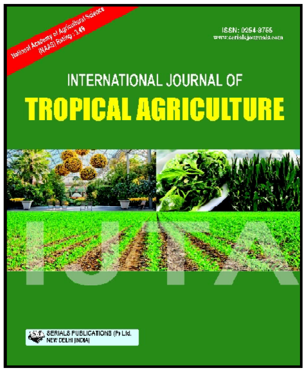


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# Evaluation of Pearl Millet Genotypes for their Response to Climate Change

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***Abstract:*** Climate change has major impact on ecosystems and human beings across all the continents and oceans (IPCC 2014). Global Inter-Governmental Panel on Climate Change (IPCC, 2007) reported that due to increase in greenhouse gases, the global mean annual temperature was recorded higher by 0.40-0.76 %. In this concern Pearl millet is the most important cereals grown in semi-arid areas. In this order to improved efficiency of breeding programs and releasing new cultivars in these areas, the best drought resistant criteria as a good selection index should be recognized. Here in this study, an experiment was conducted on eight hybrids and four populations including three checks in Randomized Block Design (RBD) with three replications under normal and drought stress conditions at the research farm of AICRP on pearl millet centre, Mandor during kharif 2013-14. The observations were recorded on grain yield, stover yield, drought susceptibility index (DSI), drought tolerance efficiency (DTE), grain reduction percentage and harvest Index. Maximum grain yield was recorded for MP 1790 (2028 kg/ha) under irrigated conditions recorded while it was highest for genotype MP 520 (1547kg/ha) under terminal stress conditions. Genotype MP 1790 was observed to higher stover yield (5722 kg/ha) under irrigated condition. The lowest drought susceptibility index (DSI) in MPMH 17 (0.361) which shows genotypes better adaption under present climate change condition.

***Key words:*** Drought, Pearl Millet, Agrometerology, Drought Susceptibility Index (DSI), Drought Tolerance Efficiency (DTE)

## INTRODUCTION

India is the largest producer of pearl millet (*Pennisetum glaucum* (L.) R. Br.). It occupies third position among the cereals which is next is to rice and wheat, both in terms of area (7.10 mha) and production (9.18 mt) with an average productivity of 1272 kg/ha (Yadav and Kumar, 2016). Drought is the major constraint which trims down the production of crop. It is known that pearl millet thrives well under drought prone condition. However, there is a greater variability for yield performance of different pearl millet genotypes under drought situation. Efforts to measure the degree of tolerance with a single parameter has limited value because of the multicity of the factors and their interactive condition. Different workers used different methods to evaluate genetic differences in drought tolerance (Bidinger *et al.,* 1982). One of the greatest challenges in drought is to sow a seed type that has the capacity to produce abundant bimas and cover in a short period of time (Van den Berg 2002). The present investigation was therefore planned to find out the simple and precise field techniques for evaluation of pearl millet genotypes for their response to climate resistance and to quantify loss in yield.

## MATERIAL AND METHODS

Twelve entries (eight hybrids and four populations including three checks) of pearl millet received from AICRP on pearl millet centre Mandor, were evaluated during kharif season of 2013-14 at research farm of AICRP on pearl millet centre Mandor, Agricultural University, Jodhpur under moisture stress ($I_a$) and irrigated ($I_b$) conditions. The experiment was conducted in randomized block design with three replication in each set. Each entry represented by two rows of 5 m length with the row to row and plant to plant spacing of 60 x 10 cm respectively. One set of experiment was sown under rainfed situation with sufficient soil moisture condition for good germination. Additional irrigations were given to irrigated experiment at flowering stage of the crop.

Drought susceptibility index (DSI) was calculated by the formula given by Fischer and Maurer (1978).

$$DSI = (1-Y_a / Y_b) / D$$

Where, $Y_a$ = Grain yield of the genotype under moisture stress condition.

