

**EFFECT OF CRITICAL PERIOD OF CROP-WEED COMPETITION ON
NUTRIENT CONTENT AND UPTAKE BY WEED AND RABI CASTOR
(*Ricinus communis* L.) UNDER SOUTH GUJARAT CONDITION**

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ABSTRACT

*A field experiment entitled “Effect of critical period of crop-weed competition on nutrient content and uptake by weed and rabi castor (*Ricinus communis* L.) under South Gujarat condition” was conducted at Instructional Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during rabi 2009-10. Total twelve treatments viz., Weed free up to 30 DAS, Weed free up to 60 DAS, Weed free up to 90 DAS, Weed free up to 120 DAS, Weed free up to harvest, Weedy up to 30 DAS, Weedy up to 60 DAS, Weedy up to 90 DAS, Weedy up to 120 DAS, Weedy up to harvest, Two hand weeding and interculturing at 30 and 60 DAS and Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS were evaluated with three replications in a randomized block design (RBD). The results revealed that treatment weed free up to harvest recorded significantly lowest weed density; dry weight of weeds; nutrient uptake by weed and maximum nutrient uptake by weeds & yield by crop which found statistically on par with the treatment weed free up to 120 DAS and weed free up to 90 DAS. However, treatment having weed free condition up to 90 days recorded maximum net return (70484) as well as B:C ratio (3.28) as compared to all the treatments. Thus, to realize the potential monetary return and seed yield of castor with reducing the weed competition, crop should be kept weed free up to initial 90 days after sowing, which is more crucial for crop weed competition.*

KEY WORDS: *Castor, crop-weed competition, nutrient content, nutrient uptake*

INTRODUCTION

Castor (*Ricinus communis* L.), being a valuable non-edible oilseed crop playing an important role in agriculture economy mostly grown with wider spacing and in *rabi* season. Its initial growth is very slow, which provides congenial condition for weed growth. In addition to that, South Gujarat region have great problem of weeds throughout the year due to heavy soils. Weeds are one of the

major causes for the poor yield of castor, as they compete with the crop for moisture, nutrients, light and space. Yield losses due to crop-weed competition in castor have been estimated up to the 73.6 per cent (Dungarwal *et al.*, 2002), and the critical period of weed-competition in castor have been reported 30 to 60 days after sowing (Anonymous, 2008). Physiologically, weeds and crop plants are very identical as both demand

similar things from the environment for their growth and development. When weeds utilize any of the component from the environment, these components become less available to crop. If crop and weeds are growing independent of each other and the supply of essential growth factors is in excess of the need of both, then no competition will occur or there will be less severe competition. Competition begins when crop and weeds interfere with one another and the supply of a single necessary factor falls below the demand of both. Once this occur the factors for plant growth cannot be used effectively even though they are present in adequate quantity.

Several measures have been suggested to control the weeds. But, weed management needs to be resorted to a period during which weeds cause's considerable losses in the yield by competing with the crop plant. Therefore, determination of critical period becomes imperative for planning weed management programme and to curtail unwise expenditure towards weed management practices. Little scientific information is available for castor in this matter and hence, this experiment was planned at the Instructional Farm, N. M. college of Agriculture, Navsari Agricultural University, Navsari, Gujarat.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* - 2009-10 at Instructional Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari located at the 20° 57' N latitude and 72° 54' E longitude and has an altitude of 10 m above the mean sea level under Agro-Ecological Situation (AES)-III of South Gujarat Heavy Rainfall Zone. The soil was clayey in texture having medium availability of nitrogen (212 kg/ha) and

phosphorus (43 kg/ha) and fairly rich in available potassium (318 kg/ha). The soil was slightly alkaline in reaction (pH 7.8) with normal electrical conductivity (0.212 dS/m).

