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Effect of Sowing Dates on Productivity and Economics of Irrigated Castor (*Ricinus communis* L.) in Bawal Region, Haryana

P. S. John Daniel, J. S. Yadav, Jagdev Singh

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Abstract An field experiment were carried out for two consecutive years of 2013-14 and 2014-15 conducted to study the influence of various sowing dates on productivity and economics of castor (20th June, 5th July, 20th July and 5th August) in a split plot design with 3 replications under irrigated conditions. Among the different dates of sowing, 20th June recorded taller plants and higher dry matter production over 5th July, 20th July and 5th August dates of sowing. Similar trend was noticed with number of spikes per plant that recorded highest with early sowing date, while the castor sown during 5th August registered higher number of capsules per spike and 100 seed weight, 20th June date of sowing provided significantly higher seed yield than other sowing dates and comparable with 5th July date of sowing and 5th August sowing date recorded the lowest yield among the various sowing dates. In economic analysis of two year data, profitability of castor in terms of returns was substantially high in 20th June date of sowing with gross returns (Rs 2,03,702 ha^{-1} and 216480 ha^{-1}), net returns (Rs 1,50,622 ha^{-1} and 1,63,809 ha^{-1}) and B:C ratio (3.84 and 4.11) as compared to other sowing dates.

Keywords Castor, DCH-177, Date of sowing, B: C ratio, Economics.

P. S. John Daniel*, J. S. Yadav, Jagdev Singh
Department of Agronomy, CCS Haryana Agricultural University, Hisar 125004, Haryana, India
e-mail : penumaka.johndaniel@gmail.com
*Correspondence

Introduction

India is one of the largest producers of non-edible oil seeds in the world. Castor is an important non-edible oil seed crop of India playing a pivotal role in the agrarian economy. Despite phenomenal increase in the production and productivity of castor over the past decade, there is wide disparity in productivity among various growing regions of India. High yield in castor can achieved through better management practices such as time of sowing which are considered as the principal non-monetary inputs. India currently produces 16,44,000 tonnes of castor seed compared to world castor production of 18,65, 447 tonnes [1]. Although Haryana holds very less in terms of area (2,000 ha) and production (3,000 tonnes) but productivity of castor is quite high in Haryana (1,500 kg ha^{-1}) as comparable to leading states like Gujarat (1988 kg ha^{-1}) and Rajasthan (1,530 kg ha^{-1}) [2]. The variety DCH-177 exhibit enormous results and reaping better yields under irrigated conditions in Bawal region, Haryana. Keeping this in view, the present investigation was undertaken to assess the influence of sowing date on productivity and economics of castor.

Table 1. Growth parameters of castor as influenced by various dates of sowing.

Treatments	Plant height (cm) at 120 DAS		Leaf area index		Drymatter accumulation (g plant^{-1})		Plant population (000'/ha) At 90 DAS	
	2013	2014	2013	2014	2013	2014	2013	2014
Dates of sowing								
20th June	122.7	120.8	4.03	4.22	773.9	804.9	9.22	9.23
5th July	116.6	114.1	3.89	4.03	734.2	765.2	9.22	9.22
20th July	114.7	102.9	3.75	3.79	619.9	650.9	9.22	9.23
5th August	96.1	84.1	3.15	3.35	552.8	583.8	9.20	9.22
SEm ±	0.7	1.8	0.04	0.05	1.36	1.34	0.01	0.02
CD (p=0.05)	2.6	6.3	0.14	0.19	4.80	4.74	NS	NS

Materials and Methods

The field experiment was conducted at regional research station, Bawal, CCS Haryana Agricultural University during 2013-14 and 2014-15 crop seasons. The treatments comprised of four different dates of sowing i.e., 20th June, 5th July, 20th July and 5th August was laid out in randomized block design with three replications. The soil of the experiment is loamy sand in texture, alkaline in the reaction with pH 8.3, available nitrogen 148 kg ha^{-1}, available phosphorus 15 kg ha^{-1}, and available potassium 182 kg ha^{-1}, respectively. All the treatments were supplied with recommended dose fertilizers i.e., 80 kg N, 50 kg P_2O_5 in form of urea and DAP. Half of N (40 kg ha^{-1}) and full dose of P_2O_5 (50 kg ha^{-1}) was applied as basal dose and remaining 50% N (40 kg ha^{-1}) was top dressed in two equal splits at 120 days crop growth stage and 30 days thereafter. Seeds were scarified by rubbing against rough surface to enhance germination. Seeds were soaked before sowing in water for 24 h and dried under shade before sowing. Seeds were treated with carbendazim @ 1g kg^{-1} of seed to protect from seed borne diseases. The spacing adopted was 120 × 90 cm. The crop was kept free from diseases through suitable protection measures. The crop was harvested in six to seven pickings manually based on physiological maturity of the capsules. Total rainfall of 797.5 and 860.9 mm was received during 2013-14 and 2014-15 crop seasons.

