, D 765 (Early DMR2 x CM 560) pool 8 sib 4 and early DMR Comp. 2 were early flowering types and were responsive to poor farming conditions. The genotypes responsive to average farming conditions were stable in performance but were observed to be invariably late in silking. Superiority of genotypes DHM 101, MS-1 and Him-128 for grain yield; Syn DO x (CM 202 x CM 111) and Iowa 2 Ear H.O for kernel oil content; RHORYD x Vijay, Syn Do x P 102, Manjri composite and Syn Do x (CM 202 x CM 111) for embryo oil content were exhibited under favourable farming conditions. Genotype Iowa 2 Ear H.O x Vijay and Soan x Suwan 2 W showed higher kernel oil content under average and poor farming conditions, respectively. Genotype Syn DO x Vijay exhibited higher embryo oil content in poor farming conditions. In general, H 201-45 was a good combination of high yield, high oil and earliness. Stability parameters showed association between x and b for days to flowering and grain yield.

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INTRODUCTION

A long term policy to overcome edible oil crisis of our country is to increase the total production of vegetable oil by improving the yield of existing oil seed crops and by utilizing non-traditional oil yielding crops. Maize is not usually classified as an oil seed but it's large acreage and high yield potentiality can substantially bridge the demand supply gap of edible oil. Owing to the high content of unsaturated fatty acid, maize oil is considered as one of the best edible oil. Most of the oil is in the embryo of the kernel. However, analysis of the whole kernel is adequate to determine the amount of commercially extractable oil due to the positive linear relationship between embryo oil content and

TABLE 1

Pooled analysis of variance.

Source	*d. f.*	*Mean Squares*			
		Kernel oil content	*Embryo oil content*	*Days to 50% silking*	*Grain yield*
Genotypes (G)	63	1.776**++	12.726**++	36.675**++	132.754**++
Environments (E)	3	4.137**++	58.450**++	8515.300**++	76.130++
GXE	189	0.201**++	5.314++	12.807++	44.760++
Environ + (GXE)	192	0.262**++	6.144++	145.659**++	45.249++
Environ (linear)	1	12.412**++	175.361**++	25545.953**++	228.411*++
GXE (linear)	63	0.334**++	4.806++	15.423*++	43.426++
Pooled deviation	128	0.133++	5.482++	11.325++	44.715++
Pooled error	756	0.003	0.219	2.514	12.146

* P = 0.05 **P = 0.01 (with pooled deviation)

+P = 0.05 ++P = 0.01 (with pooled error)

TABLE 2

Stability parameters of genotypes showing desirable stability parameters for 4 charac-ters in maize and correlation ceofficients among them.

No.	Genotypes	Days to Silking			Grain yield		
		$\bar{X}$	b	S^2d	$\bar{X}$	b	S^2d
1	2	3	4	5	6	7	8
1.	RHOR 4D x (CM202 x CM111)	64.1	1.35	35.06**	46.0	1.11	40.64*
2.	Syn DO x P 102	65.0	1.12	16.30**	43.9	2.89	56.78**
3.	Syn DO x CM 202	67.2	1.13	—1.56	45.8	—1.64	—2.63
4.	RHOR YD x Vijay	65.0	1.12	—1.13	45.3	—1.14	21.19
5.	Syn DO x (CM202 x CM111)	67.8	1.22	0.17	51.8	0.73	—6.19
6.	Iowa 2 Ear H. O. x P 101	64.1	0.87	5.61*	48.6	—1.38	96.36**
7.	Iowa 2 Ear H.O. x CM 202	64.8	1.01	4.21	53.6	1.33	11.31
8.	RDB 144 M 3 x P 102	66.1	1.04	—0.87	42.1	—0.50	31.68**
9.	RDNLB x P 102	64.8	0.90	6.29*	55.8	—1.38	35.69*
10.	Iowa 2 Ear H.O. x Vijay	64.8	0.99	0.17	44.3	—2.62	—8.58
11.	Vijay Composite	66.7	1.14	13.15**	58.10	—1.67	181.20
12.	RHOR YD x P 102	65.5	1.25	4.46	51.50	1.75	—4.04
13.	Syn DO x Vijay	66.0	1.16	—0.09	37.40	—1.62	—8.64
14.	(Zia x Phil DMR COMP 2) Pool 6 Sib 4	62.8	0.98	—1.76	56.60	2.83*	—11.27
15.	(Early DMR 2 x CM 560) Pool 8 Sib 4	58.4	0.57	5.58*	42.1	—6.02	101.82**
16.	Pool 6 x Suwan	63.0	0.83	1.67	37.7	0.99	27.70*
17.	Soan x Suwan 2 W	63.3	0.91	5.80*	50.10	—4.91	94.88**
18.	MS 1	65.0	1.90	—1.02	62.10	6.14	30.27*
19.	G-41	61.8	0.86	5.17*	53.10	—0.66	11.28
20.	Ganga 5	65.9	0.96	10.32**	59.40	—0.14	2.67
21.	DHM 101	65.1	1.12	20.63**	64.10	5.48**	40.17
22.	EVB-VI (IFS 1)	64.8	0.98	—1.61	48.10	5.27	—6.16
23.	Early DMR Comp	58.5	0.70	—0.54	43.40	6.01**	47.55**
24.	Iowa 2 Early H.O.	65.1	0.99	40.22**	43.80	1.45	—5.35
25.	D-747	58.5	0.72	0.33	53.70	—2.16	2.93
26.	D-771	56.9	0.59*	—1.44	45.10	—2.99	1.03
27.	D-765	57.4	0.71	12.57**	50.60	—1.96*	—10.69
28.	Manjari Composite	64.4	1.06	23.83**	47.80	—2.78	47.12**
29.	Him 128	69.9	1.29	7.89**	58.30	3.50	89.86**
30.	H 201-45	60.1	0.64	7.71**	52.30	2.18	84.56**
	Mean	64.43			50.42		
	$(\bar{X}.b)$		0.8678**			0.3779**	
	$(X.S^2d)$		—0.1597			0.0900	
	$(b.S^2d)$		—0.1627			—0.0473	

