INNOVARE JOURNAL OF AGRICULTURAL SCIENCE

Vol 2, Issue 2 , 2014 ISSN: 2321-6832

Original Article

IRRIGATION AND INTEGRATED NUTRIENT MANAGEMENT IN CASTOR (*RICINUS COMMUNIS* L.)

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Received:17 July 2013, Revised and Accepted:18 December 2013

ABSTRACT

The results of a two year's field experiment conducted at Junagadh (Gujarat) on clayey soils to evaluate the effect of irrigation (0.4 and 0.8 IW:CPE), biofertilizer (control and seed treatment with *Pseudomonas striata*), nitrogen (50, 75 and 100 kg N/ha) and phosphorus (0, 25 and 50 kg P_2O_5/ha) revealed that irrigation scheduled at 0.8 IW:CPE, seed inoculation with phosphate solubilizing bacteria, application of 100 kg N/ha and 50 kg P_2O_5/ha significantly increased growth and yield attributes, and yield of castor as well as also proved economical in terms of net realization.

Keywords: Seed, yield , plant , castor, irrigation.

INTRODUCTION

Although India is the largest producer of castor in the world, its productivity is very low as against obtained in Asia and the world. In India, its productivity is low even in the leading castor growing states. The crop is mainly cultivated as a rainfed annual crop on marginal fertility lands, which is one of the important reasons for low yields of this crop. Therefore, there is a further scope to increase crop productivity through irrigation and fertilizer management. Phosphorus fixation is the main constraint for phosphorus availability particularly in calcareous clayey soils. This necessitates the use of efficient strain of phosphate solubilizing microorganisms. Keeping these points in view, the present investigation was undertaken to study the response of castor to irrigation scheduling based on IW:CPE ratio and phosphate solubilizing microorganism *Pseudomonas striata* vis-à-vis levels of nitrogen and phosphorus.

MATERIALS AND METHODS

The field experiment was conducted at Sagadividi Farm, Junagadh Agricultural University, Junagadh for two consecutive *kharif* seasons of 2010-11 and 2011-12. The soil of experimental site was medium black clayey in texture having bulk density 1.45 g/cm^3, field capacity 39.0%, permanent wilting point 19.0% with organic carbon 0.65%, available N 214 kg/ha, available P_2O_5 29 kg/ha, available K_2O 305 kg/ha, pH 7.8 and E.C. 0.39 dS/m. The experiment was laid out in split-split plot design with three replications. The main plots comprised IW:CPE ratios (I_1= 0.4 and I_2= 0.8), sub plots comprised biofertilizer *Pseudomonas striata* (B_0= untreated control and B_1=seed treatment) and sub-sub plots comprised combination of nitrogen (N_1= 50, N_2= 75 and N_3= 100 kg N/ha) and phosphorus (P_0= 0, P_1= 25 and P_2= 50 kg P_2O_5/ha). Castor hybrid 'GCH 7' was sown at 90 cm x 60 cm spacing on 27th August, 2010 and 14th August, 2011 with a seed rate of 12 kg/ha. Phosphorus as per treatments was applied at sowing, while nitrogen was applied in two equal splits; half at sowing and remaining half at 45-60 days after sowing. Seeds were inoculated with phosphate solubilizing culture (*P. striata*) @ 50 ml/kg seed. Irrigations each of 50 mm depth were applied at cumulative pan evaporation of 125 and 62.5 mm to maintain 0.4 and 0.8 IW:CPE, respectively. Rainfall received during the crop growing season was 1558 and 963 mm during 2010-11 and 2011-12, respectively.

RESULTS AND DISCUSSION

Irrigation

Seed and stalk yields of castor were significantly influenced by irrigation based on IW:CPE ratios during both the years as well as in pooled results (Table 1). The IW:CPE ratio of 0.8 recorded 13.9 and 15.6 % higher seed and stalk yields, respectively as compared to IW:CPE ratio of 0.4. This ratio also found economical as it recorded higher net realization over 0.4 IW:CPE. Growth and yield attributes viz., plant height, days to 50 % flowering, branches/plant, spikes/plant, length of main spike, capsules/main spike, 100-seed weight and seed weight/plant were significantly improved under irrigation scheduled at 0.8 IW:CPE (Table 2), which ultimately resulted in higher seed and stalk yield over IW:CPE of 0.4. These findings are in agreement with those of Sudhakar and Rao (1998) and Patel *et al.* (1999).

Biofertilizer

Seed inoculation with *Pseudomonas striata* significantly increased seed and stalk yields over control in individual years and pooled results (Table 1). On an average, biofertilizer registered 14.7 and 14.6 % higher seed and stalk yield, respectively over control. Inoculation of phosphobacteria also accrued higher net realization over control. This might be attributed to improved growth and yield attributes viz., plant height, branches/plant, spikes/plant, length of main spike, capsules/main spike, 100-seed weight and seed weight/plant with application of biofertilizer (Table 2). These results corroborates with those reported by Arangarsaran *et al.* (1999).