$Y_b$ = Grain yield of the genotypes under irrigated condition

$$D = \frac{Mean\ \ yield\ of\ all\ strains\ under\ moisture\ stress\ condition}{Mean\ \ yield\ of\ all\ strains\ under\ irrigated\ condition}$$

Drought tolerance efficiency (DTE) was estimated by using formula given by Fischer and wood (1981).

$$DTE\% = \frac{Yield\ under\ stress}{Yield\ under\ non-stress} \times 100$$

## RESULT

The meteorological data at the research farm of AICRP on pearl millet centre Mandor, Agricultural University, Jodhpur during kharif, 2013-14 are presented in Table 1. Among twelve entries, the maximum grain yield was obtained in the genotypes MP520 (2178 kg/ha) and MP519 (2067 kg/ha) followed by MH 1790 (2028 kg/ha) and MH 1700 (1875 kg/ha), under irrigated condition. Genotype MP 520 (1547 kg/ha) and Raj171 (1394 kg/ha) followed by MPMH17 (1389 kg/ha) were observed to have maximum yield under terminal stress condition, highest harvest index was found in MP 1790 (38.45%) followed by ICTP 8203 (37.12%). Maximum test weight was recorded in the genotype MH1790 (10.88 gm) followed by ICTP 8203 (10.52 gm) under irrigated condition while it was highest for ICMH356 (10.12 gm) followed ICTP8203 (9.28 gm) under terminal stress. Highest DST and percentage reduction were found in MPMH 17 (0.361

& 29.21) followed by RAJ171 (0.399 & 33.28) under terminal stress condition while also highest DTE was observed for MPMH 17 (77.40 %, Table 2).

## DISCUSSION

Having understood the trend of changes in weather variables and likely future climatic scenario in this arid part of country, we may focus primarily towards alleviation of stress due to water scarcity and/or rise in ambient temperature. In other words plants are likely to be exposed to different intensities and duration of water and temperature stress during different growth phases. Thus, all interventions that helps in ameliorating the adverse effects of these stresses shall play crucial role in maintaining productivity under water stress condition. However, to sustain productivity and to cope with the increasing demand, in terms of both quantity and quality. Drought is the most severe abiotic stress reducing Pearl millet yield in rainfed drought areas. Variant in intensity and severity of drought from season to season and place to place requires cultivation of Pearl millet varieties with different level of drought tolerance in different areas. Multi environment evaluation of breeding lines helps breeder to identify appropriate entry for areas prone to similar level of drought stress. A study by Poonia and Rao (2013) showed that air temperatures by the end of 21 st century are likely to increase by +3.3°C at Bikaner, +3.4°C at Jaisalmer, +2.9°C at Jodhpur and +2.5°C at Pali. Jodhpur experience the highest temperature of 48.3°C on 8th June 2011 and warmest winter in 2008-09. Similarly annual rainfall is likely to be increased by +100 mm at Bikaner, +124 mm at Jaisalmer, -40 mm at Jodhpur and +21 mm at Pali. A study by Rao and Poonia (2011) revealed that water requirement of pearl millet in the arid region is 308-411mm. Taking the projected 4°C rise in temperature due to global warming by the end of the 21st century, water requirement from current level will increase by 12.9% for pearl millet. The increase crop water requirements will result in reduction in crop growing period by 5 days. As a result the crop acreage where rainfall satisfies crop water requirements will be reduced by 23.5% in pearl millet. The impact will be more severe on rabi crops than kharif crops. A study of weather parameters over a long period revealed that both maximum and minimum temperatures showed increasing trend over time. The increasing temperature will most likely to have adverse impact on crop productivity in this region**.** There is a growing interest in pearl millet cultivation as irrigated summer season crop where temperature (42°C) are of common occurrence during flowering. such high air temperature coinciding with flowering in this region can cause spikelet sterility, leading to drastic reductions in grain yield (Gupta *et.al,* 2015). In present study Grain reduction percentage and harvest Index. Maximum stover yield, under irrigated conation recorded by entry MH179 (5722 kg/ha) and under terminal stress condition MP 519 recorded the highest Stover yield (3889 kg/ha). The lowest drought susceptibility index (DSI) in MPMH 17 (0.361) fallowed by RAJ (0.399) which shows genotypes better adaption under high temperature condition. Deshmukh *et. al.,* (2004) reported that the drought resistant genotype had highest drought tolerance efficiency, minimum drought susceptible index and minimum reduction in grain yield due to moisture stress. They also reported that it maintained highest harvest index and very low values of membrane injury index under rainfed as well as irrigated condition. Efficiency (DTE), least drought susceptibility index (DSI) and minimum reduction in seed yield due to stress. It also maintained the highest harvest index (HI) under moisture stress and irrigated condition indicated that the genotype MPMH 17 may be rated as drought tolerant genotype for moisture stress condition. In pearl millet (Pennisetum glaucum), co-mapping of the harvest index and panicle harvest index with grain yield revealed that greater drought tolerance was achieved by greater partitioning of dry matter from stover to grains (Yadav *et al.,* 2004).

