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Yield and water use of summer transplanted pearlmillet (*Pennisetum glaucum* L.) as influenced by IW : CPE ratios, mulches and antitranspirant

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ABSTRACT

A field experiment was conducted at College Agronomy Farm, B.A. College of Agriculture, Anand, Gujarat on loamy sand soil during summer season of the year 2006 and 2007 to elucidate the effect of irrigation, mulches and antitranspirant on yield and water use efficiency of summer transplanted Pearlmillet (*Pennisetum glaucum* L.). The results revealed that significantly higher pearlmillet grain and dry fodder yields were obtained under 1.1 IW : CPE ratio, though it was at par with 0.9 IW : CPE ratio. Among the mulches white plastic sheet mulch was found significantly superior and which was at par with an application of pearlmillet Bhusa. Which increased the consumptive use of water and water use efficiency over control. Also antitranspirant 6 % kaolin spray recorded significantly higher grain and fodder yields of pearlmillet.

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Key words : Pearlmillet, IW : CPE ratio, Mulch, Kaolin and Yield

INTRODUCTION

In summer season, water is the limiting factor and costly input for crop production for semi arid and arid tropics. Water is a key factor to enhance the crop productivity and is also prerequisite for an efficient utilization of all the farming inputs. Summer cultivation of transplanted Pearlmillet (*Pennisetum glaucum* L.) particularly in irrigated areas of the Gujarat has got importance, because of the assurance of targeted crop yield. Irrigation in summer pearlmillet is one of the major input of crop production. Supply of timely and adequate irrigation is a key factor for high and economic yield. Parihar *et al.* (1974) advocated more practicable approaches of the use of IW : CPE ratio for different crops. Mulches maintains the soil water status through reducing evaporation, runoff and weeds. Application of mulches on the soil surface obstructs the solar radiation inducing into the soil. It also checks the escape of water vapour by physical obstruction. It exerts a decisive effect on earliness, yield and quality of the produces. Judicious application of reflective pigments to increase the albedo and thus, decrease the net radiation load on the canopy and material. It should be possible to reduce transpiration by use of antitranspirant kaolin without affecting the photosynthesis and thus increase water use efficiency. Reducing loss of water through transpiration appears to be a promising approach for the efficient water utilization in summer season. Accorrdingly, an experiment was planned to evaluate the effect of irrigation, mulches and antitranspirant on yield and water use efficiency of summer transplanted Pearlmillet under middle Gujarat conditions.

MATERIALS AND METHODS

A field experiment was conducted at the College Agronomy Farm, Department of Agronomy, B. A. College of Agriculture, Anand Agricultural University, Anand during the years 2006 and 2007 during summer season on loamy sand soil. The soils of the experimental site was free from any kind of salinity or sodicity hazards, low in organic carbon and nitrogen, medium available phosphorus and high in potassium. There were 18 treatment combinations, comprising of three levels, each of irrigation schedules (0.7, 0.9 and 1.1 IW : CPE ratios) and mulches (Control, Pearlmillet Bhusa @ 5 t ha^{-1} and White plastic sheet, 200 gauge) and two levels of antitranspirant (Control *i.e.* water spray and 6 % kaolin spray at 20 and 50 DATP) embedded in a split-split plot design with four replications. A recommended fertilizer dose of chemical fertilizer 120-60-0 kg NPK per hectare was applied uniformly. Full dose of phosphorus (60 kg P_2O_5 ha^{-1}) through diammonium phosphate and 50 per cent nitrogen (60 kg N ha^{-1}) from diammonium phosphate as well as ammonium sulphate were applied in opened furrows

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before transplanting. Remaining 50 per cent nitrogen (60 kg N ha^{-1}) was applied in the form of urea in two equal splits at an interval of 20-25 days after transplanting during both the seasons of field experimentation. After fertilization, pre-transplanting irrigation was given to the experimental plot. The uniform healthy seedlings of pearlmillet cv. GHB–558 having an age of twenty five days were uprooted after applying the irrigation to the nursery and one seedling per hill was transplanted at 45 cm x 15 cm spacing. One common irrigation was given uniformly to all treatments for proper establishment of seedlings. The irrigation soil depth was maintained 50 mm in each irrigation. The total numbers of applied irrigation were 7, 9 and 11 under 0.7, 0.9 and 1.1 IW : CPE ratio, respectively. The mulches were applied in the respective treatments, leaving the pearlmillet rows open. Thus, mulches were used in such a way that soil surface in between the space (45 cm) of two lines were covered by leaving row of pearlmillet crop. Mulches *i.e.*, pearlmillet Bhusa (*Bajari*) @ 5 t ha^{-1} (organic mulch) and white plastic sheet (200 gauge) were applied at 20 days after transplanting of the crop for M_1 and M_2 treatments, respectively during both the years. Water spray as a control treatment (AT_0) and 6 % kaolin (AT_1) were sprayed on the crop plants at 20 and 50 days after transplanting of the crop during both the years. The mean total quantity of water applied under the treatment I_1, I_2 and I_3 was 400 mm, 500 mm and 600 mm, respectively.

RESULTS AND DISCUSSION

The results obtained from the present investigation are presented in Table 1.

Effect of irrigation:

Irrigation scheduling at 1.1 IW : CPE ratio registered significantly higher values of grain and dry fodder yields than treatment I_1 (0.7 IW : CPE ratio), but it was statistically at par with the treatment I_2 (0.9 IW : CPE ratio). This might be due to increase in irrigation frequency tended to increase consumptive use of water (CUW), which provided congenial conditions through out the crop growth period resulting in an improvement of yield attributing characters, thereby higher grain yield. The other reason might be due to that treatment I_3 (1.1 IW : CPE ratio) had a favourable effect on all the yield attributes which resulted into higher grain production as compared to rest of the irrigation treatments. Increased number of irrigation which raised the moisture status of the soil for a longer period and resulted into maximum depletion of available soil moisture through the process of evapotranspiration. Increased frequency of irrigation increased the total consumptive use. The another reason might be that higher frequency of irrigation coupled with higher grain yield under this ratio might be responsible for higher water use efficiency (Vyas *et al.*, 1994).

