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Short Communication

# Restoration studies involving *milo* and *maldandi* sources of male sterility in sorghum [*Sorghum bicolor* (L.) Moench]

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The lone or only source of cytoplasmic-genetic male sterility in sorghum [*Sorghum bicolor* (L.) Moench] used extensively for commercial hybrid seed production is the *milo* source [1]. The hazards of such a narrow cytoplasmic base are apparent and consequently new diverse sources like A2, A3, A4, *maldandi*, VZM and G1 were identified [2, 3, 4]. However, the commercial exploitation of these sources has not been possible because of the difficulty in fertility restoration on these sources. *Maldandi and* A2 sources can be utilized more easily compared to the other sources [5, 6]. The present investigation was conducted with an aim to identify stable restorers for the *maldandi* and *milo* sources of cytoplasm. For this purpose, diverse germplasm accessions representing various regions were selected to study their sterility maintenance/fertility restoration abilities on *milo* and *maldandi* sources of male sterility.

The male sterile lines used in this study were 104A and M31-2A representing *milo* and *maldandi* sources of male sterility, respectively. Twenty-seven genotypes representing various regions were crossed to each of these two male sterile lines and were grouped under the headings, *milo* based hybrids (Set-I) and *maldandi* based hybrids (Set-II), respectively. Twenty-seven hybrids each of Set-I and Set-II were planted during *rabi* 1999-2000 at two locations *viz.*, Dharwad and Bijapur. The hybrids were grown each in a single row of four meters length with spacing of 45 cm × 15 cm. Three heads from each row were bagged three days before stigma emergence and the observations on seed set percentage were noted. Seed set percentage was calculated by counting the number of seeds set out of the total number of spikelets per earhead.

Out of twenty seven genotypes, except two genotypes *viz.*, R 9808 and Madhabavi local which were found to be maintainers the remaining 25 restored fertility on *milo* source of cytoplasm (104A) at both the locations (Dharwad and Bijapur) (Table 1). The average seed set values on *milo* based hybrids were 67.20 and 72.91 per cent at Dharwad and Bijapur, respectively. On *maldandi* source of cytoplasm, only three crosses

**Table 1.** Seed set percentage in $F_1$ hybrids derived from two male sterile lines having *milo* and *maldandi* cytoplasms and twenty-seven male parents during *rabi* 1999-2000.

| Female parents | Seed set percentage in hybrids 104A (*milo*) | | M31-2A (*maldandi*) | |
|---|---|---|---|---|
| Male parents | Dharwad | Bijapur | Dharwad | Bijapur |
| 1. Barsi Prakash | 70.0 | 85.4 | S* | S |
| 2. BRJ 185 | 85.2 | 75.4 | S | S |
| 3. SPV 1090 | No germination | 65.6 | S | S |
| 4. SPV 462 | 80.0 | 80.4 | S | S |
| 5. SPV 1445 | 50.0 | 60.5 | S | S |
| 6. IS 33742 | 50.3 | 66.7 | S | S |
| 7. GRS 1 | 86.4 | 80.4 | S | S |
| 8. BRJ 171 | 47.7 | 55.7 | S | S |
| 9. Muddi hali jola | 69.6 | 80.4 | S | S |
| 10. R 9808 | S | S | S | S |
| 11. BRJ 67 | 19.8 | 56.4 | 60.4 | 73.3 |
| 12. IUS 177 | 72.0 | 90.4 | S | S |
| 13. IUS 113 | 47.7 | 58.4 | S | S |
| 14. SPV 570 | 70.0 | 70.4 | S | S |
| 15. SPV 1460 | 86.3 | 85.3 | S | S |
| 16. CR 9 | 83.9 | 85.7 | 73.3 | 80.6 |
| 17. RS 29 | 56.5 | 69.5 | S | S |
| 18. Honnutagi local | 80.6 | 95.4 | S | S |
| 19. 9-13 | 69.6 | 65.4 | S | S |
| 20. M 35-1 | 76.4 | 75.5 | S | S |
| 21. M 148-138 | 71.0 | 77.4 | S | S |
| 22. RS 615 | 69.6 | 75.4 | S | S |
| 23. RS 585 | 75.5 | 70.3 | S | S |
| 24. Madhabavi local | S | S | S | S |
| 25. IUS 195 | No germination | 76.3 | S | S |
| 26. KSV 18R | 52.5 | 57.5 | S | S |
| 27. BRJ 62 | 73.6 | 63.3 | 70.2 | 74.5 |
| Average | 67.2 | 72.9 | 67.9 | 76.1 |

*S-Sterile

corresponding to male lines BRJ 67, CR 9 and BRJ 62 restored fertility at both the locations. Other 24 genotypes have been found to be maintainers. The mean seed set percentage of the fertile *maldandi* based hybrids was higher at Bijapur (76.12%) compared to Dharwad (67.91%).