The twelve treatments viz., Weed free up to 30 DAS, Weed free up to 60 DAS, Weed free up to 90 DAS , Weed free up to 120 DAS , Weed free up to harvest, Weedy up to 30 DAS, Weedy up to 60 DAS, Weedy up to 90 DAS, Weedy up to 120 DAS, Weedy up to harvest, Two hand weeding and interculturing at 30 and 60 DAS and Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS were evaluated with three replications in a randomized block design (RBD). The experimental field was prepared by tractor drawn implements. The field was cultivated in both the directions followed by planking for leveled and made the experiment plots 6.0 m wide and 6.0 m long. The sowing of castor var. GCH-7 was done with spacing 120 cm x 60 cm by manual labourers in the month of October. The crop was fertilized as per recommended dose (80-40-0 kg NPK/ha) for hybrid castor crop. A whole dose of phosphorus in the form of SSP and half dose of nitrogen in the form of urea were applied evenly in furrows before sowing. Remaining half dose of nitrogen was top dressed in two equal splits at 50 and 75 days after sowing. Data on weed population and dry weight of weeds were recorded randomly from 1.0 m² quadrant from net plot area from each treatment periodically. Data on weed population and dry weight were transformed through square-root ($\sqrt{X + 1.0}$)

method before statistical analysis.

All the data pertaining to yield were recorded from net plot. At harvest, N concentration in castor seed

and stalk and weeds by modified Kjeldahl method; P concentration by vanadomolybdophosphoric acid yellow colour method using spectrophotometer; and K concentration by flame photometry method (Prasad *et al.*, 2006) were determined. Data on weed population and dry weight were transformed through square-root ($\sqrt{(X + 1.0)}$)

method before statistical analysis.

The data related to each parameter of the experiment were statistically analyzed using MSTATC software. The purpose of analysis of variance was to determine the significant effect of treatments on weed and castor. LSD test at 5% probability level was applied when analysis of variance showed significant effect for treatments (Steel and Torrie, 1980). The net realization was calculated by deducting the total cost of cultivation from the gross realization for each treatment. The benefit cost ratio (BCR) was calculated on the basis of the formula given below:

$$\text{BCR} = \frac{\text{Net realization (₹/ha)}}{\text{Cost of cultivation (₹/ha)}}$$

RESULTS AND DISCUSSION

Weed flora

The experimental field was infested in un-weeded plot by number of weed species comprising of monocot weeds viz., *Echinochloa crusgalli* (L.) Beauv, *Digitaria sanguinalis* L. and *Eragrostis major*, dicot weeds viz., *Amaranthus viridis* L., *Alternanthera sessilis*, *Digera arvensis* Forsk., *Convolvulus arvensis* L., *Trienthma portulacastrum* L., *Euphorbia hirta* L., *Physalis minima* L., *Euphorbia mudaropsiensis* and among sedge *Cyperus rotundus* L.

predominantly during the course of experimentation

Effect on weed population and dry weight of weed

All the treatments significantly reduced the population and dry weight of all the above weed floras per m² as compared to weedy up to harvest treatment at all the stages. Treatment of weed free up to harvest registered almost nil weeds population at all stages of growth (at 30, 60, 90, 120 DAS and at harvest), which was closely followed by treatments weed free up to 120 DAS and weed free up to 90 DAS (Table 1). It might be due to better weed control effectiveness with weeding, hence, it resulted into the lowest weed counts and finally, reduced the dry weight of weeds at harvest (Table 2) might be due to the rapid growth of castor crop as indicated by taller plants and more number of branches per plant, greater crop canopy which did not allow to weeds to grow vigorously due to smothering effect. The findings are confined with those reported by Bhadoriya and Chauhan (1995) in mustard, Gamit (2009) in mustard and Patel (2011) in castor.

Effect on nutrient content and uptake by weed and crop

Different critical period of crop-weed competition treatments showed significant influence on contents of major nutrients i.e., nitrogen, phosphorus and potassium by weed and crop at harvest (Table 3 and 4). No losses of nitrogen, phosphorus and potassium by weed were noted under treatment weed free up to harvest. This might be due to strictly restricted the emergence of weed in the plot throughout the life cycle. However, nutrient content by weeds in all other treatments except weed free up to harvest were found not significant. Further higher dry weight

of weeds in the treatment weedy up to harvest leads to higher nutrient uptake which was remained statistically at par with the treatment weed free up to 30 DAS. Similar results were reported by Madhu and Nanjappa (1996) in rice.

