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Effect of irrigation, sowing methods and phosphorus in lucerne (*Medicago sativa*)

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ABSTRACT

A field experiment conducted on loamy sand soil during 1992-94 at Sardar Krushinagar revealed that green fodder yield of lucerne (*Medicago sativa* L.) and consumptive use of water (CU) increased with the increase in irrigation levels from IW : CPE ratio of 0.75 to 1.25. A reverse trend was observed in case of water use efficiency (WUE). Moisture extraction decreased with the increase in soil depth. Highest extraction of moisture 0-45 cm was observed under IW : CPE ratio of 1.25. Line sowing at 25 cm recorded numerically higher values of yield, CU and WUE. Green fodder yield, CU and WUE increased with increase in P levels from 60 to 120 kg P_2O_5/ha.

Key words : Irrigation, Sowing method, Phosphorus, Lucerne

Lucerne (*Medicago sativa* L.) a multicut forage crop, capable of giving repeated cuttings provides a high tonnage of nutritive fodder, particularly during the period of scarcity (March-May) of green fodder. Having a longer season of active vegetative growth period, it needs frequent irrigations. Since irrigation water is one of the costlier inputs, its economic and efficient utilization becomes quite imperative. Besides, spatial arrangement of plants play an important role not only in optimizing forage production per unit area but also facilitates the cultural operations, light penetration and better root growth which helps in efficient use of applied water. The deficiency of P in soil severely limits the root and shoot growth and thereby CU, WUE and moisture extraction pattern. Keeping in view the above facts a study was undertaken to get precise information on these aspects.

MATERIALS AND METHODS

A field experiment was conducted at Sardar Krushinagar during *rabi* seasons of 1992-93 and 1993-94. The experiment was laid out in a split-plot design with 4 replications. The treatments comprised 3 irrigation

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schedules based on IW : CPE ratio (0.75, 1.00 and 1.25) as main plots and 4 P levels (60, 80, 100 and 120 kg P_2O_5/ha) as subplots. The soil was loamy sand, low in N (0.018-0.019%). and medium in available P (36-42 kg/ha) and K (286-290 kg/ha) with pH 7.8. The values of FC, PWP and BD were 8.93%, 2.80% and 1.58 g/cc in 0—30 cm soil depth, respectively. The crop was sown on 20 and 25 November in 1992-93 and 1993-94 respectively. The entire dose of P as per treatment was applied at sowing. Three common irrigations immediately after sowing, 5-6 DAS and 14–15 DAS, each of 60 mm depth were given to all the plots. A fixed depth of 60 mm irrigation water was applied in each irrigation based on IW : CPE ratios. Total quantity of irrigation water applied in IW : CPE ratio of 0.75, 1.00 and 1.25 received 14, 19 and 23 during 1992-93 and 12, 17 and 21 irrigations during 1993-94, respectively. The total quantity of irrigation water applied in IW : CPE ratios of 0.75, 1.00 and 1.25 was 1,020, 1,320 and 1,560 mm during 1992-93, and 900, 1,200 and 1,440 mm during 1993-94 respectively. A total 5 cuttings were taken during both years.

RESULTS AND DISCUSSION

Effect of irrigation

The total green fodder yield of lucerne increased significantly with an increase in the supply of irrigation water from IW : CPE ratio of 0.75 to 1.25 (Table 1). The green fodder yield over the seasons increased by 33.7 and 23.7% when irrigation was scheduled at 1.25 and 1.00 IW : CPE ratios, respectively over IW:CPE ratio of 0.75. Boehle *et al.* (1961) reported that yield of lucerne was directly proportional to the number of irrigations and quantity of irrigation water applied. As expected, the consumptive use of water (CU) increased as the frequency of irrigation increased from IW : CPE ratio of 0.75 to 1.25. Dhaliwal *et al.* (1987) also observed similar findings. The CU in crop irrigated more frequently was higher due to easy availability of moisture in the evaporating soil surface. The water use efficiency (WUE) decreased with increasing moisture supply. The highest WUE of 33.9 and 37.1 kg/ha-mm was recorded in IW : CPE ratio of 0.75 in 1992-93 and 1993-94, respectively (Table 2). The soil moisture extraction decreased progressively with increase in soil depth. The moisture extraction ranged between 63.85 and 70.83 and 36.14 and 29.18% from 0—45 cm and 45—90 cm soil depth respectively under various irrigation schedules. The highest extraction of moisture (70.83%) was recorded in IW : CPE ratio of 1.25, followed by IW : CPE ratio of 1.00 (67.27%), and was the lowest in IW : CPE ratio of 0.75 (63.85%) from first half of root zone (0-45 cm). The pattern of moisture extraction under various IW : CPE ratios from 45-90 cm soil depth was almost reverse as compared with 0-45 cm soil depth. This may be explained from the fact that once soil moisture had decreased in upper layer, plants have to depend more on water stored in deeper layers through development of long, finer and more branched roots. Similar results were also reported by Patel (1992).

