

Influence of irrigation, nitrogen and phosphorus on yield, nutrient uptake and water-use efficiency of blond psyllium (*Plantago ovata*)

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Received: August 1994

ABSTRACT

A response of 'Guj. 1' blond psyllium (*Plantago ovata* Forskaal) to different levels of irrigation and fertilizer was studied during the winter season of 1988–89 to 1990–91 on medium black clayey soil of Junagadh. Scheduling irrigation each of 50 mm depth and fertilizing the crop with 20 kg/ha each of nitrogen and phosphorus gave highest yield, consumptive use of water, water-use efficiency and nutrient removal by the crop.

Blond psyllium or *isabgul* (*Plantago ovata* Forskaal) plays an important role in agricultural economy in India and holds a monopoly in production and trade in the world. North Gujarat and Southern part of Rajasthan are major *isabgul*-production area, but now-a-day its cultivation is extended to non-traditional area including Saurashtra region. Irrigation water and fertilizer are costly and scarce inputs and their prudent use is important to get maximum use efficiency under limited resource conditions. The information on irrigation based on different approaches and fertilizer requirement of this region is lacking and hence this experiment was conducted.

MATERIALS AND METHODS

An experiment was carried out at Junagadh during winter season of 1988–89

to 1990–91 in split-plot design with 3 replications. The soil was medium black clayey, rich in total N (672 kg/ha available), low in available phosphorus (27 kg/ha) with pH 8.1. The field capacity, permanent wilting point and bulk density of 45 cm-soil profile were 22.4%, 12.3% and 1.4 g/cm³ respectively. *Isabgul* 'Guj. 1' was sown using 4 kg seeds/ha in the second week of November and harvested in the second week of March in different years. The consumptive use of water was worked out by the formula suggested by Dastane (1972).

RESULTS AND DISCUSSION

Effect of irrigation

Scheduling irrigation at 1.0 IW : CPE yielded significantly the highest seed and stover, which were 299 and 163 kg/ha higher over 0.6 and 0.8 IW : CPE ratios re-

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Table 1. Seed and stover yields, nutrient uptake, consumptive use of water, water-use efficiency and water-expense efficiency of *isabgul* as influenced by irrigation, nitrogen and phosphorus

Treatment	Yield (kg/ha)		Nutrient uptake (kg/ha)				Consumptive use of water (mm)	Water-use efficiency (kg seed/ha c.u. mm)	Water-expense efficiency (seed yield kg/ha mm water use)	Net return (Rs/ha)
	Seed	Stover	N		P					
			Seed	Stover	Seed	Stover				
<i>IW : CPE</i>										
0.6	946	4,179	14.617	16.946	2.185	1.464	169.562	5.116	3.459	3185
0.8	1,083	4,811	16.658	20.887	2.495	1.809	184.674	5.175	3.180	4101
1.0	1,245	5,322	18.698	23.400	2.938	2.238	202.538	5.251	2.651	5057
CD (P = 0.05)	176	311	0.291	0.594	0.079	0.115	1.778	NS	0.069	
<i>N (kg/ha)</i>										
0	1,010	4,618	15.851	18.584	2.354	1.676	178.885	4.882	2.002	4389
10	1,096	4,709	16.199	21.185	2.516	1.860	185.800	5.358	3.211	4913
20	1,168	4,986	17.922	21.465	2.749	1.975	192.085	5.307	3.277	5382
CD (P = 0.05)	29	NS	0.392	0.623	0.079	0.075	0.700	0.129	0.080	
<i>P₂O₅ (kg/ha)</i>										
0	1,033	4,618	15.257	17.242	2.220	1.361	178.805	4.974	2.873	4538
10	1,075	4,779	16.935	19.341	2.516	1.801	184.996	5.148	3.078	4781
20	1,166	4,916	17.781	24.650	2.882	2.348	192.973	5.421	3.339	5338
CD (P = 0.05)	29	155	0.392	0.623	0.079	0.075	0.700	0.129	0.080	

spectively. This ratio also accrual maximum net realization (Rs, 5057). Consumptive use of water increased substantially with each increment in IW : CPE ratio from 0.6 to 1.0 (Table 1). Remarkably higher water use of 202.538 mm was recorded under IW : CPE ratio of 1.0 over 0.8 and 0.6. Water-use efficiency under different IW : CPE ratio did not differ significantly. The higher seed yield with higher water use as compared to other ratios resulted in higher water-use efficiency under high ratio. The findings are in accordance with those of Randhawa *et al.* (1985). The water-expense efficiency significantly decreased with an increase in IW : CPE ratio

Scheduling irrigation at IW : CPE ratio of 1.0 to recorded significantly the highest N and P uptake by seed and stover of over the lower IW : CPE ratios of 0.8 and 0.6. The reason for higher nitrogen and phosphorus uptake under higher IW : CPE ratio of 1.0 was due to maximum 8 irrigations and higher dry-matter production.

Effect of N

Fertilizing *isabgul* with 20 kg N/ha recorded significantly the highest seed and stover yields and consumptive use (192.09 mm) of water. This level also showed the

maximum net realization (Rs 5,382). Water-use efficiency and water-expense efficiency at 20 and 10 kg N/ha did not differ statistically but significantly higher over the control. This level removed significantly the highest nitrogen and phosphorus by seed and stover over rest of lower levels of nitrogen except in case of nitrogen uptake by fodder. Increased uptake by increasing the application of nitrogen was reported by Kalyansundaram *et al.* (1982).

Effect of P

Application of phosphorus at 20 kg/ha significantly recorded the highest seed and stover yields than lower level of phosphorus. Maximum net return (Rs 5,338) was also realized with this level. Consumptive use of water, water-use efficiency and water-expense efficiency recorded at 20 kg P_2O_5 /ha was significantly highest over rest of the levels.

Application of 20 kg P_2O_5 /ha removed significantly higher nitrogen and phosphorus by seed and stover. Increasing levels of phosphorus increased the nitrogen and phosphorus uptake, because of the increasing trend in dry-matter production. The added phosphorus has resulted in increased availability of available

Table 2. Effect of irrigation x nitrogen interaction on consumptive use of water (mm)

Irrigation	N (kg/ha)			Mean
	0	10	20	
IW : CPE				
0.6	168.984	168.168	171.536	169.563
0.8	176.374	185.831	191.817	184.674
1.0	191.301	203.401	212.912	202.538
Mean	178.886	185.800	192.088	
CD (P = 0.05)	1.213			

phosphorus under proper environmental conditions of the plant growth.

Interaction of irrigation and nitrogen in respect of consumptive use of water was found significant. Irrespective of IW : CPE ratios, consumptive use of water increased significantly with increase in nitrogen levels from 0 to 20 kg/ha. Under the same levels of 10 and 20 kg N/ha the water used increased significantly with increase in IW : CPE ratio for 0.6 to 1.0. The treatment combination of irrigation at IW : CPE ratio of 1.0 with 20 kg N/ha recorded significantly the highest

consumptive use of water by 212.912 mm. over rest of the combinations.

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