Nutrient content by seed and stalk of castor was not differed significantly due to different treatment treatments. However, treatment weed free up to harvest recorded significantly higher uptake of nutrient which was statistically at par with the treatment weed free up to 90 DAS and weed free up to 120 DAS. This might be due to lesser crop weed competition during the crop period resulted into good growth and development of the crop ultimately resulted into higher yield which was positively reflected higher nutrient uptake. These results are in accordance with those reported by Madhu and Nanjappa (1996) in rice.

Effect on yield of castor

Various treatments of critical period of crop-weed competition were significantly influenced seed yield of castor (Table 5). Significantly the highest seed yield (3110 kg/ha) and stalk yield (3390 kg/ha) were recorded under treatment of weed free up to harvest which was remained statistically at par with the treatment weed free up to 90 DAS and weed free up to 120 DAS. The remarkable increase in seed and stalk yields under these treatments might be due to effective control of weeds, reduced dry weight of weeds as well as lower weed competition index which cumulatively facilitated the crop to utilize more nutrients and water for better growth and development measure in terms of various growth attributing characters. These findings are in close agreement with those reported by Kaneria and Patel (1995) in greengram and Dungarwal *et al.* (2002) and Patel (2011) in castor. Weedy condition up

to 60 DAS and more than it as well as weed free up to 30 and 60 DAS recorded lower values of castor yield. Weed management treatments *i.e.* two hand weeding and interculturing at 30 & 60 DAS and pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS out yielded 2887 and 3019 kg/ha castor seed yield, respectively which revealed that the field should be weed free up to 90 DAS at least.

Economics

The highest net realization (₹ 70484/ha) was obtained in treatment of weed free up to 90 DAS with BCR value of 3.28 followed by the treatment weed free up to 120 DAS and weed free up to harvest (Table 5). The lowest net realization of ₹ 9550/ha was noted in treatment weedy up to 120 DAS with BCR value of 0.64.

CONCLUSION

Thus, it can be concluded that to realize the economic and potential seed yield of castor with reducing the weed competition, crop should be kept weed free up to initial 90 days after sowing, which is more crucial for crop weed competition.

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Table 1: Weed population per square meter as influenced by different treatments.

Treatment	At 30 DAS	At 60 DAS	At 90 DAS	At 120 DAS	At Harvest
Weed free up to 30 DAS	1.00 (0.00)	5.18 (26.00)	6.80 (45.33)	8.33 (69.33)	8.76 (76.33)
Weed free up to 60 DAS	1.00 (0.00)	1.00 (0.00)	5.24 (26.67)	8.25 (67.33)	8.65 (74.00)
Weed free up to 90 DAS	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	6.38 (40.33)	6.80 (45.67)
Weed free up to 120 DAS	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	6.10 (37.00)
Weed free up to harvest	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy up to 30 DAS	6.12 (36.67)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy up to 60 DAS	6.25 (38.33)	7.62 (57.33)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy up to 90 DAS	5.82 (33.33)	7.44 (55.00)	8.31 (68.33)	1.00 (0.00)	1.00 (0.00)
Weedy up to 120 DAS	6.59 (42.67)	7.74 (59.33)	8.59 (73.00)	8.98 (79.67)	1.00 (0.00)
Weedy up to harvest	6.00 (35.67)	7.77 (59.67)	8.41 (70.00)	9.16 (83.00)	9.30 (85.67)
Two hand weeding and interculturing at 30 and 60 DAS	5.08 (25.00)	4.78 (22.33)	3.63 (12.67)	7.00 (48.33)	7.20 (51.33)
Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS	1.79 (2.33)	4.53 (19.67)	3.85 (14.33)	6.26 (38.67)	7.13 (50.33)
S. Em ±	0.31	0.29	0.30	0.36	0.36
CD (P=0.05)	0.89	0.86	0.87	1.06	1.05

Note: Data in parenthesis indicates actual value and outside parenthesis indicates

($\sqrt{X + 1.0}$) transformed value

Table 2: Dry weight of weeds (g/m²) as influenced by different treatments.