Effect of sowing method

Sowing methods failed to manifest their significant effect on green fodder yield during 1993-94 and in pooled data. However,

Table 1. Effect of irrigation, sowing method and phosphorus on green fodder yield of lucerne and consumptive use of water

Treatment	Green fodder yield (q/ha)								Consumptive of water (mm)	
	I cut	II cut	III cut	IV cut	V cut	1992-93	1993-94	Pooled	1992-93	1993-94
IW : CPE ratio										
0.75	50.9	74.5	76.4	63.3	56.7	321.9	321.9	321.9	949	867
1.00	67.6	88.9	93.9	81.9	66.3	396.3	400.4	398.3	1,217	1,142
1.25	72.2	98.1	98.9	86.1	75.0	424.3	436.4	430.3	1,395	1,325
CD (P = 0.05)	4.03	3.27	3.68	5.11	3.41	11.10	18.02	10.14		
Sowing method										
Broadcast	63.4	85.9	88.1	75.4	64.6	374.1	380.7	377.4	1,185	1,109
Line sowing at 25 cm	63.8	88.4	91.2	78.8	67.4	387.5	391.8	389.6	1,189	1,113
CD (P = 0.05)	NS	NS	NS	NS	NS	9.07	NS	NS		
P_2O_5 (kg/ha)										
60	57.2	79.3	82.5	67.4	60.9	346.0	348.6	347.3	1,174	1,098
80	61.4	84.6	87.2	75.6	64.3	369.5	376.8	373.2	1,184	1,108
100	67.2	91.3	93.6	81.8	68.5	399.4	405.3	402.3	1,193	1,116
120	68.5	93.5	95.1	83.7	70.5	408.3	412.2	411.2	1,198	1,123
CD (P = 0.05)	2.61	2.40	5.53	2.23	4.48	5.55	7.65	4.68		

Actual evaporation during crop growth period was 1,314.2 mm during 1992-93 and 998.0 mm during 1993-94

Table 2. Effect of irrigation, sowing method and phosphorus on water use efficiency and moisture extraction pattern in lucerne

Treatment	Water use efficiency (kg/ha-mm)		Moisture extraction (%)			
	1992-93	1993-94	1992-93 Soil depth (cm)		1993-94 Soil depth (cm)	
			0-45	45-90	0-45	45-90
IW/CPE ratio						
0.75	33.9	37.1	63.69	36.31	64.02	35.98
1.00	32.5	35.1	68.00	32.00	66.55	33.45
1.25	30.4	32.9	77.53	28.47	70.13	29.87
Sowing method						
Broadcast	31.6	34.3	67.59	32.41	66.96	33.04
Line sowing at 25 cm	32.6	35.2	67.89	32.11	66.84	33.16
P_2O_5 (kg/ha)						
60	29.5	31.8	66.43	33.57	66.64	33.36
80	31.2	34.0	67.22	32.78	66.73	33.27
100	33.5	36.3	68.49	31.51	67.05	32.95
120	34.1	36.9	68.82	31.18	67.18	32.82

line sowing at 25 cm during 1992-93 (Table 1) gave more green fodder yield. The CU and WUE under line sowing was tended to be higher than broadcast sowing. This might be due to higher fodder yield in line sowing. The moisture extraction from different soil depths was not influenced by sowing method (Table 2).

Effect of phosphorus

Application of 120 kg P_2O_5/ha gave significantly highest green fodder yield during both the years and in pooled data (Table 1) over the seasons. Green fodder yield with 120, 100 and 80 kg P_2O_5/ha increased by 18.4, 15.8 and 7.5%, respectively over 60 kg P_2O_5/ha. Tomer *et al.* (1974) reported that the improvement in yield with phosphorus application is the result of improved growth resulting from increase in cell division, better root development and high microbial activity which supplied adequate nutrients to the plants. The CU, and WUE increased with increase in levels of phosphorus. Application of phosphorus increased the root proliferation which resulted in better absorption of soil moisture and nutrients. Dhaliwal *et al.* (1987) reported an increase in CU, and Hukkeri *et al.* (1976) found higher WUE at higher levels of phosphorus. Moisture extraction from different depths of soil was not influenced by phosphorus application (Table 2).

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