Of the 27 genotypes, only three genotypes *viz.*, BRJ 67, CR 9 and BRJ 62 have been found to be common restorers on *milo* (104A) and *maldandi* (M31-2A) sources of cytoplasm. This clearly indicated that, identification of stable restorers on *maldandi* source as compared to that on *milo* source of male sterility is a tough task. Some earlier studies have also identified common restorers on *milo* and *maldandi* sources of cytoplasm [5, 7]. The identification of common restorers helps to develop alloplasmic hybrids. Of the 25 restorers on *milo* (104A) cytoplasm, six restorers *viz.*, Honnutagi local, SPV 1460, CR 9, IUS 177, BRJ 185 and SPV 462 have been found to show stable and high fertility restoration (mean seed set > 80%) across both the locations (Table 2), whereas, on the *maldandi* cytoplasm (M31-2A) none of the restorers could exhibit mean seed set greater than 80% across the two locations.

**Table 2.** Restorers showing stable and high restoration (more than 80% seed set) at two locations

| Sl. No. | Restorer line | Seed set percentage | | |
|---|---|---|---|---|
| | | L-I (Dharwad) | L-II (Bijapur) | Mean |
| I | On *milo* | | | |
| 1. | Honnutagi local | 80.6 | 95.4 | 88.0 |
| 2. | SPV 1460 | 86.3 | 85.3 | 85.8 |
| 3. | CR 9 | 83.9 | 85.7 | 84.8 |
| 4. | IUS 177 | 72.0 | 90.4 | 81.2 |
| 5. | BRJ 185 | 85.2 | 75.4 | 80.3 |
| 6. | SPV 462 | 80.0 | 80.4 | 80.2 |
| II | On *maldandi* | | | |
| 1. | CR 9 | 73.3 | 80.6 | 76.95 |

On both *milo* (104A) and *maldandi* (M31-2A) based hybrids, average seed set percentage was found to be higher at Bijapur compared to Dharwad. This difference appears to be mainly due to difference in flowering period and prevailing minimum temperature at the time of flowering. Majority of the hybrids at Dharwad flowered during first standard week of January 2000 during which the mean minimum temperature was 12.3°C (Table 3). Whereas at Bijapur, the flowering of the majority of the hybrids coincided with the fiftieth standard week of 1999 during which the mean minimum temperature of the week was 14.8°C. Several workers have recorded the influence of low temperature on seed set percentage in sorghum hybrids. Night temperature of 13°C or less during flowering affects seed set percentage (8).

**Table 3.** Period of flowering of hybrids and mean/range of minimum temperature during flowering

| Location | Total number of hybrids | Number of hybrids flowered | | Standard week of the year | Minimum temperatures (°C) | |
|---|---|---|---|---|---|---|
| | | *Milo* | *Maldandi* | | Range | Mean |
| I. Dharwad | 27 | a) 20 | 20 | 1 (1-7 Jan 2000) | 11.1 to 13.8 | 12.3 |
| | | b) 07 | 07 | 2 (8-14 Jan 2000) | 12.9 to 19.4 | 16.9 |
| II. Bijapur | 27 | a) 25 | 24 | 50 (10-16 Dec 1999) | 14.0 to 15.3 | 14.8 |
| | | b) 02 | 03 | 51 (17-23 Dec 1999) | 14.9 to 16.1 | 15.5 |

The present study clearly indicated that the seed set percentage in hybrids with similar restorers varied considerably across locations, depending upon the prevailing minimum temperature during flowering. In the present study although six restorers exhibited a high seed set percentage across locations on *milo* source of male sterility, none did on *maldandi* source. Hence, there is an urgent need to identify restorers which are tolerant to lower minimum temperature and exhibit high and stable seed set particularly on *maldandi* source of male sterility to develop commercial hybrids on *maldandi* source.

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