Treatment	At 30 DAS	At 60 DAS	At 90 DAS	At 120 DAS	At Harvest
Weed free up to 30 DAS	1.00 (0.00)	4.77 (22.00)	10.04 (100.00)	15.57 (241.67)	17.92 (320.33)
Weed free up to 60 DAS	1.00 (0.00)	1.00 (0.00)	4.94 (23.67)	11.78 (140.00)	15.18 (231.33)
Weed free up to 90 DAS	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	10.33 (106.33)	13.61 (184.67)
Weed free up to 120 DAS	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	10.19 (103.33)
Weed free up to harvest	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy up to 30 DAS	5.69 (31.67)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy up to 60 DAS	5.79 (33.00)	10.59 (111.33)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Weedy up to 90 DAS	5.11 (25.67)	10.56 (111.00)	12.34 (151.33)	1.00 (0.00)	1.00 (0.00)
Weedy up to 120 DAS	5.88 (33.67)	10.85 (117.00)	12.60 (158.00)	15.76 (248.33)	1.00 (0.00)
Weedy up to harvest	5.01 (24.67)	10.86 (117.00)	12.75 (163.00)	16.11 (259.33)	18.26 (333.00)
Two hand weeding and interculturing at 30 and 60 DAS	4.31 (17.67)	4.00 (15.33)	3.77 (14.00)	12.66 (160.33)	15.16 (229.67)
Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS	1.46 (1.17)	7.36 (53.33)	3.56 (12.00)	9.51 (91.00)	12.48 (155.67)
S. Em ±	0.31	0.28	0.36	0.55	0.47
CD (P=0.05)	0.90	0.81	1.06	1.62	1.37

Note: Data in parenthesis indicates actual value and outside parenthesis indicates

($\sqrt{X + 1.0}$) transformed value

Table 3: Nutrient content and uptake by seed and stalk of castor as influenced by different treatments.

Treatment	Nutrient Content by Seed (%)			Nutrient Content by Stalk (%)			Nutrient Uptake by Seed (kg/ha)			Nutrient Uptake by Stalk (kg/ha)		
	N	P	K	N	P	K	N	P	K	N	P	K
Weed free up to 30 DAS	1.253	0.512	0.242	0.241	0.143	0.847	19.57	7.98	3.78	4.10	2.44	14.38
Weed free up to 60 DAS	1.257	0.513	0.250	0.243	0.145	0.872	27.19	11.10	5.40	5.72	3.43	20.57
Weed free up to 90 DAS	1.260	0.514	0.254	0.245	0.147	0.886	38.64	15.77	7.78	8.17	4.90	29.62
Weed free up to 120 DAS	1.267	0.517	0.256	0.249	0.149	0.897	39.17	15.99	7.93	8.39	5.04	30.27
Weed free up to harvest	1.270	0.518	0.257	0.251	0.151	0.901	39.50	16.12	7.99	8.52	5.10	30.54
Weedy up to 30 DAS	1.263	0.516	0.251	0.246	0.147	0.879	31.90	13.02	6.34	6.79	4.04	24.17
Weedy up to 60 DAS	1.243	0.507	0.244	0.240	0.143	0.853	18.14	7.40	3.55	3.82	2.27	13.56
Weedy up to 90 DAS	1.240	0.506	0.242	0.238	0.142	0.848	17.29	7.05	3.38	3.62	2.16	12.90
Weedy up to 120 DAS	1.223	0.499	0.239	0.235	0.140	0.835	11.65	4.75	2.27	2.44	1.45	8.67
Weedy up to harvest	1.220	0.498	0.238	0.233	0.139	0.834	10.70	4.37	2.09	2.23	1.33	7.98
Two hand weeding and interculturing at 30 and 60 DAS	1.267	0.517	0.248	0.246	0.147	0.869	36.55	14.92	7.14	7.74	4.61	27.25
Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS	1.270	0.518	0.249	0.247	0.147	0.872	38.42	15.68	7.53	8.13	4.84	28.72
S. Em ±	0.027	0.012	0.007	0.005	0.003	0.025	1.92	0.79	0.36	0.41	0.24	1.38
CD (P=0.05)	NS	NS	NS	NS	NS	NS	5.63	2.33	1.06	1.19	0.71	4.09

Table 4: Nutrient content and uptake by weed as influenced by different treatments.

