Research Note

Increasing Seed Set in Hybrid Sorghum by Manipulating Flowering Synchrony

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ABSTRACT

One of the problems with hybrid seed production is synchronising the flowering of the parental lines. For the sorghum hybrid Punjab Sudex Chari-1 (*Sorghum bicolor* (L.) Moench x *Sorghum sudanense* (Piper) Stpaf), the parents flower some 12-15 days apart. For a 2 : 6 male to female row ratio, manipulating the flowering of the male parent by cutting to 45 mm above ground level at the four leaf stage (22 days after sowing) synchronised flowering of the parent lines, and seed yield was increased by 18%. Cutting the male parent at the six and eight leaf stages did not improve flowering synchrony and significantly reduced seed yield, while doubling the sowing rate of the male parent did not alter seed yield.

Additional index words: **Punjab Sudex Chari-1, ratooning, sowing rate, seed yield.**

EXPERIMENTAL AND DISCUSSION

Appropriate technologies for hybrid seed production are sometimes a limiting factor in the commercial success of a hybrid. The Punjab Agricultural University has recently released a multicut fodder sorghum hybrid (*Sorghum bicolor* (L.) Moench x *Sorghum sudanense* (Piper) Stapf) named Punjab Sudex Chari-1, and one problem encountered in the production of seed of this hybrid is the synchronisation of flowering of the parental lines.

The staggered sowing of parental lines is one method for improving flowering synchrony (Umashanker and Bommegowda, 1983), although environmental conditions may affect the response (Vadivelu, Krishnasamy and Ramaswamy, 1983). Selective irrigation, fertilizers and seed soaking may also narrow the gap between flowering, although usually only marginally (Singh, Bhale and Borikar, 1984). If the gap between the flowering of the parents is greater than 10 days (it is 12-15 days for Punjab Sudex Chari-1), then ratooning (leaf cutting) of the early parent may be an option (Vilichku, Pavlenkova, Spitsine and Abbasov, 1991), although the time of cutting is obviously important. The aim of our work was to maximise seed yield of the fodder sorghum hybrid Punjab Sudex Chari-1 by manipulating plant density and leaf cutting of the male parent.

The study was conducted at the Punjab Agricultural University seed farm (30°-56' N latitude, 75°-52' E longitude) in the summer (Kharif) of 1993. The parental lines were sorghum 2077-A as the female parent and sudangrass SGL-87 as the male parent. The trial site was isolated from any other sources of pollen.

Plot size was 16 x 10m and three replicates of each treatment were arranged in a randomised block design. Seed of the parental lines was hand sown on 29 July 1993 at 10 kg ha^{-1} for the female line and 6 kg ha^{-1} for the male line and at row spacings of 500 mm. For each plot the male/female row ratio was 2 male to 6 female. Treatments were control (no leaf cutting of the male parent), leaf cutting of the male parent at either the four, six or eight leaf stage, and doubling the sowing rate of the male parent (but no cutting). Plants were cut to around 45 mm above ground level. All rows were aligned north-south, which was perpendicular to the wind direction.

Days from sowing to first flowering and the number of days until 50% of the plants had begun flowering were recorded for all the male parent treatments plus the female parent. Seeds per panicle were determined by removing five panicles at random from each row just prior to harvest and counting the number of seeds present. Plots were hand cut, seed was hand threshed and screen cleaned, and seed yield and thousand seed weight recorded.

Seed yield for the control was 624 kg ha^{-1} (Table 1). Seed yield was significantly increased by cutting the male parent at the four leaf stage, because more seeds were present in each panicle (Table 1). Cutting the male parent at the six and eight leaf stages significantly reduced seed yield because seeds per panicle were reduced (Table 1), while doubling the sowing rate of the male parent had no effect on seed yield. Thousand seed weight did not differ among the treatments (Table 1).

