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# Screening of Pearl Millet Genotypes for Supra Heat Tolerance

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AICRP on Pearl Millet (ICAR), ARS, Mandor, Jodhpur (Raj.)-342304

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**Abstract**

A nursery comprising of 90 lines (80 B and 10 R lines) and a Heat Tolerant B Composite was evaluated at Mandor, along with 5 hybrid checks. 2 heat tolerant (86M11, 86M64), 3 heat susceptible (ICMB 04555, ICMB 10999 and ICMR 08666) for flowering period heat stress during Summer-2014. Data loggers (U23-001, HOBO Pro v2 Temp/RH) were installed in the experimental area at panicle height and programmed to record weather variables every one hour. At dough stage, seed set was recorded on randomly selected plants. Finally, data were considered only for those plants which got exposed to air temperatures of ≥42$^{o}$C during flowering time. Hybrid 86M11 had highest seed set (68%) amongst checks and it was followed by 86M64 with (54%), while the susceptible checks had 0.0 to 15% seed set. Among identified designated seed parents ICMB 02333, ICMB 04888, ICMB 04999, ICMB 05666, ICMB 06555 and ICMR 09222 had seed set of >50%, and 5 other B-lines (non designated) had seed set of ≥ 50%. Seed set in heat tolerant B composite varied from 55 to 90%.

**Key Words** Hybrid, composite, heat tolerant, seed set%, B-lines, R-lines.

**Introduction**

Pearl millet (*Pennisetum glaucum* (L). R. Br.) known variously in different Indian and foreign languages has a protogynous habit of flowering, making it a highly cross-pollinated crop. Being a $C_4$ plant, it has very high photosynthetic efficiency and dry matter production capacity. The crop is better adapted to driest and marginal soils than most other cereals. It is often cultivated under extremely harsh conditions of frequent drought, high temperature, low and erratic rainfall, and infertile soils with poor water holding capacity. It may even produce some grain and fodder in areas where annual rainfall is less than 300 mm.

India has the largest area (7.95 millon ha) with 8.79 millon tons of production (Project Coordinator Review 2014). Pearl millet is ranked third after rice and wheat and is grown in Rajasthan, Maharastra, Gujrat, Uttar Pradesh, Harayana, Tamil Nadu, Andhra Pradesh and karnataka. Drought, heat and poor soil fertility, structure are the most important factors associated with pearl millet cultivation. They usually occur in combination, leading to the low average grain yield of the crop (Andrews and Bramel-Cox 1993).

Heat stress affects plant growth throughout its ontogeny, though heat-threshold level varies considerably at different developmental stages. For instance, during seed germination, high temperature may slow down or totally inhibit germination, depending on plant species and the intensity of the stress. Based on a complete understanding of such mechanisms, potential genetic strategies to improve plant heat-stress tolerance include traditional and contemporary molecular breeding protocols and transgenic approaches. While there are a few examples of plants with improved heat toler-

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ance through the use of traditional breeding protocols, the success of genetic transformation approach has been thus far limited. The latter is due to limited knowledge and availability of genes with known effects on plant heat-stress tolerance, though these may not be insurmountable in future. The present study was undertaken to identify the heat tolerant breeding material to the utilized in future breeding programmes for development of heat tolerant cultivars.

**Materials and Methods**

The present investigation was carried out at All India Coordinated Research Project on Pearl Millet, A.R.S. Mandor, Jodhpur during summer - 2014. A nursery comprising of 90 lines (80 B and 10 R lines) and a Heat Tolerant B Composite was evaluated at Mandor, along with 5 hybrid checks. 2 heat tolerant (86M11, 86M64), 3 heat susceptible (ICMB 04555, ICMB 10999 and ICMR 08666) for flowering period heat stress. Nursery was planted on 3 different dates (08.03.2014, 18.03.2014, and 28.03.2014) at intervals of about 10 days to coincide the temperatures of $\geq 42^{o}C$ with flowering in at least one of the planting dates. Thirty one hybrid seed parents (21 designated seed parents and 10 designated restorer parents) identified with high seed set (AICPMIP 2013) were planted in augmented plot design in each of planting dates. Row length was 2m, and plants within the rows were spaced at 10-15cm. Heat Tolerant Composite was planted in 20 rows in each planting date. Check hybrids (both heat tolerant and susceptible) were planted after every 20 row in the nursery. At boot leaf stage five randomly selected plants were tagged. On each tagged plants date of boot leaf stage was recorded. After complete seed set, the panicles were bagged to protect from bird damage. Percent seed set data for panicles at dough stage was recorded. Data loggers (U23-001, HOBO Pro v2 Temp/RH) were installed in the experimental area at panicle height at Mandor and were programmed to record weather variables at an interval of every one hour. Normal package of practices were followed to raise good crop and the nursery was irrigated at regular intervals to avoid moisture stress in the field.

**Results and Discussion**

An examination of data on heat tolerance presented in Table-1 revealed that Hybrid 86M11 had highest seed set (68%) amongst checks and it was followed by 86M64 with (54%), while the susceptible checks had 0.0 to 15% seed set. Among identified designated seed parents ICMB 02333, ICMB 04888, ICMB 04999, ICMB 05666, ICMB 06555 and ICMR 09222 had seed set of >50%, and 5 other B-lines(non designated) had seed set of ≥ 50%. Seed set in heat tolerant B composite varied from 55 to 90%.