Treatment	*Nutrient Content (%) by Weed			**Nutrient Uptake (kg/ha) by Weed		
	N	P	K	N	P	K
Weed free up to 30 DAS	0.656 (1.310)	0.395 (0.476)	0.758 (1.700)	6.554 (42.08)	4.025 (15.24)	7.544 (55.96)
Weed free up to 60 DAS	0.651 (1.290)	0.391 (0.466)	0.749 (1.695)	5.536 (29.93)	3.408 (10.65)	6.329 (39.29)
Weed free up to 90 DAS	0.648 (1.280)	0.390 (0.464)	0.745 (1.750)	4.955 (23.59)	3.092 (08.61)	5.677 (31.42)
Weed free up to 120 DAS	0.643 (1.260)	0.390 (0.463)	0.743 (1.685)	3.739 (13.08)	2.401 (04.78)	4.283 (17.49)
Weed free up to harvest	0.018 (0.000)	0.018 (0.000)	0.018 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (00.00)
Weedy up to 30 DAS	0.643 (1.260)	0.391 (0.465)	0.746 (1.580)	2.223 (03.97)	1.571 (01.48)	2.519 (05.42)
Weedy up to 60 DAS	0.646 (1.270)	0.395 (0.473)	0.747 (1.640)	3.891 (14.19)	2.501 (05.26)	4.461 (18.94)
Weedy up to 90 DAS	0.650 (1.287)	0.397 (0.480)	0.751 (1.700)	4.524 (19.49)	2.875 (07.27)	5.190 (25.96)
Weedy up to 120 DAS	0.653 (1.300)	0.402 (0.490)	0.755 (1.780)	5.762 (32.42)	3.622 (12.17)	6.622 (43.05)
Weedy up to harvest	0.653 (1.297)	0.406 (0.500)	0.756 (1.785)	6.645 (43.34)	4.199 (16.68)	7.677 (58.14)
Two hand weeding and interculturing at 30 and 60 DAS	0.650 (1.287)	0.391 (0.465)	0.746 (1.680)	5.513 (29.44)	3.411 (10.66)	6.307 (38.91)
Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS	0.647 (1.277)	0.392 (0.467)	0.744 (1.670)	4.562 (19.96)	2.870 (07.28)	5.210 (26.30)
S. Em ±	0.009	0.006	0.009	0.225	0.114	0.243
CD (P=0.05)	0.028	0.02	0.028	0.700	0.355	0.757

* Data in parenthesis indicated actual value and those outside are arcsine transformed values

**Data in parenthesis indicated actual value and those outside are $\sqrt{X+1}$ transformed values

Table 5: Effect of critical period of crop weed competition on yield, quality and economics of castor.

Treatment	Stalk Yield (kg/ha)	Seed Yield (kg/ha)	Gross Realization (₹ /ha)	Net Realization (₹ /ha)	BCR
Weed free up to 30 DAS	1698	1558	46730	27714	1.46
Weed free up to 60 DAS	2358	2163	64900	44384	2.16
Weed free up to 90 DAS	3343	3067	92000	70484	3.28
Weed free up to 120 DAS	3372	3094	92819	70303	3.12
Weed free up to harvest	3390	3110	93301	69785	2.97
Weedy up to 30 DAS	2754	2526	75790	52774	2.29
Weedy up to 60 DAS	1590	1459	43770	21754	0.99
Weedy up to 90 DAS	1522	1396	41890	20874	0.99
Weedy up to 120 DAS	1038	952	28566	9550	0.50
Weedy up to harvest	956	877	26324	10308	0.64
Two hand weeding and interculturing at 30 and 60 DAS	3147	2887	86602	65586	3.12
Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS	3291	3019	90576	70375	3.48
S. Em ±	150.8	138.4	-	-	-
CD (P=0.05)	142	406	-	-	-

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