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OPTIMIZATION OF CASTOR (Ricinus communiS L.) PRODUCTION UNDER LIMITED RESOURCE CONDITIONS IN CENTRAL DRY ZONE OF KARNATAKA

V. VENKATACHALAPATHI[1], GANGADHAR ESWAR RAO[2] AND T. RUDRAMUNI[3]
[1,2,3] *Zonal Agricultural Research Station (UAHS), AICRP on Castor, Babbur Farm, Hiriyur-560 065(Karnataka), India*

Abstract
Field trials for optimization of castor production in relation to limiting production factors (fertilizers, plant protection and weeding) were conducted at Zonal Agricultural Research Station, Hiriyur on medium black soil to identify the hierarchy of production factors for efficient use of resources for optimum production. The results revealed that adoption of Recommended Package of Practices (RPP) is highly remunerative in castor production. Among the individual production factors, withdrawal of weeding (660 Kg ha^{-1}) from recommended package of practice (RPP), alone caused substantial reduction in yield (57 %), followed by fertilizer (30 %) and plant protection (12 %). Fertilizer alone or plant protection in the absence of weeding did not increase yield considerably. Thus, weeding emerged out to be the most limiting factor in castor production under rainfed condition.
Keywords: Castor, Fertilizer, Plant protection, Recommended Package of practices and Weeding

I. INTRODUCTION

Castor is one of the ancient and important industrial and non-edible oil crops of the world. Castor (*Ricinus communis L.*) occupies an important place in the country's vegetable oil economy. In 2010-11, castor occupied an area of 8.85 lakh ha with a production of 13.37 lakh tonnes in the country. Interestingly, the yield levels have increased from 1334 Kg ha^{-1} in 2009-10 to 1512 Kg ha^{-1} in 2010-11 (Anonymous, 2011). In Karnataka, castor crop is cultivated as a as an intercrop with groundnut and that too mostly under rainfed conditions under marginal and sub marginal lands with local varieties leaving the crop thirsty and hungry by the resource poor farmers. Rainfed farmers, with their limited investment capacity cannot afford to adopt Recommended Package of Practices (RPP) resulting limited per unit area productivity. Among various components of Recommended Package of Practices, weeding, fertilizer and plant protection contribute much towards the growth and yield of castor under rainfed condition. But, relative contribution of these factors has not been quantified in Central Dry Zone of Karnataka. Hence, present study was conducted to identify the hierarchy of production factors (Fertilizer, Weeding and Plant protection either alone or in combination) according to their contribution to the yield. Efficient use of resources under limited resource condition could be done by giving maximum emphasis to those particular inputs which contributes maximum towards yield.

II. MATERIAL AND METHODS

A Field experiment was conducted at Zonal Agricultural Research Station, Babbur Farm, Hiriyur, University of Agricultural Sciences, Bangalore during *kharif* season of 2009, 2010 and 2011. The experiment was laid out in Randomized Block Design with eight treatments consisted of P_1: Recommende Package of Practices (All components of the Package), P_2: Recommended Package of

Practice without fertilizer application, P_3: Recommended Package of Practice without adoption of Plant protection measures , P_4: Recommended Package of Practice without adoption of Weeding, T_5: Recommended Package of Practice without application of fertilizers and adoption of Plant protection measures, P_6: Recommended Package of Practice without application of fertilizers and adoption of Weeding, P_7: Recommended Package of Practice without adoption of plant protection measures and weeding, P_8: Recommended Package of Practice without application of fertilizers , without adoption of plant protection measures and weeding. The treatments are replicated thrice.

