# RESPONSE OF CRITICAL PERIOD OF CROP-WEED COMPETITION ON GROWTH PARAMETERS, YIELD ATTRIBUTES, YIELD AND QUALITY OF *RABI* CASTOR (*Ricinus communis* L.) UNDER SOUTH GUJARAT CONDITION

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## ABSTRACT

***A field experiment entitled "Response of critical period of crop-weed competition on growth parameters, yield attributes, yield and quality of 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. 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 eveluted with three replications in a randomized block design (RBD). The results revealed that treatment weed free up to harvest recorded significantly lowest weed density and dry weight of weeds and maximum values for all the growth and yield attributes of castor viz. plant height, number of branches per plant, number of spikes per plant, length of spike, capsules per spike, test weight, seed yield, which found statistically at 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, quality, weed, yield

## INTRODUCTION

Castor (*Ricinus communis* L.), being a valuable non-edible oil seed crop playing an important role in agriculture economy mostly grown with wider spacing 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 causes 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 entitled "Response of critical period of crop-weed competition on growth parameters, yield attributes, yield and quality of *rabi* castor (*Ricinus communis* l.) under South Gujarat condition" 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, which is located at the $20^{o}$ 57' N latitude and $72^{o}$ 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 sowing of castor var. GCH-7 was done in a plot of 6.0 m x 6.0 m 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 $m^2$ quadrant from net plot area from each treatment periodically. Data on weed population and dry weight were transformed through square-root method before statistical analysis. Weed index (WI) was calculated

on the basis of following formula given by Nandekar (2005).

All the data pertaining to growth, yield attributes and yield were recorded from net plot. 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:

BCR = Net realization(₹/ha) / Cost of cultivation (₹/ha)

## RESULTS AND DISCUSSION

### *Effect on growth and yield attributes of castor*

All the growth parameters were significantly influenced by different treatments. Plant height (181.00 cm) and number of branches per plant (14.86) were found significantly higher under the treatment weed free up to harvest (Table 1), which was found statistically at par with the treatments weed free up to 120 DAS, weed free up to 90 DAS, weed free up to 60 DAS as well as 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 at all the growth stages (at 45 DAS, 90 DAS and at harvest). This might be due to effective control of weeds under these treatments during the crop season, which improved the growth of crop and checked nutrient drain by weeds. The minimum plant height and number of branches per plant were recorded under treatment weedy condition up to 60 DAS and more than it which might be due to severe competition by weeds for take up soil moisture and nutrients; consequently the plant growth was affected. The results are in conformity with the results reported by Sadangi and Barik (2007) in cotton, Gamit (2009) in mustard and Patel (2011) in castor.

Similarly, treatment weed free up to harvest found best for number of spikes per plant (12.22), length of spike (64.24 cm), capsule per spike (57.24) and seed index (30.13 g) followed by the treatments weed free up to 120 DAS, weed free up to 90 DAS as well as 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 at all the growth stages (at 45 DAS, 90 DAS and at harvest) (Table 1). Less crop-weed competition due to microclimate around plants due to weed control may allow plants to grow profusely during vegetative growth and resulted in to more accumulation of photosynthates, which ultimately converted in to economic yield. Maintaining high soil fertility status by way of removing less plant nutrient through weeds might have modified yield attributes. Significant improvement in growth characters also might have resulting higher yield attributing characters. Similar results were reported by Parmar (1989) in sunflower, Patel (2000) in pigeonpea, Sivakumar and Subbian (2002) in cotton and Patel (2011) in castor. Most of all the treatment having weedy condition up to 60 DAS and more than that as well as weed free up to 30 and 60 DAS recoded lower values of yield attributing characters.

### *Effect on yield of castor*

Various treatments of critical period of crop-weed competition were significantly influenced seed yield of castor (Table 2).

Significantly the highest seed yield (296 g/plant and 3110 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 yields under these treatment 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 such as plant height and number of branches per plant and yield attributing characters such as number of spikes per plant, length of main spike and number of capsules per spike. All these parameters showed positive and highly significant influence on seed yields of castor, besides minimum depletion of nutrients by weeds and better uptake by castor which might be cumulatively reflected in higher seed yields of castor. 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 that 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.

***Effect on quality parameters***

Oil content in seed was found non-significant due to different treatments (Table 2). This might be due to being a genetically governed character; oil content may not be influenced. Similar findings were also reported by Patel (2011) in castor. The highest oil yield (1475 kg/ha) was recorded with treatment weed free up to harvest and remained on same bar with the treatment weed free up to 90 DAS and weed free up to 120 DAS among different treatments of critical period of crop weed competition (Table 2). The increase in oil yield might be due to higher content as well as higher seed yield under effective critical periods of crop-weed competition treatment. Similar findings were also reported by Singh *et al*. (2003) in *Brassica* species and Patel (2011) in castor.

***Weed flora***

The experimental field was infested in unweeded 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., *Eurphorbia mudarosptiensis* 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 of above weed floras and dry weight of weeds per $m^2$ 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 3 and 4). 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, 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.