The female parent took 70 days after sowing (DAS) to flower, and had reached 50% flowering by 76 DAS (Table 2). In contrast the male parent (control) first flowered 56 DAS and had reached its 50% flowering by 68 DAS (ie before the female parent). Cutting the male parent at the four leaf stage brought its flowering into synchrony with the female parent (Table 2), and hence seeds per panicle and seed yield were increased. While cutting at the six and eight leaf stages delayed flowering so that the 50% flowerings of the male and female parents did not coincide, seed was still set because of the availability of flowers beyond the 50% flowering period. In sorghum the stigma is receptive for more than 12 days

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Table 1 Effect of manipulation of the male parent on seed yield, seeds per panicle and thousand seed weight (TSW) for the F1 hybrid

Treatment	Seed yield (kg ha^{-1})	Number of seeds per panicle	TSW (g)
Control	624	1803	20.3
Cut four leaf stage	739	2241	20.4
Cut six leaf stage	535	1364	20.1
Cut eight leaf stage	163	292	19.9
Dense sowing rate	640	1892	20.4
LSD P<0.01	39	174.9	NS

Table 2 Effect of manipulation of the male parent on synchronisation of flowering.

Treatment	Days from sowing to first flowering	Days from sowing to 50% flowering	Time to 50% flowering (days)
Female line (2077A)	70	76	6
Control	56	68	12
Cut four leaf stage	66	77	11
Cut six leaf stage	84	94	10
Cut eight leaf stage	96	104	8
Dense sowing rate	55	71	16

Table 3. Effect of manipulation of the male parent on seeds per panicle for each row of the female line (2077A)

Treatment	Row Number					
	1	2	3	4	5	6
Control	2068	1987	1574	1380	1722	2085
Cut four leaf stage	2562	2452	2043	1747	2184	2456
Cut six leaf stage	1663	1461	1058	805	1574	1620
Cut eight leaf stage	362	372	255	236	288	235
Dense sowing rate	2209	2198	1509	1331	1735	2370

(Jaster and Miller, 1985), and flowers within a panicle bloom for 6 to 10 days.

Seed number per panicle declined with increasing distance from the pollen source. That is, as the male parent was sown on the outer edge row of each plot, seed number per panicle was usually greatest for rows 1 and 6 of the female parent and lowest in rows 3 and 4 (Table 3). Krishnasamy and Ramaswamy (1984) demonstrated that wind direction and distance from the pollen source influenced seed setting of a male sterile line of sorghum, and therefore wind direction can have a significant effect *ie* it must be able to move pollen from the source to the female rows.

Under the conditions at this site and with a 2:6 male/female ratio, cutting the male parent at the four leaf stage (which was 22 days after sowing) significantly increased seed yield of this hybrid, and this practice should be adopted for commercial seed production.

REFERENCES

1. Jaster, J.R. and Miller, F.R. 1985. Analysis of seed set and stigma receptivity among cytoplasmic male sterile sorghum cultivars. *Sorghum Newsletter* 28: 130-131.

2. Krishnasamy, V. and Ramaswamy, K.R. 1984. Determination of extent of seed set in the male sterile plants as influenced by the distance of pollen source. *Madras Agricultural Journal* 71 (9): 627-628.

3. Singh, A.R., Bhale, N.L. and Borikar, S.T. 1984. Induction of early flowering by simple water soaking treatment in 2077A. *Sorghum Newsletter* 27: 134.

4. Umashanker, M. and Bommegowda, A. 1983. Hybrid seed production studies in CSH-5 sorghum. *Sorghum Newsletter* 26: 7-8.

5. Vadivelu, K.K., Krishnasamy, V. and Ramaswamy, K.R. 1983. Further studies on the flowering behaviour of the parental lines of CSH-5 and Kavilpatti tall sorghum hybrid under coimbatore conditions. *Madras Agricultural Journal* 70 (9): 615-617.

6. Vilichku, F.K., Pavlenkova, I.A., Spitsine, N.A. and Abbasov, G.G. 1991. Method of synchronising the flowering of parental forms. *Kukuruza-i Sorgo* 5: 38-41. (*Plant Breeding Abstracts* 62: 6872).