The soil of the experiment block was medium black with p^H value 7.68, low in available nitrogen (192.0 kg ha^{-1}), medium available P_2O_5 and K_2O of 21.8 and 278.0 kg ha^{-1}, respectively. As per the treatments, fertilizers were applied based on the recommended dose (40 kg N, 40 kg P_2O_5 and 20 kg K_2O per hectare) in the form of urea, single super phosphate and muriate of potash and hand weeding was done. One third of nitrogen along with the entire dose of phosphorus and potassium was applied as basal dose at sowing by band placement. Remaining two thirds of nitrogen was applied in two equal split doses each at 45 and 75 days after sowing. Three weeding at 20, 40 and 60 DAS were done in all the treatments except in the treatments where weeding was withdrawn, plant protection measures were adopted as per the treatments. The seeds of castor hybrid DCH-177 were dibbled at 90 X 60 cm spacing in the 2nd fortnight of July. The crop was harvested in three pickings manually based on physiological maturity of the capsule. Data pertaining to crop growth, yield attributes and yield were collected at harvest and analyzed statistically. The economics for various treatments were calculated based on market price. Gross returns were calculated by multiplying seed yield and prevailing market price. Net returns were based on gross returns and cost of cultivation and B: C ratio was calculated based on the gross returns and cost of cultivation.

III. RESULTS AND DISCUSSION

The pooled results revealed that adoption of all components of recommended package of practices (P_1) resulted in significantly higher seed yield (1534 kg ha^{-1}) over other treatments. The increase in seed yield was mainly attributed to significanty increased number of spikes/plant, capsules/spike and higher spike length and 100 seed weight (Table 1).

Table 1: Seed yield and yield components of castor as influenced by Resource constraints in rain fed castor (2009-11)

Treatment	Number of Spikes per plant				Length of primary spike (cm)				Number of capsules per spike				100 seed weight (g)				Seed yield (kg ha^{-1})			
	2009	2010	2011	Poole d	2009	2010	2011	pooled	2009	2010	2011	pooled	2009	2010	2011	Poole d	2009	2010	2011	poole d
P_1	7.7	5.9	4.1	5.9	31.2	43.3	39.7	38.0	35.0	40.2	49.3	41.5	27.2	37.8	27.3	30.8	1190	1769	1643	1534
P_2	6.7	3.4	4.5	4.9	27.0	28.9	43.9	33.3	30.2	31.0	44.3	35.0	25.1	24.8	24.0	24.7	660	1002	1551	1071
P_3	6.9	5.3	4.5	5.6	30.5	42.2	43.5	38.7	27.8	39.8	45.8	37.5	27.0	30.9	26.7	28.2	737	1740	1581	1353
P_4	5.3	2.8	3.0	3.7	27.7	27.5	35.5	29.0	25.3	22.9	38.9	27.0	22.7	23.9	24.7	23.8	514	615	851	660
P_5	7.0	5.0	5.3	5.8	27.9	39.7	38.7	35.4	22.4	38.3	38.3	32.9	25.1	29.3	27.3	27.2	526	1194	1162	961
P_6	5.4	3.1	3.0	3.8	23.9	28.3	31.8	29.2	23.0	26.7	34.7	28.0	23.2	24.6	28.0	25.3	475	673	728	625
P_7	6.6	4.7	1.7	4.4	24.1	38.7	30.0	30.9	19.5	34.7	33.8	31.0	24.3	28.8	28.0	27.0	383	934	894	737
P_8	3.8	3.5	1.2	2.8	27.5	30.3	24.5	27.4	18.2	31.5	27.9	25.7	20.9	27.3	22.0	23.4	284	685	247	406
S.Em ±	1.1	0.5	0.4	0.4	1.6	2.5	3.0	1.4	2.1	3.5	4.3	1.8	1.7	2.8	1.3	1.0	55.0	112.0	113.2	60.0
C.D (P=0.05)	3.2	1.4	1.1	1.3	4.8	7.6	8.9	4.0	6.5	10.5	12.7	5.2	5.0	8.5	3.8	3.0	168	332.8	332.1	178.4