P* = 0.05

( ) † : Figure in parenthesis indicates oil yield per plant in gms.

Kernel oil content				*Embryo oil content*		
$\bar{X}$ ( ) †		*b*	S^2d	*X*	*b*	S^2d
9		10	11	12	13	14
4.1	(1.886)	2.16	0.03*	35.6	1.63	0.12
4.5	(1.799)	2.60*	0.01*	35.9	1.61	0.93**
5.2	(2.355)	—0.48	0.15**	35.9	—1.35	36.64**
5.3	(2.400)	1.08	0.01	36.9	2.06	0.64*
5.8	(3.000)	1.71	0.04**	34.3	1.62	2.41
5.3	(2.575)	0.94	0.14**	34.6	1.42	—0.02
5.3	(2.840)	0.16	0.02**	31.3	1.66	2.65**
4.3	(1.810)	0.04	0.03**	30.1	—0.01	0.32
3.6	(2.000)	1.19	0.04**	32.2	2.67	15.32**
5.7	(2.525)	1.07	0.05**	32.1	—2.81	20.70**
3.9	(2.265)	1.08	0.01	31.6	—0.04	1.75**
5.2	(2.678)	0.76	0.07**	30.7	—0.04	29.97**
5.4	(2.019)	1.54	0.08**	34.8	—0.18	5.50**
3.7	(2.094)	0.15	0.18**	30.5	0.44	4.15*
3.5	(1.473)	0.86	0.02**	33.5	1.23	—0.14
4.5	(1.699)	0.45	0.10**	32.2	3.60	28.50**
5.5	(2.755)	0.70	0.38**	33.8	1.30	0.41
4.8	(2.980)	0.83	0.09**	31.6	2.26	3.20**
4.3	(2.283)	2.40	0.16**	31.6	0.90	0.51*
4.1	(2.435)	0.14	0.02**	31.5	1.35	2.34**
4.3	(2.756)	—0.40	0.10**	32.1	3.14	4.44**
4.8	(2.308)	—0.65	0.63**	33.3	3.76	3.14**
5.3	(2.300)	—0.51	0.41**	32.9	—0.22	2.17**
5.8	(2.540)	1.30	0.01	33.9	2.62	0.71*
4.1	(2.201)	5.98	0.25**	31.7	2.27	1.96**
4.4	(1.984)	—1.38**	—0.01	32.0	0.94	0.08
5.2	(2.631)	0.65	0.03	31.4	1.04	0.12
5.1	(2.437)	2.09	0.20**	34.8	1.69	4.06**
3.7	(2.157)	4.54	0.06**	31.7	2.02	8.33**
4.7	(2.458)	2.08	0.01**	33.7	1.97	0.09
4.37	(2.203)			32.10		
		—0.1883			0.0531	
		0.0870			—0.0518	
		0.0779			—0.1587	

kernel oil content. It is also important to breed high oil lines having wider adaptability. So far the yield levels of maize strains is not stable over locations and seasons. A planned study regarding stability performance for seed yield and oil content will help in identifying the high oil — high yielding genotypes having wider adaptability.