**Table 1**
**Meteorological data of mandor during kharif 2013-14**

| *Meteorological data (weekly)* | *Rainfall (mm)* | | *Temperature °C* | | *Humidity* | |
|---|---|---|---|---|---|---|
| | *Rain fall* | *Rainy days* | *Minimum* | *Maximum* | *Minimum* | *Maximum* |
| July 2-8 | 7 | 1 | 30.4 | 37.6 | 43 | 83 |
| July 9-15 | - | - | 27.6 | 39.9 | 44 | 87 |
| July 16-22 | - | - | 27.7 | 36.2 | 46 | 92 |
| July 23-29 | 89 | 2 | 26.2 | 34 | 60 | 99 |
| July-Aug. 30-5 | 14 | 1 | 27 | 34.4 | 56 | 95 |
| Aug. 6-12 | - | - | 27.4 | 33 | 57 | 90 |
| Aug. 13-19 | 105.4 | 4 | 26.3 | 31.8 | 69 | 98 |
| Aug. 20-26 | - | - | 27.1 | 35.1 | 51 | 85 |
| Aug.-Sept 27-2 | - | - | 26.9 | 34.3 | 45 | 81 |
| Sept. 3-9 | - | - | 26.2 | 34.5 | 41 | 77 |
| Sept. 10-16 | - | - | 28.1 | 39 | 29 | 63 |
| Sept. 17-23 | - | - | 25.6 | 37.8 | 38 | 85 |
| Sept. 24-30 | 165 | 5 | 25.3 | 31.3 | 70 | 99 |
| Oct. 1-7 | - | - | 25.4 | 34.7 | 47 | 97 |
| Oct. 8-14 | - | - | 24.4 | 34.9 | 40 | 94 |
| Oct. 15-21 | - | - | 21.3 | 36 | 23 | 80 |
| Oct. 22-28 | — | - | 16.6 | 38.8 | 21 | 78 |
| Oct.-Nov.29-4 | - | - | - | - | - | - |

**Table 2**
**Performance of different genotypes for grain, fodder yield (Kg/ha) and drought tolerance related characters influenced by different genotypes**