Studies conducted at Bawal, Gujrat, Kanpur, Mandor and Yethapur on optimization of castor production under resource constraints also indicated the need for adoption of full package of practices to obtain the highest seed yield of castor (Anonymous, 2009). Decline in yield attributes and seed yield of castor was observed with the non adoption of various components (Weeding, fertilizer application and plant protection) of recommended package of practices either alone or in combination. Among the individual production factors, withdrawal of weeding (660 kg ha^{-1}) from recommended package of practices, alone caused substantial reduction in yield (57 %) followed by non adoption of fertilizer

application (30 %) and plant protection measures (12 %). This indicates that fertilizer is the next most important factor after weeding to enhance productivity of castor under rainfed conditions.

Non adoption of weeding allowed the weeds to grow throught the crop period, which completely smothered the castor and also suppressed plant growth due to severe competition for inputs viz., soil moisture and nutrients, as a result castor produced lower number of spikes/plant, capsules/spike, shorter raceme and 100 seed weight which ultimately reflected in poor seed yield. Further withdrawal of fertilization, affected the castor growth and seed yield due to poor available nitrogen, medium available phosphorus and potassium in the soil. However non adoption of plant protection measures (T_3) from full package caused less reduction in seed yield as compared to non adoption of weeding and fertilizer, because of flexuation in the seviority of pests and disease incidence in different seasons, as incidence of pest and diseases is season bound.

Non adoption of fertilizer and plant protection (961 kg ha^{-1}), withdrawal both fertilizer and weeding (625 kg ha^{-1}) and weeding and plant protection (737 kg ha^{-1}) decreased seed yield by 37, 59 and 52 percent respectively over adoption of full package. Non adoption of the three factor gave the least yield (406 kg ha^{-1}). Fertilizer alone or plant protection in the absence of weeding did not increase yield considerably. Thus, weeding emerged out to be the most limiting production factor in castor under rainfed condition in the central dry zone of Karnataka.. At Navasari (Gujrat), non adoption of weeding significantly suppressed castor yield (1809 kg ha^{-1}) closely followed by non adoption of fertilizer input (3437 kg ha^{-1}) as compared to full package (3940 kg ha^{-1}), thus proving their importance in castor production (Anonymous, 2010).

Table 2: Economics of castor as influenced by Resource constraints (2009-11)

Treatments	Gross returns (Rs.ha^{-1})				Net returns (Rs. ha^{-1})				B:C ratio			
	2009	2010	2011	Pooled	2009	2010	2011	Pooled	2009	2010	2011	Pooled
P_1	26775	60157	59148	48693	14625	46062	43644	34777	2.2	4.3	3.8	3.4
P_2	14850	34057	55833	34913	4700	21462	41979	22714	1.5	2.7	4.0	2.7
P_3	16583	59149	56910	44214	5253	46154	42616	31341	1.5	4.6	4.0	3.3
P_4	11565	20908	30644	21039	2335	8013	16460	8936	1.3	1.6	2.2	1.7
P_5	11835	40596	41840	31424	2405	29101	29196	20234	1.3	3.5	3.3	2.7
P_6	10688	22872	26207	19922	2278	11477	13673	9143	1.3	2.0	2.1	1.8
P_7	8618	31740	32200	26819	1288	19945	19226	13486	1.2	2.7	2.5	2.1
P_8	6390	23301	8907	13799	-120	13006	-2417	3490	1.0	2.3	0.8	1.3

Economic analysis of different production factors also revealed that adoption of recommended package accrued greater monetary benefits (net returns and B:C ratio of Rs.34777/ha and 3.4 respectively). Non-adoption of weeding, fertilizer and plant protection measures individually from the whole package reduced the net returns by Rs.25841/ha, Rs.12063/ha and Rs.3436/ha respectively (Table 2), these results are in agreement with the findings of Singh (2008). Non-adoption of weeding and fertilizer either alone or in conjunction depressed net returns to greater extent. Non adoption of plant protection, weeding and fertilizer made this crop non remunerative.

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