MATERIALS AND METHODS

Sixty four divergent genotypes of maize were evaluated in a randomized block design with 4 replications at Anand and Godhra during kharif and rabi seasons in 1981-82. Each plot comprised of two rows of 4.5 m length each adopting an inter-row spacing of 0.75 m and intra-row spacing of 0.20 m.

Bulked sibbed samples from each plot were used for estimating kernel oil content and embryo oil content by Ether extraction (A.O.A.C. 1955). As most of the oil is in the germ of maize kernel dissected dried embryos of sibbed kernels were used for estizuating of embryo oil content. Stability parameters were worked out as suggested by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Mean squares due to genotypes and environments were highly significant when tested against both pooled deviation and pooled error for all characters except grain yield in which mean squares due to environments were not significant when tested against pooled deviations indicating that difference due to these factors were real (Table 1). The significant genotypes x environment interactions for characters under study indicated inconsistent behaviour of the genotypes over environments. The significant genotype x environment (linear) interactions indicated that the difference among the regression coefficients pertaining to various genotypes on the environmental means were real. The significant mean squares due to pooled deviations indicated that the linear regression as well as deviations from linearity were the major components for the stability of genotypes for characters under study. The linear components exhibited higher magnitude of mean squares for all characters which indicated that the prediction for most of the genotypes appears to be positive for the characters under investigation. Geerthsen (1980) reported a successful use of linear regression technique in the evaluation and utilization of genotype x environment interaction in predicting yield performance of double cross hybrids.

Earliest silking with below average response and non significant deviation observed for genotypes 26, 27 and 15 indicated their responsiveness to poor environments and were stable. The genotypes viz, 6, 8, 13, 14, 16, 18, 19, 22 having unit regression and non-significant deviation indicated their suitability for average environments but were observed to be invariably late in silking.

Genotype 21 exhibited the highest grain yield, specific adaptation to favourable environments and was unstable (Table 2). G 9 and G 11 having high mean, $b<1$ and significant deviations, whereas G5, G19, G20 and G25 having high mean, $b<1$ and non-significant deviations indicated the superiority of these genotypes in poor farming conditions, the former group showing the unstable performance and later stable performance over environments for grain yield.

For kernel oil content, G13 showed higher mean and better response to favourable

environments whereas G6 and G10 showed higher mean better response to average farming conditions with unstable performance over environments for these genotypes (Table 2). Genotype 4 exhibited high mean response to average farming condition and was stable. Genotype 7, 12 and 17 had higher mean, better response to poor environments with unstability of performance.

For embryo oil content G26 showed average mean, better response to average farming and was stable (Table 2). Genotype 4 exhibited the highest mean, better response to favourable environments with stability of performance, whereas G1 and G2 exhibited higher mean, better response to favourable environments, the former being stable and later unstable. Genotype 3 exhibited higher mean, better response to poor environments and was instable.

The correlation coefficients calculated between three parameters for the characters under study (Table 2) suggested the presence of possible linkage between the genetic systems governing these parameters. Highly significant positive correlation between X and b for days to 50% silking and grain yield indicated that the mean value of these characters could be used in order to judge the stability of these genotypes. The non-significant correlation observed between three parameters of stability suggested that different genetic systems are involved in the control of these parameters for respective characters.

The analysis indicated superiority of genotypes 21, 18 and 29 for grain yield: genotypes 5 and 24 for kernel oil content and genotypes 4, 2, 28 and 5 for embryo oil content under favourable farming conditions. Genotypes, 5, 19, 20 and 25 were promising for grain yield and genotypes 7, 12 and 17 for kernel oil content in poor farming conditions. Genotype 4 showed high kernel oil content in average farming conditions. However, no genotype showed their adaptability to average farming conditions for grain yield. Genotype 13 exhibited higher embryo oil content in poor farming conditions. In general, genotype 30 was a good combination of high yield, high oil and earliness. It is suggested that genotypes of superior performance for each character i.e. grain yield, oil content and earliness may be incorporated in hybridization programme followed by selection based on the knowledge of intercharacter associationship to develop early, high yielding, high oil and stable genotypes of maize suited for specific farming conditions.

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