GAU Res. J. 1994. 19 (2) : 113-116

Influence of Irrigation and NP Fertilization on Yield, Consumptive Use of Water, Wate Use Efficiency and Nutrient Uptake by Summer Pearl Millet in South Saurashtra Region

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A field experiment was conducted during summer 1988-89 at Instructional Farm, Gujarat Agricultural University, Junagadh to workout the irrigation, nitrogen and phosphorus requirement of pearl millet in a split plot design with three replications. Irrigation was scheduled at IW/CPE ratios, 0.6, 0.8 and 1.0 with irrigation depth of 50 mm in main plot and NP levels (N_0P_0, $N_{40}P_{20}$, $N_{80}P_{40}$ and $N_{120}P_{60}$) in sub plots. The soil of experimental plot was medium black having pH 8.2, EC 0.27 dsm^{-1} at 25°C, field capacity on w/w basis 26.8% (0-15 cm), permanent wilting point on w/w basis 14.0% (0-15 cm), bulk density 1.419 g/cμ cm (0-15 cm), total N 0.08%, available P_2O_5 21.23 kg/ha and available K_2O 268 kg/ha. The crop was sown on 9th Feb., 1989 and harvested on 16th May, 1989. The gross and net plot size kept were 6.0 x 4.5 m and 4.0 x 2.7 m, respectively.

The consumptive use of water was calculated as per the procedure suggested by Dastane (1972). Total number of irrigation applied as per treatments during crop season were 7, 9 and 11 for IW/CPE ratios 0.6, 0.8 and 1.9, respectively.

Consumptive use of water by pearl millet increased substantially with each increase in IW/CPE ratio from 0.6 to 1.0 (Table 1). The maximum water use of 437.92 mm was recorded under IW/CPE ratio of 1.0. The reason for higher water use under higher ratio of 1.0 is attributed to the fact that this ratio received maximum water (550 mm).

Similar to consumptive use of water, high IW/CPE ratio of 1.0 recorded significanlty higher water use efficiency of 11.37 kg ha^{-1} mm as compared to lower IW/CPE ratio of 0.6. Remarkably higher frequency of irrigation coupled with higher yield under this ratio may be responsible for higher water use efficiency.

Fertilizing the pearl millet with $N_{120}P_{60}$ stood first by recording significantly the highest consumptive use and water use efficiency of 391.11 mm and 12.26 kg ha^{-1} mm, respectively over rest of the lower levels. The higher water use efficiency under this level is attributed to higher grain yield (Table 1).

TABLE 1

Consumptive use of water, water use efficiency, protein nutrient uptake, yield and net return of pearl millet as affected by irrigation and NP fertilizer.

Treatment	Yield ($q\ ha^{-1}$)		Consumptive use (mm)	Water use efficiency (kg grain/ ha mm)	Protein content (%)	Total nutrient uptake ($kg\ ha^{-1}$)		Net return Rs/ha
	Grain	Straw				Nitrogen	Phosphorus	
IW/CPE ratio								
0.6	29.48	102.12	321.33	9.15	9.15	91.72	12.35	5286
0.8	38.86	112.31	377.33	10.06	10.22	116.97	15.19	72.51
1.0	49.87	123.15	437.92	11.37	10.68	151.74	19.37	9599
C.D. at 5%	5.46	8.89	9.97	1.54	0.37	11.00	1.29	
Fertilizer (NP)								
N_0P_0	31.30	100.83	370.78	8.44	9.83	91.43	12.44	7062
$N_{40}P_{20}$	35.74	108.24	373.44	9.46	10.17	109.05	14.28	7925
$N_{80}P_{40}$	41.57	115.83	380.11	10.61	10.39	126.76	16.60	9106
$N_{120}P_{60}$	48.89	125.28	391.11	12.26	10.88	153.33	19.14	10665
C.D. at 5%	4.35	7.03	7.39	1.35	0.31	9.61	1.12	

TABLE 2

Interaction effect of I x NP on nitrogen uptake (kg/ha) by pearl millet.

