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RESEARCH PAPER

Effect of irrigation and nitrogen levels on forage yield and quality of pearl millet [*Pennisetum glaucum* (L.) R.Br.]

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Abstract : An experiment was conducted to study the effect of irrigation and nitrogen on pearl millet during summer 2010 at Anand Agricultural University, Anand. Twelve treatment combinations of four irrigation levels (0.4, 0.6, 0.8 and 1.0 IW: CPE ratio), three levels of nitrogen (80, 120 and 160 kg N ha^{-1}) were tested in split plot design with four replications. The result revealed that the frequent irrigations at 1.0 IW : CPE ratio significantly increased the plant height, tillers per meter row length and leaf : stem ratio and produced significantly the highest green forage, dry matter and crude protein yields and registered the highest net returns. However, lower irrigation level of 0.4 IW: CPE ratio was significantly superior in WUE than 1.0 IW : CPE ratio. Successive increase in nitrogen application increased yield attributes, leaf, stem ratio, crude protein content as well as WUE. Application of 160 kg N ha^{-1} recorded significantly the highest green forage, dry matter and crude protein yields of pearl millet and gave the highest net returns.

Key Words : Irrigation, Nitrogen, Forage, Pearl millet

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INTRODUCTION

Livestock are becoming agriculture's most economically important sub sector. In animal seed supply, cereals have major role and four major cereals *viz.*, maize, barley, sorghum and pearl millet account for about 44 per cent of total cereals fodder production. Gujarat state has total animal population of 18.44 million heads and their optimum fodder requirement worked out is 42.2 million tonnes, whereas only 20.0 million tonnes of fodder is made available in normal year.

Forage pearl millet is a good risk cover crop for sustained forage production under irrigated condition. The important of cultivation of pearl millet is being emphasized due to its profuse tillering habit, multicut nature, drought tolerance, resistance to insect pest and disease and absence of poisonous prussic acid, good performance even in poor soil, good per day productivity and leafiness. Multicut pearl millet [*Pennisetum glaucum* (L.) R.Br.] is becoming more popular among the farmers community.

It is drought resistant, quick growing and palatable to animals. It gives 2-3 cutting and supplied green fodder during the scarcity period of May-June. It can be feed to animals at any stage of growth without deleterious effects.

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Water is the basic input for increasing crop production. Agricultural productivity can't be maintained without assured supply of moisture to the plant which is accomplished by irrigation.

Nitrogen is an important constituent of protein and chlorophyll. It imparts dark green colour to plant, promote vegetative growth and rapid early growth. It improves the quality and metabolizable energy besides improving succulence and palatability of fodder crops. Being a non-legume and multi-cut fodder crop it responds more to fertilizers and irrigation. Under Gujarat conditions no research work has been done so far regarding its irrigation and fertilizer requirements. Keeping this in view, the present study was planned.

MATERIAL AND METHODS

An experiment was conducted to study the effect of irrigation and nitrogen on pearl millet during summer 2010 at Anand Agricultural University, Anand. There were total twelve treatment combinations of four irrigation levels (0.4, 0.6, 0.8 and 1.0 IW : CPE ratio) and three levels of nitrogen (80, 120 and 160 kg N ha^{-1}). The field experiment was laid out in split plot design with four replications, wherein irrigation levels were relegated in the main plots and nitrogen levels were assigned to sub-plots.

The soil of the experimental field was loamy sand in texture having good drainage capacity. It was medium in organic carbon (0.43%) and medium in available nitrogen (188 kg N ha^{-1}), phosphorus (48 P_2O_5 ha^{-1}) and potassium (140 K_2O kg/ha). Nitrogen was given as per respective treatment *i.e.* 80, 120 and 160 kg N ha^{-1} in the form of urea. The full dose of phosphorus from SSP and nitrogen in the form of urea were applied in four equal split, first at basal, second at 30 DAS, third at after first cut and fourth at after second cut. The crop was shown at a spacing of 30 cm using the seed rate of 12 kg/ha and three cuts were taken for green forage. The first cut was taken at 50 days after sowing, while the second cut was taken at 30 days after first cut and third cut at 30 days after second cut. The green plant samples were taken at time of harvesting for oven dried at 70^0 C and crude protein content was worked out on dry weight basis using Kjeldhal's method (Jackson, 1973). The economics was worked out on current market price basis.

Statistical analysis :

The obtained data was analyzed by statistical significant at P<0.05 level, S.E. and C.D. at 5 per cent level by the procedure given by (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of irrigation :

The forage yield and quality of pearl millet were significantly affected by irrigation levels (Table 1). Application of irrigation at 1.0 IW:CPE ratio recorded

Table 1 : Effect of irrigation (IW : CPE ratio) and nitrogen (kg ha^{-1}) levels on yield WUE and economics of pearl millet