Effect of mulches:

Grain and dry fodder yield of summer transplanted pearlmillet was significantly higher under treatment M_2 (white plastic sheet mulch) as compared to control treatment (M_0). While, treatment M_1 (pearlmillet Bhusa @ 5 t ha^{-1}) remained next after treatment M_2 by exerting its significant influenced on control treatment (M_0). This might be due to that mulches played an important role in changing the hydro-thermal regime of soil and conserving soil moisture for the better growth of plants. Polyethylene being completely impervious, the loss of water was mostly due to transpiration by the plants. However, the loss of water under control condition without mulch was maximum because of both evaporation from soil and transpiration by plants. Less loss of moisture from soil under pearlmillet Bhusa was due to cover provided the mulch and existence of low thermal gradients. Thus, evaporation from soil under polyethylene mulch (white plastic sheet)being negligible, there was more of transpiration loss which was responsible for increasing the grain yield (Jat and Gautam , 2000 and Chaudhary *et al.,* 2002).

Effect of antitranspirant:

Application of 6 % kaolin spray significantly improved grain and dry fodder yield of pearlmillet. Kaolin treated plants might have higher relative water content as compared with water spray indicating that this antitranspirant checked the transpiration to a reasonable extent owing to reflexion of incident radiation from the leaf surface or to partial closing of stomata. Thus, better moisture status of the plant due to kaolin spray resulted in to less leaf senescence and higher photosynthesis. These favourable effects could result in better grain development and ultimately in increased grain yield (Kaushik and Lal, 1996).

Water use efficiency:

Water use efficiency was computed as the sum of irrigation water, effective rainfall and profile water depletion. The mean consumptive use of water and water use efficiency were influenced due to different irrigation schedules. The highest consumptive use of water was recorded under treatment I_3 (1.1 IW : CPE ratio), followed by I_2 (0.9 IW: CPE ratio) treatment. While, the lowest consumptive use of water was observed under treatment

Table 1 : Yield and water use efficiency of summer transplanted pearlmillet as influenced by irrigation, mulches and antitranspirants levels (Pooled mean of 2 years)

Treatments	Grain yield (kg ha^{-1})	Dry fodder Yield (kg ha^{-1})	C U (mm)	WUE (kg ha-mm^{-1})
Main Plot (Irrigation) (I)				
I_1 : 0.7 IW:CPE Ratio	4479	7579	297.6	15.05
I_2 : 0.9 IW:CPE Ratio	5060	8108	398.4	12.70
I_3 : 1.1 IW:CPE Ratio	5294	8462	500.3	10.58
S.E. $\pm$	103.91	126.89		
C.D. (P=0.05)	320.19	391.03		
C. V. (%)	14.56	10.92		
Sub Plot (Mulches) (M)				
M_0 : Control	4606	7621	281.4	16.37
M_1 : Pearlmillet Bhusa @ 5 t ha^{-1}	5013	8131	306.1	16.38
M_2 : White plastic sheet (200 gauge)	5213	8398	311.4	16.74
S.E. $\pm$	97.27	105.14		
C.D. (P=0.05)	279.45	302.07		
C. V. (%)	13.63	9.05		
Sub Sub Plot (Antitranspirants) (AT)				
AT_0: Control (Water spray)	4716	7846	286.3	16.48
AT_1 : 6 % Kaolin spray at 20 and 50 DATP	5172	8254	291.0	17.77
S.E. $\pm$	74.79	89.56		
C.D. (P=0.05)	212.20	254.10		
C.V.%	12.84	9.44		

I_1 (0.7 IW : CPE ratio). In general, the consumptive use of water was increased with increase in quantity of irrigation water applied. The highest water use efficiency was observed under treatment I_1 (0.7 IW : CPE ratio), followed by treatments I_2 (0.9 IW : CPE ratio). While the lowest water use efficiency was registered under treatment I_3 (1.1 IW : CPE ratio). This might be due to higher number of irrigations with high quantity of water, which increased the consumption of water due to better crop growth and simultaneously the loss of water through evaporation. Inadequate moisture supply to the crop under treatment I_1 (0.7 IW : CPE ratio) resulted in lower CU of water (Vyas *et al*., 1994).

The mean consumptive use of water and water use efficiency were also influenced due to mulching in summer pearlmillet crop. Treatments M_1 (Pearlmillet Bhusa @ 5 t ha^{-1}) and treatment M_2 (white plastic sheet mulch) registered higher consumptive use of water. The lowest consumptive use of water was noticed under treatment M_0 (no mulching). The highest water use efficiency was observed under the treatment M_2 (white plastic sheet mulch), followed under treatment M_1 (Pearlmillet Bhusa @ 5 t ha^{-1}). The lowest water use efficiency was recorded under M_0 (no mulching). The increase in water use efficiency might be due to higher grain yield which was obtained under an application of white plastic sheet, followed by pearlmillet Bhusa as compared to control treatment (Singh *et al.*, 1997).

An application of 6 % kaolin spray (AT_1) recorded higher consumptive use of water, whereas control treatment (AT_0) recorded the lowest consumptive use of water. An application of 6 % kaolin spray (AT_1) recorded the highest water use efficiency as well as water expense efficiency. While, control treatment (AT_0) recorded the lowest water use efficiency. The increase in water use efficiency might be due to higher grain yield which was obtained with an application of kaolin as compared to control treatment (Kaushik and Lal, 1996).

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