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Water Use Efficiency in Pearl Millet

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Pearl millet (*Pennisetum glaucum* (L.) Br.) is an important drought tolerant crop grown extensively in arid and semi arid regions under rainfed conditions. Drought resistance is considered to be a consequence of advantages conferred by one or more physiological or morphological characters (Turner 1982). Idenification of simple morphological or physiological traits which confer an advantage under one or more specific stress conditions is required for assessment of drought resistance as yield to yield component relationships under stress were a result of yield component to phenology relationship (Bidinger *et al.* 1987 a). Thus, sufficient knowledge of physiological traits is needed for plant improvement in drought environments. The present study envisages upon the photosynthesis and transpiration rates and instantaneous water use efficiency of pearl millet genotypes through their growth and development.

An experiment with 21 pearl millet genotypes in a randomised block design with three replications was laid out at Agricultural Research Station, Fatehpur Shekhawati during *kharif* 1987 under rainfed condition. Most recently expanded leaves were selected on the plant for recording observations on photosynthesis and transpriation rates with a portable infrared gas analyser (Analytical Development Corporation, England) in the field. A minimum of three independent readings with three different plants in each replicate of all the genpotypes were recorded over four development stages *viz.*, vegetative, half bloom, dough and physiological maturity. The rainfall received during the season was 253.6 mm distributed in two spells of 96.3 mm of rain during the vegetative stage and the second spell of 157.3 mm at half bloom stage. Thus, the available soil moisture was high at vegetative stage and half bloom stages compared to at dough and physiological stages. The values of instantaneous water use efficiency were calculated from the observed values of photosynthesis and transpiration rates and expressed as mg CO_2 fixed per g of H_2O lost. Analysis of variance was performed for all the parameters and the values of least significant differences were determined following standard procedures.

The photosynthetic rates of all the genotypes were similar at the first three stages. However, at the physiological maturity there was a significant decline. The seasonal varietal means of RCB-2, RHB-22, EICH-8301, IV 83113, MDS-29 and MBH-110 (Group I) were at par and significantly higher than those of CZMP-84, IV-83117, IH-87951 and WC-C 75 (Group II) (Table 1). All group II genotypes had significantly lower rates compared to RCB-2, IV 83113 and MDS-29 at vegetative stage. No significant differences were observed in the transpiration rates of 21 genotypes at the various stages. Comparison of stage means revealed that the rates were high at the vegetative stage and continued to decline significantly till maturity (6.7 to 4.0 m mol H_2O m^{-1} sec^{-1}). An analysis of seasonal varietal means showed that except for IV- 83117 all the group-II genotypes had significantly lower transpiration rates as well, compared to the group-I members (Table 1).

The estimated values of the 21 genotypes for water use efficiency were also statistically similar at the various growth stages. Analysis of stage means revealed that there was no definite trend in water use efficiency values at different stages. Though the seasonal means were not statistically different among the various genotypes, the group- I genotypes had higher values of water use efficiency compared to the group II genotypes (Table 1).

Breeding for adaptation to environmental stress include determining the genetic variability for adaptation (Bidinger *et al.* 1987 b). The decrease in photosynthesis rate at physiological

Table 1 *Seasonal means of photosynthesis, transpiration and water use efficiency rates of Pearl millet genotypes*

Genotype	Photosynthesis (μ mol CO_2 m^{-2} sec^{-1})	Transpiration (m mol H_2O m^{-2} sec^{-1})	Water use Efficiency (mg CO_2 fixed per g H_2O lost)
MDS–29	10.2	5.5	4.6
RCB–2	10.0	5.2	4.6
RHB–22	10.0	5.7	4.4
EICH–8301	10.0	5.3	4.6
IV–83113	9.9	5.5	4.4
MBH–110	9.9	5.4	4.4
MBH–8601	9.7	4.8	4.8
MH–179	9.6	5.5	4.2
LCB–10	9.6	5.3	4.4
ECII–C_0	9.5	5.6	4.2
HHB–67	9.4	5.2	4.4
IV–87902	9.2	4.7	4.8
LCB–1	9.2	5.0	4.4
CZMH–140	9.2	5.1	4.4
ICTP–8203	9.1	5.3	4.2
HHB–60	8.7	5.6	3.9
BK–560	8.6	5.0	4.2
IV–83117	8.3	5.3	3.9
WC–C 75	8.1	4.8	4.2
CZMP–84	7.8	4.5	4.2
IH–87951	7.7	4.8	3.9
Varietal means	9.2	5.2	4.3
CD at 5%	1.5*	0.7*	NS

maturity is due to the leaf senescene which has already set in the present experiment. Lower values of water use efficiency during vegetative stage are due to high evaporative demand and incomplete crop cover. Similar changes in water use efficiency values during growth stages were also observed in barely (Yadav *et al.* 1987). Since it is very difficult to document that, economic yield and photosynthesis rate are related in any direct way, genpotypes with lower transpiration rates and higher water use efficiency values are better suited for arid environments.

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