The parental lines (seed parent and restorer) identified with high seed set under high heat stress will open up opportunity for development of heat tolerant hybrids after undertaking genetics of heat tolerance through using appropriate mating designs such as line x tester, diallel etc. A major challenge in conventional breeding for heat tolerance is the identification of reliable and effective screening methods to facilitate detection of heat-tolerant plants. The screening methods and their validation for heat tolerance to identify superior heat tolerant genotypes. It also describes the genetic mechanisms and nature and magnitude of different types of gene actions involved in the inheritance of supra-optimal temperature tolerance in pearl millet.

**Temperatures (max. and min.) and RH (max. and min.) at Mandor during flowering period in summer heat screening nursery 2014**

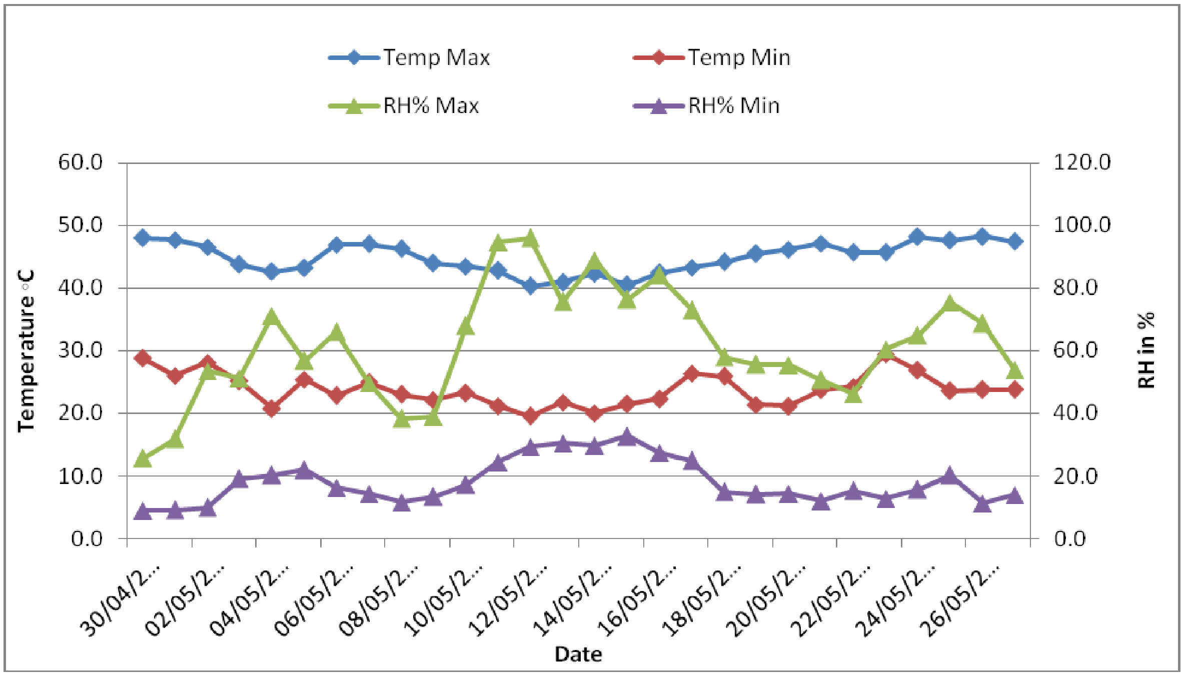


**Table 1: Seed set of parents, composite and checks evaluated for heat tolerance at Mandor during Summer-2014**

| S. No. | Entry | Seed Set % (mean of number of plants exposed to ≥ 42◦C) |
|---|---|---|
| 1 | ICMB 02333 | 58.3 |
| 2 | ICMB 04888 | 55.1 |
| 3 | ICMB 05666 | 54.3 |
| 4 | ICMB 004999 | 54.0 |
| 5 | ICMB 06555 | 52.8 |

| | | |
|---|---|---|
| 6 | ICMR 09222 | 52.0 |
| 1 | (ICMB 01666 x ICMB 01222)-49-1-2-7-B | 61.9 |
| 2 | {(MC 94 S1-34-1-B x HHVBC)-16-2-1-1-1-1-B-B-5 x (MC 94 S1-34-1-B x HHVBC)-10-4-1-2-1-B-B-1-30-2-4-3-3 | 59.5 |
| 3 | (ICMB 04888 x ICMB 02333)-3-1-3-1 | 52.1 |
| 4 | (ICMB 99555 x ICMB 00555)-5-4-3-B-B-3 | 51.3 |
| 5 | (EEDBC S1-425-2-1-2-3-B-1-B-8-1 x B-bulk (3981-4011/S06 G1))-3-3-3-B | 50.3 |
| 1 | HT Composite | 55-90 |
| **Checks** | | |
| Susceptible | ICMB 04555 | 0.0 |
| Susceptible | ICMB 10999 | 15.0 |
| Susceptible | ICMR 08666 | 3.3 |
| Tolerant | 86M11 | 68.3 |
| Tolerant | 86M64 | 54.0 |

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