Weed index, which is the indicator of losses in seed yield due to presence of weeds. Treatment weed free up to harvest is considered as base for calculating weed index. Treatment weed free up to 120 DAS recorded the lowest weed index (0.52 %) followed by the treatment weed free up to 90 DAS (1.39 %) (Table 2). This might be due to effective weed control achieved under these treatments in terms of reduced biomass of weeds and higher weed control competence. Results were also almost similar to those reported by Mehriya *et al.* (2007) in cumin and Kumar *et al.* (2009) in fieldpea.

***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 among different treatments of critical period of crop weed competition in castor (Table 2). 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: Effect of critical period of crop weed competition on growth parameters and yield attributes of castor.**

| Treatment | Plant Height (cm) at harvest | Number of Branches Per plant at Harvest | Number of Spikes Per Plant | Length of Main Spike (cm) | Number of Capsules Per Spike | Seed Index (g) |
|---|---|---|---|---|---|---|
| Weed free up to 30 DAS | 149.7 | 10.38 | 8.24 | 45.00 | 37.67 | 26.65 |
| Weed free up to 60 DAS | 168.0 | 13.00 | 10.90 | 55.00 | 47.67 | 26.96 |
| Weed free up to 90 DAS | 175.0 | 14.00 | 11.52 | 59.00 | 52.33 | 30.11 |
| Weed free up to 120 DAS | 178.0 | 14.43 | 11.84 | 61.67 | 54.67 | 30.11 |
| Weed free up to harvest | 181.0 | 14.86 | 12.22 | 64.24 | 57.24 | 30.13 |
| Weedy up to 30 DAS | 153.0 | 11.19 | 8.96 | 55.71 | 48.95 | 27.03 |
| Weedy up to 60 DAS | 140.3 | 9.05 | 7.05 | 45.00 | 40.00 | 26.57 |
| Weedy up to 90 DAS | 139.0 | 8.86 | 6.88 | 44.00 | 37.33 | 26.37 |
| Weedy up to 120 DAS | 131.7 | 7.81 | 5.95 | 38.90 | 31.90 | 25.92 |
| Weedy up to harvest | 131.3 | 7.76 | 5.91 | 38.81 | 31.81 | 25.68 |
| Two hand weeding and interculturing at 30 and 60 DAS | 172.0 | 13.57 | 11.08 | 60.86 | 53.67 | 29.60 |
| Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS | 174.0 | 13.86 | 11.33 | 62.24 | 54.81 | 29.60 |
| S. Em ± | 8.1 | 1.17 | 0.43 | 3.09 | 2.67 | 0.88 |
| CD (P=0.05) | 23.8 | 3.42 | 1.26 | 9.07 | 7.84 | 2.57 |

**Table 2: Effect of critical period of crop weed competition on yield, quality and economics of castor.**

| Treatment | Seed Yield (g/plant) | Seed Yield (kg/ha) | Weed Index (%) | Oil Content (%) | Oil Yield (kg/ha) | Gross Realization (₹ /ha) | Net Realization (₹ /ha) | BCR |
|---|---|---|---|---|---|---|---|---|
| Weed free up to 30 | 167 | 1558 | 49.91 | 46.96 | 733 | 46730 | 27714 | 1.46 |
| Weed free up to 60 | 209 | 2163 | 30.44 | 47.13 | 1020 | 64900 | 44384 | 2.16 |
| Weed free up to 90 | 268 | 3067 | 1.39 | 47.17 | 1445 | 92000 | 70484 | 3.28 |
| Weed free up to 120 DAS | 274 | 3094 | 0.52 | 47.37 | 1463 | 92819 | 70303 | 3.12 |
| Weed free up to | 296 | 3110 | 0.00 | 47.43 | 1475 | 93301 | 69785 | 2.97 |
| Weedy up to 30 DAS | 239 | 2526 | 18.77 | 47.33 | 1197 | 75790 | 52774 | 2.29 |
| Weedy up to 60 DAS | 149 | 1459 | 53.09 | 47.20 | 689 | 43770 | 21754 | 0.99 |
| Weedy up to 90 DAS | 136 | 1396 | 55.10 | 47.17 | 658 | 41890 | 20874 | 0.99 |
| Weedy up to 120 DAS | 99 | 952 | 69.38 | 47.00 | 447 | 28566 | 9550 | 0.50 |
| Weedy up to harvest | 95 | 877 | 71.79 | 46.17 | 405 | 26324 | 10308 | 0.64 |
| Two hand weeding and interculturing at 30 and 60 DAS | 255 | 2887 | 7.18 | 47.33 | 1371 | 86602 | 65586 | 3.12 |
| Pendimethalin @ 1 kg/ha (as pre-emergence) + one hand weeding and interculturing at 60 DAS | 266 | 3019 | 2.92 | 47.33 | 1428 | 90576 | 70375 | 3.48 |
| S. Em ± | 17.9 | 138.4 | - | 0.86 | 69.8 | - | - | - |
| CD (P=0.05) | 52.5 | 406.0 | - | NS | 204.9 | - | - | - |

**Table 3: 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 4: Dry weight of weeds (g/m$^2$) 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***

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