Treatments	Yield (q /ha)			Water use efficiency (kg ha^{-1} mm)	Economics	
	Green forage	Dry matter	Crude protein		Net realization (Rs./ha)	B.C.R.
Irrigation (IW : CPE ratio) (I)						
I_1 – 0.4	562	101.7	9.83	160.56	21514	1.04
I_2 – 0.6	772	148.0	15.25	155.31	36872	1.72
I_3 – 0.8	918	186.8	19.86	131.19	46506	2.07
I_4 – 1.0	979	212.5	23.79	115.22	50340	2.17
S.E. ±	13.9	2.5	0.32	4.18	-	-
C.D. (P=0.5)	44.5	8.1	10.01	13.39	-	-
C.V. (%)	5.96	5.4	6.35	10.32	-	-
Nitrogen (kg/ha) (N)						
N_1 – 80	730	138.3	14.04	125.78	34981	1.76
N_1 – 120	809	161.7	16.92	140.25	40388	1.99
N_1 – 160	888	186.7	20.59	155.63	45859	2.20
S.E. ±	13.3	20.6	0.35	2.56	-	-
C.D (P=0.5)	38.8	7.7	1.01	7.48	-	-
C.V. (%)	6.56	6.48	8.04	7.29	-	-

significantly the highest green forage yield (979 q/ha), dry matter (212.5 q/ha) and crude protein (23.79 q/ha) than other levels of irrigation. The highest green fodder yield under 1.0 IW:CPE ratio (I_4) could be attributed to cumulative effect of significant increase in plant height and number of tillers per meter row length under this treatments. The per cent increase in green forage yield under I_4 was 74.35, 26.13 and 6.65 per cent over I_1, I_2 and I_3 treatment, respectively. The increase in forage yield of pearl millet crop with increase in irrigation frequency was also observed by Chaurasia *et al.* (2006a).

Application of irrigation at 1.0 IW: CPE ratio (I_4) recorded significantly higher crude protein content in mean of three cuts (11.24 %) than other treatment. However, frequent irrigations applied at 1.0 IW: CPE ratio registered significantly the highest values of leaf: stem ratio (1.75) than other irrigation levels. Irrigation levels failed to exhibits their significant influence on neutral detergent fibre content of forage pearl millet (Table 2). Application of irrigation at 0.4 IW: CPE ratio was found significantly superior in water use efficiency (160.56 kg/ha mm) than irrigation at 1.0 IW : CPE ratio. Frequent irrigation given at 1.00 IW: CPW ratio to pearl millet crop also gave the maximum net realization Rs. 50340 Rs./ha and B.C.R. of 2.17.

Effect of nitrogen :

Increase in nitrogen application from 80 to 160 kg N/ha increased the green forage, dry matter and crude protein yields (Table 1). Significantly the highest green forage, dry matter and crude protein yields were produced with 160 kg N ha^{-1} (888, 186.7 and 20.59 q ha^{-1}, respectively), The remarkable increasing in yields with higher levels of nitrogen might be attributed to favourable effect on yield attributes. The increasing in leafy part due to nitrogen application might have ultimately resulted in higher photosynthetic activities and also in production of more photosynthates. This rapidly supplied food growing parts might have helped in improvement of growth and yield attributes. Application of 160 kg N ha^{-1} also registered significantly the highest leaf: stem ratio than other levels. Earlier workers also reported such response of nitrogen in forage pearl millet by Tiwana and Puri (2005) and Chaurasia *et al*. (2006b).

The magnitude of increase in average green forage, dry matter and crude protein yields were in order of 10.08 and 21.64, 16.91. and 35.06 as well as 46.65 and 20.51 per cent by application of 120 and 160 kg N ha^{-1} over 80 kg N ha^{-1}, respectively. Earlier work also reported such liner response of nitrogen in forage pearl millet have been reported by Shivran and Pareek (2001); Tiwana *et al.* (2003); Tiwana and Puri (2005) and Chaurasia *et al.* (2006a).

Successive increase in nitrogen application from 80 to 160 kg N ha^{-1} significantly increased the crude protein content of forage pearl millet, while NDF content was progressively decreased with each increase in nitrogen application (Table 2). Water use efficiency was increased with an increase in levels of nitrogen. Increase in nitrogen application also increased net realization and the highest

Table 2 : Effect of irrigation (IW : CPE ratio) and nitrogen (kg ha^{-1}) levels on yield attributing characters and quality parameters of pearl millet

Treatments	Plant height at harvest (cm)	Number of tillers / m row	Leaf stem ratio	Crude protein content (%)	Neutral detergent fibre content (%)
Irrigation (IW : CPE ratio) (I)					
I_1 – 0.4	135.3	59.2	1.45	9.59	70.62
I_2 – 0.6	142.3	6038	1.49	10.23	70.63
I_3 – 0.8	151.7	66.9	1.59	10.76	70.98
I_4 – 1.0	165.8	71.3	1.75	11.24	71.61
S.E. ±	2.7	0.9	0.02	0.08	0.52
C.D. (P=0.05)	7.8	2.7	0.07	0.23	NS
C.V. (%)	10.89	8.58	9.97	4.63	4.44
Nitrogen (kg/ha) (N)					
N_1 – 80	139.3	61.5	1.50	10.05	72.49
N_1 – 120	147.8	64.0	1.56	10.35	70.64
N_1 – 160	159.2	68.1	1.64	10.98	69.75
S.E. ±	2.2	0.6	0.02	0.07	0.43
C.D. (P=0.05)	6.1	1.8	0.06	0.20	1.21
C.V. (%)	10.09	6.95	10.48	4.72	4.20

NS=Non-significant

values of net realization (Rs. 45859/ha) and B.C.R (2.20) were recorded under treatment 160 kg N ha^{-1} (Deore *et al.,* 2013 and Sheta *et al.,* 2010).

Interaction was found not significant for green forage and dry matter yields. However, crude protein yield was significantly affected due to irrigation and nitrogen levels.

Conclusion :

From the ongoing discussion it can be concluded that application of irrigation at 1.0 IW:CPE ratio and 160 kg N ha^{-1} recorded significantly the highest green forage yield, dry matter and crude protein of pearl millet and gave the highest net returns.

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