| *S. No.* | *Genotypes* | *Grain Yield (kg/ha)* | | *Fodder Yield (kg/ha)* | | *Reduction %* | *DTE %* | *DSI %* | *HI* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Ia* | *Ib* | *Ia* | *Ib* | | | | *Ia* | *Ib* |
| 1 | MH 1700 | 1218 | 1875 | 3278 | 3500 | 53.94 | 64.96 | 0.560 | 26.74 | 32.40 |
| 2 | MH 1771 | 1055 | 1550 | 2600 | 3500 | 46.90 | 68.07 | 0.510 | 29.09 | 33.21 |
| 3 | MH 1790 | 822 | 2028 | 3111 | 5722 | 146.62 | 40.55 | 0.950 | 21.21 | 38.54 |
| 4 | MPMH 17 | 1389 | 1795 | 2611 | 3722 | 29.21 | 77.40 | 0.361 | 35.03 | 34.48 |
| 5 | MP 519 | 1163 | 2067 | 3889 | 4444 | 77.70 | 56.27 | 0.698 | 22.16 | 36.44 |
| 6 | MP 520 | 1547 | 2178 | 3556 | 4333 | 40.80 | 71.02 | 0.463 | 30.45 | 35.94 |
| 7 | RHB121 | 878 | 1672 | 2778 | 4500 | 90.54 | 52.48 | 0.759 | 24.96 | 35.18 |
| 8 | ICMH 356 | 1106 | 1506 | 2555 | 3556 | 36.18 | 73.43 | 0.424 | 29.62 | 35.67 |
| 9 | RAJ 171 | 1394 | 1858 | 3667 | 4667 | 33.28 | 75.03 | 0.399 | 27.31 | 31.41 |
| 10 | ICTP 8203 | 943 | 1465 | 2389 | 3889 | 55.30 | 64.39 | 0.569 | 27.90 | 37.12 |
| 11 | GHB 558 | 722 | 1322 | 2000 | 3722 | 83.15 | 54.60 | 0.725 | 26.46 | 36.67 |
| 12 | HHB 67 Imp. | 794 | 1497 | 2444 | 2444 | 88.50 | 53.05 | 0.750 | 25.10 | 36.98 |
| | **CD at 5 %** | 251.1 | 278.7 | 881.8 | 1119.3 | - | - | - | 9.4 | 16.4 |
| | **CV%** | 13.7 | 9.5 | 17.9 | 16.5 | - | — | - | 20.4 | 27.4 |

$I_a$ – Moisture stress condition　　$I_b$ – Irrigated condition, HI - Harvest Index

DSI- Drought Susceptibility Index,　　DTE- Drought Tolerance Efficiency

## REFERENCES

Bidinger, F.R., Mahalaxmi, V., Talukdar, B.J. and Algarswamy. G., (1982). Improvement of drought resistance in pearl millet. Workshop on Principles and Methods of Crop Improvement for Drought Resistance with Emphasis on Rice, IRRI, Los Banos, Phillipines, on May. 4-8th 1981. pp: 45-49.

Deshmukh, D.V., Mhase, L.B. and Jamadagni, B.M., (2004). Evaluation of chickpea genotypes for drought tolerance. *Indian J. Pulses Res.,* 17: 47-49.

Fischer, K.S. and Wood, G., (1981). Breeding and selection for drought tolerance in tropical maize. In: *Proc. Symp. on Principles and Methods in Crop Imprt. for Drought Resist. with Emphasis on Rice, IRRI, Philippines, 23-25th* May, 1981.

Fisher, R.A. and Maurer, R., (1978). Drought resistance in spring wheat cultivars. I. Grain yield responses in spring wheat. *Australian J. Agric. Sci.,* 29: 892-9 12.

IPCC. *(2007). The Physical Science Basis. Contribution of the Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate.*

IPCC., (2014). Understanding and Attributing Climate change. pp 663-746.

Poonia Surendra and Rao S S., (2013). Climate change and its impact on Thar Desert Ecosystem. *Journal of Agricultural Physics.* 13: 71-79.

Rao, A.S. and Poonia Surendra., (2011). Climate change impact on crop water requirements in arid Rajasthan. *Journal of Agrometeorology* 13(1): 17-24.

Yadav R.S., Hash C.T., Bidinger F.R., Devos K.M., Howarth C.J. (2004). Genomic regions associated with grain yield and aspects of post-ûowering drought tolerance in pearl millet across environments and tester background, Euphytica 136, 265–277.

Yadav, D.V., and Kumar Anil, (2016). Present status and future prospects of pearl millet in Haryana.5 th National Seminar on Coarse Development-challaenge and opportunities in the Country Proceeding 107-112.

Gupta, S.K., K.N. Rai, Piara Singh, V.L.Ameta, Suresk K. Gupta, A.K. Jaylekha, R.S. Mahala, S. Preek, M.L. Swami and Y.S. Verma (2015). Seed set variability under high temperature during flowering period in pearl millet (Pennisetum glaucum L. (R.) Br. Field Crop Res., 171: 41-53.