Nitrogen

Seed and stalk yield significantly increased with each increment in level of nitrogen from 50 to 100 kg N/ha during both the years as well as in pooled results (Table 1). Application of 100 kg N/ha recorded significantly highest seed and stalk yields as well as net realization. Increased yield at 100 kg N/ha had evidently resulted from significantly accelerated growth and yield attributes viz., plant height, days to 50 % flowering, branches/plant, spikes/plant, length of main spike, capsules/main spike, 100-seed weight and seed weight/plant (Table 2). The results are in accordance with those reported by Mathukia and Modhwadia (1993).

Phosphorus

Application of phosphorus significantly increased seed and stalk yields during both the years and in pooled results (Table 1). Crop fertilized with 50 kg P_2O_5/ha produced significantly highest seed and stalk yield. P application @ 50 kg P_2O_5/ha was proved economical by recording highest net realization. Significantly enhanced growth and yield attributes viz., plant height, days to 50 % flowering, branches/plant, spikes/plant, length of main spike, capsules/main spike, 100-seed weight and seed weight/plant under 50 kg P_2O_5/ha were reflected in terms of higher yield (Table 2). Patel (1997) also reported similar results.

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Table 1. Effect of irrigation, biofertilizer, nitrogen and phosphorus on yield of castor and net realization.

Treatment	Seed yield (q/ha)			Stalk yield (q/ha)			Net realization (Rs/ha)		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
IW:CPE									
I_1= 0.4	20.11	22.82	21.47	26.13	29.24	27.69	7988	9633	8811
I_2= 0.8	23.90	25.01	24.46	31.00	33.01	32.01	10488	10597	10543
CD (P=0.05)	3.38	2.15	1.10	4.29	2.97	1.12			
Biofertilizer									
B_0= control	20.38	22.40	21.39	26.42	29.19	27.81	7779	8758	8269
B_1= *P. striata*	23.63	25.43	24.53	30.71	33.05	31.88	10697	11907	11302
CD (P=0.05)	2.07	1.13	0.91	2.59	1.47	1.16			
N kg/ha									
N_1= 50	19.66	22.09	20.88	25.56	28.72	27.14	7291	8641	7966
N_2= 75	21.39	23.64	22.52	27.81	30.74	29.28	8677	9864	9271
N_3= 100	24.96	26.01	25.49	32.34	33.92	33.13	11743	11836	11790
CD (P=0.05)	0.84	0.82	0.59	1.10	1.18	0.79			
P_2O_5 kg/ha									
P_0= 0	19.00	21.86	20.43	24.70	28.42	26.56	6739	8583	7661
P_1= 25	21.68	23.31	22.50	28.14	30.30	29.22	8074	9563	8818
P_2= 50	25.34	26.58	25.96	32.86	34.65	33.76	11939	12197	12068
CD (P=0.05)	0.84	0.82	0.59	1.10	1.18	0.79			

Table 2. Effect of different treatments on growth and yield components of castor (Pooled over two years).

Treatment	Plant height (cm)	Days to 50 % flowering	Branches /plant	Spikes /plant	Length of main spike (cm)	Capsules /main spike	100-seed weight (g)	Seed weight /plant (g)
IW:CPE								
I_1= 0.4	103.6	55.0	6.2	8.5	40.7	58.0	27.5	115.5
I_2= 0.8	107.9	58.4	7.0	9.4	44.1	64.0	31.1	132.2
CD (P=0.05)	2.93	1.02	0.2	0.4	1.0	2.4	1.3	6.5
Biofertilizer								
B_0= control	104.7	56.6	6.4	8.7	40.6	60.1	28.3	115.7
B_1= *P. striata*	106.8	56.7	6.8	9.2	44.2	62.0	30.4	132.0
CD (P=0.05)	2.11	NS	0.2	0.3	1.4	1.7	0.8	4.9
N kg/ha								
N_1= 50	104.5	55.6	6.0	8.4	41.2	59.9	28.5	112.7
N_2= 75	105.7	56.6	6.5	9.0	42.3	60.9	29.3	121.5
N_3= 100	107.0	57.8	7.2	9.5	43.7	62.3	30.1	137.5
CD (P=0.05)	1.05	0.4	0.1	0.2	0.4	0.6	0.4	2.8
P_2O_5 kg/ha								
P_0= 0	104.2	57.7	5.8	8.2	41.0	59.3	28.3	110.0
P_1= 25	105.7	56.5	6.5	8.9	42.3	60.7	29.3	121.1
P_2= 50	107.4	55.8	7.4	9.8	43.9	63.1	30.4	140.6
CD (P=0.05)	1.05	0.4	0.1	0.2	0.4	0.6	0.4	3.3