Results and Discussion

Growth parameters

Sowing the crop on 20th June (122.7 and 120.8 cm) resulted in taller plants in comparision with that sown on 5th July, 20th July and 5th August, but 5th July found in comparable with early sowing date (Table 1). The present findings corroborate with reports of Sreedhar and Yakadri [3] and Reddy et al. [4]. Similar trend was observed in leaf area index and dry matter production. Higher leaf area index was noticed during early sowing date i.e., 20th June sowing (4.03 and 4.22) might due to the better foliage development and favorable weather conditions during crop growth period than delayed sowing. Dry matter production of the crop sown during 20th June (789.4 and 804.9 g plant^{-1}) was higher and found to be superior compared to remaining dates of sowing and plant stand observed non significant variation at 90 DAS among the sowing dates (Table 1). Delay in sowing every fort night resulted in decrease in dry matter production of 28.6% and 27.5% observed in 5th August date of sowing. Similar conclusions are drawn also by Reddy et al. [4].

Yield attributes

Sowing during 20th June (17.3 and 19.4) recorded substantially higher number of spikes plant^{-1} when compared to 5th July (16.6 and 17.2), 20th July (15.9 and 16.5) and 5th August (12.6 and 15.6) sowing dates (Table 2). There was enhancement in higher number of spikes plant^{-1} by 37.3% and 24.3% as compared to 5th August date of sowing. Nagabhushanam and Raghavaiah [5] also reported the similar observations with regard to number of spikes plant^{-1} under varied sowing dates. The number of capsules primary spike^{-1} progressively increased towards the delayed

Table 2. Yield attributes and seed yield of castor as influenced by various dates of sowing.

Treatments	Length of the primary spike (cm)		Number of capsules primary spike^{-1}		Number of spikes plant^{-1} at harvest		100 Seed weight		Seed yield (kg ha^{-1})	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Dates of sowing										
20th June	64.5	54.7	76.7	79.6	17.3	19.4	28.6	29.0	5157	5412
5th July	62.3	59.5	79.1	79.2	16.6	17.2	29.4	29.2	5094	5264
20th July	68.6	59.5	80.6	81.6	15.9	16.5	30.7	31.8	4410	4558
5th August	74.9	71.3	82.2	83.1	12.6	15.6	31.7	32.2	3572	3787
SEm ±	0.7	1.2	0.4	1.2	0.4	0.1	0.2	0.1	34	47
CD (p=0.05)	2.7	4.4	1.5	4.4	1.3	0.4	0.7	0.5	122	165

date of sowing i.e., 5th August recorded higher number of capsules primary spike^{-1} (7.2% and 4.4%) than 20th June date of sowing (Table 2). This may be attributed to low temperature prevailed during the vegetative growth to low plant stature and dry matter accrual corresponding with quantity of assimilates diverted to sink, which results in elevated stature of capsules production. Higher primary spike length and 100 seed weight were also noticed with 5th August sowing in comparison to the earlier sowing dates due to loosening of the capsules and partitioning diverted towards the primary spike and provided sufficient time for higher production of photosynthates ultimately leads to increase in weight of the seed of primary spike. The present findings are in contrary with those of Reddy et al. [4] and Nagabhushanam and Raghavaiah [5].

Seed yield

Sowing the crop during 20th June (5157 kg ha^{-1} and 5412 kg ha^{-1}) recorded the highest seed yield followed by 5th July (5094 kg ha^{-1} and 5264 kg ha^{-1}) yield which was significantly higher than 20th July and 5th August sowing dates (Table 2). Lowest seed yield was recorded in delayed sowing i.e., 5th August date of sowing. Delay in sowing resulted in decrease of grain yield of 43.6% when compared to early sowing date. The increase in yield may be attributed to more number of effective spikes and higher dry matter production of crop elevated yield structure resulting in higher yield. The yield reductions in castor with delayed sowings were also observed by Reddy et al .[4] and Nagabhushanam and Raghavaiah [5].

Economics

Economic analysis of various sowing dates under test showed that the maximum gross returns (Rs 2,03,702 and 2,16,480 ha^{-1}) and net returns (Rs 1,50,622 ha^{-1} and 1,63,809 ha^{-1}) are noticed highest with 20th June sowing when compared other dates of sowing (Table 3). This might be attributed with timely establishment of crops which improved crop yield resulting in higher gross and net returns. The highest B: C ratio was registered with early sowing date i.e., 20th June (3.84

Table 3. Economics of castor as influenced by various dates of sowing.

Treatments	2013				2014			
	Gross returns (Rs ha^{-1})	Cost of cultivation	Net returns (Rs ha^{-1})	B: C ratio	Gross returns (Rs ha^{-1})	Cost of cultivation	Net returns (Rs ha^{-1})	B: C ratio
Dates of sowing								
20th June	2,03,702	53,080	1,50,622	3.84	2,16,480	52671	1,63,809	4.11
5th July	2,01,213	53,080	1,48,133	3.79	2,10,560	52671	1,57,889	4.00
20th July	1,74,195	53,080	1,21,115	3.28	1,82,320	52671	1,29,649	3.46
5th August	1,41,094	53,080	88,014	2.66	1,51,480	52671	98,809	2.88
SEm ±	-	-	-	-	-	-	-	-
CD (p =0.05)	-	-	-	-	-	-	-	-

and 4.11) when compared to 5th July (3.79 and 4.00), 20th July (3.28 and 3.46) and 5th August (2.66 and 2.88). The present findings are in conformity with Cheema et al. [6].

Conclusion

From the foregoing account, it could be concluded that sowing of castor on 20th June date of sowing resulted in distinctly superior growth parameters, yield attributes, seed yield and better economics compared to other sowing dates. Therefore sowing of castor on 20th June date is a suitable time for productivity and profitability with respect to growth and yield of castor in Bawal region of Haryana.

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