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DIALLEL ANALYSIS OF EAR MORPHOLOGICAL CHARACTERS IN MAIZE (*ZEA MAYS* L.)

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ABSTRACT

General and specific combining abilities were estimated for ear and grain characters in maize using 6-parent diallel cross excluding reciprocals. Variation due to general combining ability (gca) was highly significant for ear length, ear diameter, ear and cob weight/plant, kernel depth, and 100-kernel weight. Specific combining ability (sca) was very important for kernel depth and ear diameter. Variation due to gca was more pronounced than due to sca indicating the importance of additive gene effects.

Key words: Gca, sca, maize.

Genetic improvement in starch content in maize is a primary focus of our breeding programme. Maize starch is used predominantly for the preparation of ogi, a soft gel porridge. Since whole maize grain was about 60 to 70% starch [1, 2]. It is considered expedient to investigate the mode of inheritance of ear and grain morphological characters in maize.

Gardner [3] reported that additive genetic variance was more important than dominance variance for ear length in maize, while Eberhart and Gardner [4] obtained significant general and specific combining ability (gca, sca) effects for ear length, ear diameter and kernel weight. Shelled corn weight and cob weight were reported to be influenced by gca and sca effects [5]. Cross [6] using set of inbred lines showed that gca and sca effects were significant for kernel depth, kernel rows, ear length and shelling percentage. Grain yield has been reported to be under the influence of additive and dominance gene effects depending on whether the parents are open pollinated or inbred lines [6–8].

This study was undertaken to determine the nature and magnitude of gene action on the ear and grain characters of maize.

MATERIALS AND METHODS

Six cultivars belonging to different maturity, height, grain texture and yield groups were selected for the study: Pool 16 SR, TZESR-W, BC 63, DMR-ESR-W, Pop. 49 SR and Celaya Waxy.

Nonreciprocal crosses were made in diallel fashion. A set of the 15 F_1s without parents and reciprocals were utilized. The experiment was conducted at the Teaching and Research Farm of the University of Benin in randomized block design with three replications. Each plot had three 5-m long rows, spaced 75 cm apart, while plants within the rows were spaced at 50 cm. There were two plants per hill. Data were recorded on ear length, ear diameter, ear weight, cob diameter, cob weight, shelling percentage, and 100-kernel weight. Analysis of variance was done for each variable on plot mean basis and the genotype mean squares were partitioned into gca and sca using procedure of Griffing Method 4, Model 1 [5].

RESULTS AND DISCUSSION

The average performance of parents in crosses for eight ear and grain characters is presented in Table 1. Ear length ranged from 12.3 to 14.3 cm with a mean of 13.5 cm. Ear diameter with a mean of 2.7 cm ranged between 2.56 cm for Waxy maize and 2.9 cm for BC 63. Variation in cob diameter was similar to that of ear diameter with BC 63 recording the highest value of 1.3 cm and Waxy with the lowest value of 0.84 cm. Average ear weight was 95.2 g/plant with range of 76.5 g for Pool 16 SR, an early maturing variety to 114.8 g for BC 63, a late maturing variety. Variation for shelling percentage was minimum with the range of 79.6 to 83.4%. Kernel depth was the highest for BC 63 (1.68 cm) and lowest for Pool 16 SR

Table 1. Mean performance of parents for ear morphological characters of maize

Parent	Ear length (cm)	Ear diameter (cm)	Cob diameter (cm)	Ear wt. (g)	Cob wt. (g)	Shelling percen-tage	Kernel depth (cm)	100-kernel wt. (g)
Pool 16 SR	12.3	2.62	1.24	76.5	9.96	81.0	1.38	31.0
TZESR-W	13.4	2.58	1.10	92.6	11.28	81.7	1.52	37.8
BC 63	14.3	2.94	1.30	114.8	16.14	81.4	1.68	46.8
DMR-ESR-W	14.0	2.62	1.16	100.22	12.26	83.4	1.48	41.7
Pop 49 SR	13.0	2.68	1.26	94.5	12.96	80.4	1.42	38.4
Celaya Waxy	14.2	2.56	0.94	92.3	12.00	79.6	1.60	36.8
Mean	13.5	2.70	1.20	95.2	12.40	81.3	1.50	38.8

(1.38 cm). Kernel weight varied between 31.0 g in Pool 16 SR and 46.8 g in BC 63. The average kernel weight over all crosses was 38.8 g.

