Internat. J. agric. Sci. Vol.2 No.2 July 2006 : (608-609)

Evaluation of in *situ* moisture conservation practices and zinc fertilization for rainfed castor (*Ricinus communis* L.)

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ABSTRACT

In a field experiment conducted at Junagadh (Gujarat) during 2002 and 2003, moisture conservation practices and zinc fertilization were evaluated for castor (*Ricinus communis* L.) under rainfed conditions. The results explicate that broad bed and furrow and in-row subsoiling conserved the soil moisture and significantly enhanced root and shoot growth, yield, quality nutrients use as well as B:C ratio over flat bed control. Zinc fertilization @ 10 and 5 kg ha^{-1} were found equally effective and increased growth, yield, quality and nutrients uptake as well as B:C ratio over control.

Key words: Castor, *In situ* moisture conservation, Subsoiling, BBF, Zinc

INTRODUCTION

Rainwater conservation is a critical factor in stabilizing and stepping up of crop yields in drylands. Land configuration like broad bed and furrow (BBF) and non-inversion tillage like subsoiling can increase infiltration of rainwater and thus helps to improve moisture storage in soil profile. Among micronutrients, deficiency of zinc is most common, widespread and frequently found in arid and semi-arid soils. With these points in view, the present experiment was undertaken to evaluate the response of castor (*Ricinus communis* L.) to moisture conservation practices and zinc application.

MATERIALS AND METHODS

A field investigation was carried out during rainy (*kharif*) seasons of 2002 and 2003 at Department of Agronomy, Junagadh Agricultural University, Junagadh. The soil was clayey in texture and slightly alkaline in reaction (pH 7.9 and EC 0.28 dS m^{-1}) with available N 248 kg ha^{-1}, available P_2O_5 33 kg ha^{-1}, available K_2O 280 kg ha^{-1} and available Zn 0.85 mg kg^{-1}. Field capacity and permanent wilting point were 27.9 and 12.8%, respectively, whereas bulk density was 1.38 Mg m^{-3} with 44.6% porosity. There were 5 main plots assigned to moisture conservation practices viz., M_1- flat bed (FB), M_2- alternate between-row subsoiling (ABRS), M_3- between-row subsoiling (BRS), M_4- in-row subsoiling (IRS) and M_5- broad bed and furrow (BBF) and 3 sub-plots allocated to zinc levels viz., 0, 5 and 10 kg ha^{-1}. The experiment was laid out in split plot design with 4 replications. Subsoiling to a depth of 30 cm was carried out by subsoiler, while a bed of 150 cm width with furrow of 30 cm width and 15 cm depth was formed by BBF former after preparatory tillage and before sowing. The crop was fertilized with 40 kg N and 40 kg P_2O_5 ha^{-1}. Zinc in the form of $ZnSO_4$ was applied at sowing in furrows as per treatments. The castor variety 'GCH 6' was sown at 90 x 30 cm on 2nd July, 2002 and 20th June, 2003 and harvested according to maturity of different spike orders. The total seasonal rainfall of 540 and 1275 mm was received in 22 and 42 rainy days during 2002 and 2003, respectively.

RESULTS AND DISCUSSION

Moisture conservation practices

Different practices of moisture conservation could impose their significant influence on moisture content in soil as well as growth and yield attributes (Table 1). Broad bed and furrow (M_5) and in-row subsoiling (M_4), both being statistically at par, recorded significantly higher moisture content in soil at 90 days after sowing (DAS) and also improved length and dry weight of roots as compared to flat bed (M_1). Both these practices accelerated growth and yield parameters viz., pant height, leaf area index (LAI), dry matter/plant, length of main spike, capsules/main spike and spikes/plant over flat bed (M_1).

Table 1 : Effect of moisture conservation practices and zinc fertilization on physical properties of soil and growth and yield attributes of castor (pooled over two years)

