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Short Communication

Combining Ability Analysis for Fodder Yield and its Component Traits in Sorghum under Rainfed Vertisol

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A great deal of exploitation of heterosis has been achieved on the development of single cross hybrids in grain sorghum (*Sorghum bicolor* (L.) Moench). However, of late, the trend has been to intensify genetic diversity in the form of three-way crosses, which not only reduce the cost of seed production, but will also provide a broad genetic base to stabilize yields under aberrant weather. Kide *et al.* (1982) reported that development of grain sorghum is the most important genetic tool in improving yields. Ross and Kofoid (1978) utilized sterile F_1s for production of three-way crosses in grain sorghum. No reports were known on production of single and three-way crosses in fodder sorghum type, and hence, this experiment was undertaken to evaluate the male (A and B) and restorer (R) lines developed from exclusively fodder type and those combinations of single and three-way crosses.

Three male sterile lines, viz., (A) Ms 430 A, Ms 700 A and Ms 1112 A, and their maintainer (B) were intermated to produce three sterile single crosses. These sterile single crosses (A x B) were in turn crossed with 15 restorers (R) of fodder types, viz., Ks 7657, K 10, K 7, S 208, S 241, S 287, HC 136, HC 260, PC 64, PC 123, SU 52, UPFS 23, KSPS 7, IARI 13 and SSV 74 to produce 45 three-way crosses [(A x B) x R]. Similarly, each males-sterile (A) line was crossed with each restorer (R) to develop the seed of 45 fertile single crosses (A x R). Thus, three maintainers (B), 15 restorer (R), three sterile single crosses (A x B), 45 fertile single crosses (A x R), and 45 three-way crosses (A x b) x R were evaluated in a randomized block design with three replications during winter season of 1995-96 under rainfed vertisol of Agricultural Research Station, Kovilpatti. Each genotype was represented by a single row of 3 metre length with 45 cm inter-row and 15 cm intra-row spacing. Data on plant height, stem girth, number of leaves per plant, leaf length, leaf breadth, leaf: shoot ratio and dry fodder yield per plant taken from 10 plants at random were recorded. All the data were analyzed for combining ability as described by Kempthorne (1957).

The mean performance of the two hybrid types was higher than the parents in five component traits, viz., plan height, stem girth, number of leaves/plant, leaf length and leaf breadth. The restorers' performance was higher than in single and three-way crosses in respect of characters, viz., dry fodder yield and leaf:shoot ratio. However, the mean performance of three-way crosses

Table 1. Mean performance of parents and hybrids - fodder yield and its component traits

Genotypic group	Dry fodder yield (g)	Plant height (cm)	Stem girth (cm)	Number of leaves per plant	Leaf length (cm)	Leaf breadth (cm)	Leaf shoot ratio
Parents	120.79	241.00	1.77	9.64	64.96	6.10	43.94
Maintainers (B)	76.63	153.00	1.57	8.97	63.30	5.80	38.60
Restorers (R)	134.51	271.79	1.78	9.86	63.69	6.17	45.32
Sterile single crosses (A x B)	96.38	194.31	1.95	9.16	73.00	6.06	42.35
Single crosses (A x B)	115.34	289.11	1.97	10.81	76.15	7.07	38.85
Three-way crosses (A x B) x R	116.46	288.17	1.93	10.91	75.41	7.29	42.46
SE ±	1.39	5.78	0.03	0.39	1.42	0.24	1.27

was at part with that of single crosses. The use of heterozygous females showed intermediate performance for all characters except stem girth. It failed to show the expected heterozygote advantage except in specific combinations (Table 1).

The variances of genéral combining ability (σ^2 gca) were larger than that of specific combining ability (σ^2 sca) in single cross hybrids for dry fodder yield (60.70/1.61), leaf length (10.98/4.86), leaf breadth (0.28/0.05), and leaf: shoot ratio (21.80/-12.34), indicating predominance of additive gene action, whereas plant height (-273.44/28.19), stem girth (-0.22/0.01) and number of leaves/plant (-0.02/0.11) showed non-additive gene action. In three-way crosses, the specific combining ability variances was higher in magnitude for the traits, viz., dry fodder yield (-4.61/20.62), plant height (-233.62/24.13), stem girth (-0.01/0.01) and leaf: shoot ratio (7.58/14.04), expressing non-additive gene action, whereas additive gene action was noticed in the remaining traits namely number of leaves/plant (0.59/0.01) leaf length (38.65/1.04) and leaf breadth (0.07/0.02). Bhale (1977) and Kide *et al.* (1982) also reported non-additive gene action for plant height in grain sorghum. The male parent viz., Ks 7657 (34.06**/28.99**) K 10 (30.16**/23.83**), K 7 (30.12**/19.03**), HC 260 (20.92**/24.78**) and IARI 31 (17.08**/25.16**) showed significant positive gca effects for dry fodder yield in both the groups of hybrids. Among these, the parents, viz., Ks 7657 and K 10 also exhibited significant positive gca effects for other component traits except in leaf breadth and leaf:shoot ratio in three-way crosses. Hence, these two parents produced significant dry fodder yield in both groups of hybrids, as evident by sca effects and are expected to produce desirable segregants for high dry fodder yield. The female parent Ms 430 A showed good combiner for all traits in single crosses and Ms 430 A x 1112 B was a good combiner in three-way crosses for the dry fodder yield and other three component traits, viz., plant height, stem girth and leaf breadth. Hence, these parents may be utilized for dry fodder improvement programme.

The parents, viz., Ms 430 A (1.27**), Ms 430 A x 1112 B (0.95**) and Ks 7657 (34.06**/28.99**) revealed desirable gca effects for dry fodder yield. Out of 45 single cross hybrids, 15 hybrids showed significant sca effects for dry fodder yield and six hybrids out of 15 possessed Ms 430 A as female parent. Similarly, 18 hybrids exhibited significant sca effects in three way crosses, of which eight hybrids possessed Ms 430 A x 1112 B as female parent. Under this situation, the maximum fodder production may be attained with a system that can exploit both additive and non-additive effects simulataneously. In general, Ms 430 A and Ms 430 A x 1112 B showed superior performance in respect of fodder production to other two female lines in single and three-way crosses, respectively. The females in heterozygote condition (A x B) did not show sufficient diversity for most of the characters. So, to produce maximum genetic diversity new cytoplasmic sources for male-sterility may be exploited. Bhale (1977) reported that such sources are available in shallu, hegori and feterita group of sorghum.

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