Mean squares for crosses, gca and sca for eight characters are presented in Table 2. Variation among crosses was highly significant (P < 0.01) for all the traits except shelling percentage. Mean squares for gca were also highly significant (P < 0.01) for all the characters except shelling percentage. Mean squares for sca were significant only for ear diameter and kernel depth. There was preponderance of variation due to gca as compared to sca for ear length. The gca:sca ratio was moderate for ear and cob diameters, ear and cob weights, and 100-kernel weight, while it was low for shelling percentage and kernel depth.

Table 2. Mean squares for combining ability analysis for ear characters in maize

Source	d.f.	Ear length	Ear dia-meter	Cob dia meter	Ear wt.	Cob wt.	Shelling percent age	Kernel depth	100-kernel wt.
Cross	14	4.98**	0.19**	0.155**	13.4**	40.0**	19.7	0.16**	990.0**
Gca	5	4.0**	0.13**	0.10**	965.1	27.0	10.2	0.08**	687.8**
Sca	9	0.32*	0.03*	0.02	181.4	5.7	4.5	0.04**	131.7
Error	28	0.37	0.01	0.02	90.7	3.6	10.7	0.01	64.6
Gca : Sca		12.72	4.33	5.00	5.3	4.7	2.3	2.00	5.2

*,**Significant at 5% and 1% levels, respectively.

The gca effects for the eight variables of six varieties are presented in Table 3. BC 63 contributed positively to ear length while Pool 16 SR and Pop. 49 SR reduced ear length. Pool 16 SR and Pop. 49 SR are characterized by very early maturity. BC 63 and Pop. 49 SR contributed positively with greater gca effects for ear and cob diameters. TZESR and Waxy maize contributed disproportionately to ear size. Favourable genes for higher ear weight, kernel depth and 100-kernel weight were predominantly contributed by BC 63 and DMR-ESR-W. Pool 16 SR had high negative gca effects for ear length, ear weight and cob weight. Although mean squares for gca and sca were not significant for shelling percentage, DMR-ESR-W gave the highest gca values for these characters. However, Cross [6] reported significant gca and sca effects for shelling percentage using inbred lines.

The preponderance of variance due to gca as compared to sca for all the characters except shelling percentage indicates that the additive component of variation was highly predominant in the parental population. Therefore, improvement in ear and grain characters could be achieved using simple recurrent selection. The relatively lower level of

Table 3. Estimates of general combining ability effects of parents for ear characters in maize

Parent	Ear length	Ear diameter	Cob diameter	Kernel depth	100-kernel wt.	Ear wt.	Cob wt.	Shelling percentage
Pool 16 SR	-1.56	-0.08	0.09	10.18	19.30	-23.27	-3.08	-0.34
TZESR-W	-0.14	-0.09	-0.09	-0.02	-2.35	-3.20	-1.48	0.56
BC 63	1.01	0.35	0.16	0.20	20.07	24.51	4.62	0.16
DMR-ESR-W	-0.57	-0.06	-0.01	-0.05	7.40	6.35	-0.21	2.66
Pop. 49 SR	-1.74	0.02	0.12	-0.10	-0.96	-0.93	0.67	-1.02
Celaya Waxy	0.86	-0.14	-0.27	0.12	-4.85	-3.55	-0.54	-2.04

significance of sca for most of the characters may be associated with the genetic make-up of the parents. Beck et al. [9] reported almost complete absence of sca effects for agronomic traits where broad based maize populations and gene pools of CIMMYT were evaluated in a diallel cross. Assuming that the sca effects are a measure of heterosis, the results of this study indicates that heterosis was more pronounced for ear diameter and kernel depth. Highly significant sca for kernel depth was indicative of the importance of nonadditive genetic variance and this character may be improved through reciprocal recurrent selection. BC 63, an unimproved landrace cultivar, appears to have the highest positive gca effects for the majority of characters and could, therefore, be utilized in breeding programmes.

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