Treatments	Bulk density (Mg m^{-3})	Soil moisture (%) at 90 DAS	Root length (cm)	Root dry weight (g)	Plant height (cm)	LAI at 120 DAS	Dry matter /plant (g) at 120 DAS	Length of main spike	Capsules /main spike	Spikes/ plant
Moisture conservation practices										
M_1- FB	1.400	17.53	49.43	28.96	78.83	1.36	71.53	34.01	37.52	3.83
M_2- ABRS	1.392	18.12	52.60	30.40	84.03	1.49	74.29	36.23	42.03	4.50
M_3- BRS	1.382	18.20	53.90	31.49	87.94	1.66	75.38	37.94	45.88	4.64
M_4- IRS	1.323	19.32	64.84	38.94	91.83	1.71	81.51	40.43	56.48	5.27
M_5- BBF	1.356	19.41	59.01	36.92	92.94	1.69	82.63	40.51	57.53	5.23
CD (P=0.05)	NS	0.78	2.29	2.68	5.00	0.13	4.47	1.12	3.54	0.37
Zinc (kg ha^{-1})										
Z_1- 0	1.349	18.58	55.16	32.55	81.44	1.52	73.60	36.31	44.73	4.60
Z_2- 5	1.380	18.49	56.19	33.67	89.48	1.59	78.22	38.45	48.69	4.69
Z_3- 10	1.383	18.48	56.51	33.82	90.43	1.64	79.39	38.71	50.25	4.80
CD (P=0.05)	NS	NS	NS	NS	3.65	0.06	2.99	0.42	1.50	NS

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Table 2 : Effect of moisture conservation practices and zinc fertilization on yield, quality, nutrient use and B:C ratio (pooled over two years).

Treatments	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	B:C ratio	Oil (%)	Oil yield (kg ha^{-1})	Nutrient uptake (kg ha^{-1})			
						Nitrogen	Phosphorus	Potash	Zinc
Moisture conservation practices									
M_1- FB	1233	1650	1.65	46.41	572	39.58	6.028	20.30	0.118
M_2- ABRS	1286	1712	1.62	46.86	603	41.80	6.266	20.83	0.122
M_3- BRS	1318	1750	1.56	47.00	619	42.59	6.171	20.82	0.123
M_4- IRS	1452	1929	1.82	47.74	693	44.34	6.859	22.12	0.134
M_5- BBF	1463	1930	1.84	47.78	699	44.51	6.662	21.87	0.134
CD (P=0.05)	95	103	0.19	0.67	48	2.86	0.443	NS	0.008
Zinc (kg ha^{-1})									
Z_1- 0	1256	1678	1.63	46.82	589	39.56	6.344	19.20	0.114
Z_2- 5	1388	1841	1.77	47.30	656	43.73	6.513	22.00	0.131
Z_3- 10	1407	1864	1.68	47.36	666	44.40	6.334	22.36	0.134
CD (P=0.05)	47	45	0.09	0.31	22	1.62	NS	0.69	0.004

Conversely, flat bed (M_1) registered minimum values of these parameters. Broad bed and furrow (M_5) and in-row subsoiling (M_4) produced significantly higher seed and stalk yields along with higher B:C ratio, oil content, oil yield and uptake of N, P and Zn over flat bed (Table 2). On an average, broad bed and furrow (M_5) and in-row subsoiling (M_4) increased seed yield by 18.7 and 17.8% and stalk yield by 17.0 and 16.9% over flat bed (M_1), respectively. This could be attributed to increased soil moisture and favourable physico-chemical properties of soil with broad bed and furrow (M_5) and in-row subsoiling (M_4). Alike results with BBF were reported by Velayudham *et al.* (1997) in castor and with subsoiling by Nitant and Singh (1995) in pigeonpea.

Zinc levels

Zinc levels exhibited their significant outcome on growth and yield characters except spikes/plant (Table 1). Application of zinc @ 10 kg ha^{-1} (Z_3) and 5 kg ha^{-1} (Z_2) while being at par significantly excelled growth and yield attributes viz., plant height, LAI, dry matter/ plant, length of main spike and capsules/main spike. Zinc fertilization @ 10 kg ha^{-1} (Z_3) and 5 kg ha^{-1} (Z_2) also produced significantly higher seed and stalk yield as well as B:C ratio, oil content, oil yield and uptake of N, K and Zn over control (Z_1). On an average, application of zinc @ 10 kg ha^{-1} (Z_3) and 5 kg ha^{-1} (Z_2) increased seed yield by 12.0 and 10.5% and stalk yield by 11.1 and 9.7% over control (Z_1), respectively (Table 2). By virtue of involvement in various enzyme systems, carbohydrate metabolism and redox processes, zinc might have promoted growth, yield and quality of the crop. Murthy and Muralidharudu (2003) also reported analogous results.

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Received : September, 2005; Accepted : May, 2006