Irrigation (IW/CPE ratio)	*NP levels*			
	N_0P_0	$N_{40}P_{20}$	$N_{80}P_{40}$	$N_{120}P_{60}$
0.6 (I_1)	71.38	85.19	92.67	117.64
0.8 (I_2)	90.59	107.18	124.05	146.07
1.0 (I_3)	112.32	134.79	163.57	196.30
C.D. at 5%	13.71			

Scheduling irrigation at IW/CPE ratio of 1.0 removed significantly higher nitrogen and phosphorus by 151.74 and 19.33 kg ha^{-1}, respectively over rest of lower ratios. The reason for higher nutrient removal with higher IW/CPE ratio of 1.0 which received 11 irrigations is owing to reduction in soil temperature by frequent irrigation. The decline in the temperature tended to increase specific heat and thermal conductivity of the soil with wetness and greater evaporative cooling. This favourable condition increased the rate of nitrification and resulted in higher nutrient uptake. Similar observations have also been noticed by Lakkad and Patel (1978) and Malik and Sharma (1984).

Nutrient uptake increased substantially with each increase in fertilizer level from N_0P_0 to $N_{120}P_{60}$. Nitrogen and phosphorus removed at $N_{120}P_{60}$ were 153.33 and 19.14 kg ha^{-1}, respectively, which was significantly higher over rest of the lower levels of fertilizer.

Significantly the highest protein content of 10.68 and 10.88 per cent were recorded with high IW/CPE ratio of 1.0 and $N_{120}P_{60}$ fertilizer level, respectively. The high protein content under higher frequency of irrigation may be due to luxurious growth and bumper production of the crop received under this treatment. Likewise higher amount of NP level had a promoting effect on protein content in pearl millet grain.

Scheduling of irrigation at IW/CPE ratio of 1.0 outdid the rest by recording remarkably higher grain yield over rest of lower ratios. A marked increase in total uptake of nitrogen and phosphorus by crop under this ratio might have contributed towards higher grain yield. Maximum net return of Rs. 9599/ha was received under IW/CPE ratio of 1.0. The increase in net return with IW/CPE ratio of 1.0 was 81.58 per cent over IW/CPE ratio of 0.6.

Fertilizing the crop with $N_{120}P_{60}$ recorded significantly higher grain and straw yield over rest of the levels. This level also gave maximum net return of Rs. 10665/ha which was 51.02 per cent higher over control.

Interaction Effect

Interaction effect of I x NP in respect of nitrogen uptake was found significant (Table 2). Results indicate that irrespective of NP levels,

TABLE 3

Interaction effect of I x NP on phosphorus uptake (kg/ha) by pearl millet

Irrigation (IW/CPE ratio)	*NP levels*			
	N_0P_0	$N_{40}P_{20}$	$N_{80}P_{40}$	$N_{120}P_{60}$
0.6 (I_1)	10.39	11.50	12.86	14.65
0.8 (I_2)	12.44	14.01	15.85	18.47
1.0 (I_3)	14.51	17.32	21.35	24.31
C.D. at 5%	1.60			

nitrogen uptake increased substantially with increase in IW/CPE ratio from 0.6 to 1.0. Significantly higher nitrogen was removed at $N_{120}P_{60}$ over rest of the lower levels under all the levels of irrigation. Treatment combination comprised of irrigation schedule based on IW/CPE ratio 1.0 and fertilizing the crop with $N_{120}P_{60}$ removed significantly the highest nitrogen by 196.30 kg/ha over rest of the combinations.

Interaction I x NP in case of phosphorus removed by pearl millet was found significant. Data (Table 3) showed that irrespective of IW/CPE ratio, phosphorus removal increased substantially with each increment in fertilizer level from N_0P_0 to $N_{120}P_{60}$ and significanlty the highest phosphorus uptake was noticed with $N_{120}P_{60}$ over rest of the lower levels. Under same level of fertilizer doses, phosphorus removal increased significantly with increase in IW/CPE ratio from 0.6 to 1.0. The best treatment combination involving scheduling irrigation at IW/CPE ratio of 1.0 and fertilizing the crop with $N_{120}P_{60}$ removed significanlty the highest phosphorus by 24.31 kg ha^{-1} over rest of combinations.

(Received on 17th Febru. 1993)

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