

## Short Communication

### Seasonal Influence on Biomass of Pearl Millet, *Pennisetum glaucum* R. (Br.) Crop

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Plant growth and development depend on their genetic constituents and environmental conditions of soil and climate. As an ecological factor in agriculture, soil has been widely studied and better understood than climate on a quantitative basis. Much of the observed seasonal and intra-seasonal variations in the agricultural output are frequently attributed to the effect of weather conditions on plant growth. Although the effect of agronomic and physiological parameters on growth of pearl millet has been widely studied, yet precise quantitative relationships of the environmental variables with growth parameters of pearl millet have not been developed.

Field experiments were conducted on pearl millet at Indian Agricultural Research Institute, New Delhi (28°35'N, 77°10'E and 228.1 m above mean sea level) during *khari* seasons of 1992 and 1993 to identify the weather parameters associated with growth and yield. Three pearl millet varieties (Pusa-23, HHB-60 and HHB-67) were sown in two row directions (East-West and North-South) at 45x15 cm spacing. The experiment was planned in factorial randomized block design with three replications. Plant samples were drawn at 10 day interval after 20 days of sowing for dry matter and leaf area measurement. Daily data on maximum and minimum temperatures and sunshine hours were collected at meteorological observatory situated adjacent to north side of the field. Diurnal temperature range (DTR)

was calculated by taking difference between maximum and minimum temperature. Daily absorbed photosynthetically active radiation (APAR) was determined as per the procedure adopted by Rosenthal and Gerik (1991). The crop growth rate (CGR) was calculated as the ratio of dry matter increase per unit area per day. Net assimilation rate (NAR) was calculated as per the procedure adopted by Radford (1967). The per degree dry matter conservation (DMC) was computed by the method used by Narasingarao (1987).

The CGR, NAR and total dry matter were consistently higher in 1993 except during the GS<sub>3</sub> (grain filling stage). Lower total dry weight and growth rate in 1992 could be attributed to short sunshine hours, diurnal temperature range and APAR (Table 1). Maiti and Sotto (1990) reported that higher grain yield with July sowing was due to longer photoperiod and wide range of day and night temperatures. The dry matter conservation (DMC) also followed a trend similar to that of CGR, NAR and TDM.

The higher dry matter in 1993 over 1992 at vegetative (GS<sub>1</sub>) and early reproductive (GS<sub>2</sub>) stages might be due to greater absorbed PAR and greater diurnal temperature range leading to more per degree dry matter conservation in 1993. Also higher air temperature and more sunshine hours during 1993, might have resulted in higher dry matter production in 1993. Similar results were reported in rice crop (Narasingarao, 1987).

The analysis for whole growing period showed that greater absorbed PAR, sunshine hours and

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Table 1. Growth and weather parameters during different stages of crop growth

Parameter	GS-1*		GS-2*		GS-3*		Whole period	
	1992	1993	1992	1993	1992	1993	1992	1993
TDM (gm <sup>-2</sup> )	84.100	123.700	649.100	744.300	336.200	319.500	958.300	1063.700
CGR (gm <sup>-2</sup> day <sup>-1</sup> )	7.440	11.580	28.210	49.010	22.820	13.910	19.490	24.830
NAR (gm <sup>-2</sup> leaf area day <sup>-1</sup> )	8.370	9.750	10.780	15.950	7.520	4.250	8.890	10.980
Mean relative humidity (%)	79.300	75.100	80.100	60.900	74.300	71.300	77.900	69.100
Sunshine (h)	4.100	6.800	5.800	9.100	5.900	4.900	5.300	6.900
Maximum temperature (°C)	32.200	33.600	33.300	36.300	31.200	31.900	32.200	33.900
Minimum temperature (°C)	26.000	26.400	25.200	27.100	24.300	24.500	25.200	26.000
Mean temperature (°C)	29.100	30.000	29.300	31.700	27.800	28.200	28.700	29.900
DTR (°C)	6.200	7.400	8.100	9.200	6.900	7.400	7.100	8.000
DMC (g degree <sup>-1</sup> diff.)	0.055	0.081	0.104	0.149	0.068	0.040	0.076	0.091
APAR (MJ m <sup>-2</sup> day <sup>-1</sup> )	49.400	76.200	136.600	162.700	128.400	120.500	314.400	333.300

\* GS-1 : Seedling emergence to panicle initiation of main stem, GS-2: Panicle initiation to 50% anthesis, GS-3: 50% anthesis to maturity.

DTR among the weather parameters, and CGR and DMC among the growth parameters, contributed more to higher dry matter production in 1993 as compared to 1992.

Various response functions between weather and growth parameters were generated. The dry matter production was directly associated with absorbed PAR ( $r = 0.98^*$ ) and DTR ( $r = 0.78^*$ ). A positive correlation was observed for CGR with absorbed PAR ( $r = 0.91^*$ ), DTR ( $r = 0.91^*$ ) and sunshine hours ( $r = 0.80^*$ ). The net assimilation rate also showed a positive correlation with DTR ( $r = 0.87^*$ ) and sunshine hours ( $r = 0.88^*$ ). A direct relationship between dry matter and absorbed PAR was reported by Jones and Kiniry (1986) in sorghum and Rosenthal *et al.* (1989) in cotton.

Out of the considered parameters, the weather parameters like absorbed photosynthetically active radiation (APAR) and sunshine hours (SS) can give reasonable estimate of the total dry matter (TDM) using following relationships:

$$TDM = 1/(0.00000035(APAR-242.90)^2 - 0.00153) \quad (R^2 = 0.86)$$

$$TDM = SS/(-0.00551 SS + 0.0543) \quad (R^2 = 0.83)$$

#### References

- Jones, C.A. and Kiniry, J.R. 1986. *CERES-MAIZE: A Simulation Model of Maize Growth and Development*. Texas A & M University Press, College Station, TX.
- Maiti, R.K. and Sotto, G.G.I. 1990. Effect of four sowing dates environments on growth development and yield potential of 15 pearl millet cultivars (*Pennisetum americanum* (L.) Leeke) during autumn winter season in Marin NL Maxico. *Journal of Experimental Botany* **41**: 1609-1618.
- Narasingarao, Ch. 1987. Seasonal influence on growth and yield of rice varieties. *Oryza* **24**: 59-65.
- Radford, P.J. 1967. Growth analysis formulae, their use and abuse. *Crop Science* **7**: 171-175.
- Rosenthal, W.D. and Gerik, T.J. 1991. Radiation use efficiency among cotton cultivars. *Agronomy Journal* **83**: 655-658.
- Rosenthal, W.D., Vanderlip, R.L., Jackson, B.S. and Arkin, G.F. 1989. *Sorkam : A Grain Sorghum Crop Growth Model*. Texas Agriculture Experimental Station Miscellaneous Publication MP-1969.

\* Significant at 5% level of significance.