Int.J.Curr.Microbiol.App.Sci (2018) *7*(11): 2447-2454

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 11 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.711.279

Effect of Sowing Date and Chemical Foliar Sprays on Productivity and Cold Injury Management of Castor (*Ricinus communis L.*) in Western Haryana region, India

P.S. John Daniel*, J.S. Yadav, Jagdev Singh and K.D. Sharma

Department of Agronomy, CCS Haryana Agricultural University, Hisar-125004, Haryana, India

**Corresponding author*

Keywords

Castor, DCH-177, Foliar sprays, Cold injury, Economics, B: C ratio

Article Info

Accepted:
18 October 2018
Available Online:
10 November 2018

A B S T R A C T

A field experiment was carried out in consecutive years of 2013-14 and 2014-15 conducted at regional research station, Bawal, CCS Haryana Agricultural University to study effect of sowing time and chemical foliar sprays on the productivity and cold injury management in castor (*Ricinus communis* L.). The experiment was laid out in split plot design on loamy sand soil. Treatments comprised of four dates of sowing viz., 20th June, 5th July, 20th July and 5th August and four chemical foliar sprays along with water and no spray check viz., DMSO (78 ml ha^{-1}), H_2SO_4 (0.1%), Thiourea 500 ppm, Salicylic acid 100 ppm that are replicated thrice. Among the different dates of sowing, 20th June resulted in significantly higher growth and yield parameters during 2013-14 and 2014-15 crop seasons compared to other dates of sowing. 20th June date of sowing produced significantly higher grain yield i.e., 5157 kg ha^{-1} during 2013-14 and 5412 kg ha^{-1} during 2014-15 as well pooled grain yield 5285 kg ha^{-1} as compared to the 20th July and 5th August sowing dates. Application of H_2SO_4 (0.1 %) showed significantly substantial effect on grain yield (4703 kg ha^{-1}) during 2013-14 and during 2014-15 (4869 kg ha^{-1}) as well as on pooled basis (4786 kg ha^{-1}) compared to the foliar sprays. Sowing during 20th June along with application of H_2SO_4 (0.1 %) registered higher relative water, leaf water potential, chlorophyll index and lower membrane injury as compared to different sowing dates and chemical foliar sprays during 2013-14 and 2014-15 crop seasons. 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. 203702 ha^{-1} and 216480 ha^{-1}), net returns (Rs. 150622 ha^{-1} and 163809 ha^{-1}) and B:C ratio (3.84 and 4.11) as compared to other sowing dates. Among the chemical foliar sprays, H_2SO_4 (0.1 %) significantly recorded higher gross returns (Rs. 185769 ha^{-1} and Rs. 196080 ha^{-1}), net returns (Rs. 130759 ha^{-1} and Rs. 141479 ha^{-1}) and B: C ratio (3.39 and 3.59, respectively) when compared to other foliar sprays.

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. The oil extracted from the castor already has a demonstrated market, guaranteed by variety of

700 uses, ranging from medicines and cosmetics to replacing petroleum by bio-diesel, plastics and lubricants (Anonymous, 2003; Mario Osava, 2003). It is used as a lubricant in high-speed engines and aeroplanes, in the manufacture of soaps, transparent paper, printing-inks, varnishes, linoleum and plasticizers and also for medicinal and lighting purposes. 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.

India currently produces 16,44,000 tonnes of castor seed compared to world castor production of 18,65,447 tonnes (FAOSTAT, 2013). Although Haryana holds very less in terms of area (2000 ha) and production (3000 tonnes) but productivity of castor is quite high in Haryana (1500 kg ha^{-1}) as comparable to leading states like Gujarat (1988 kg ha^{-1}) and Rajasthan (1530 kg ha^{-1}) (INDIASTAT, 2013). The variety DCH-177 exhibit enormous results and reaping better yields under irrigated conditions in Bawal region, Haryana. Despite higher castor productivity in Haryana, cold injury is the major limiting factor.

Low temperature adversely affects the seed quality by reducing the seed size attributed to mobilization of photo assimilates leading to yield reduction, thereby widening the gap between the potential and actual yield. Therefore, generating recommendations for cold injury management will not only ensure higher productivity and profitability but will also help in accelerated adoption of this crop in Western Haryana region. Keeping the above points in view, the present field experiment was conducted with objective to study of effect of sowing time and chemical foliar sprays on the productivity and cold injury management in castor (*Ricinus communis* L.).

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. Treatments comprised of four dates of sowing viz., 20th June, 5th July, 20th July and 5th August and four chemical foliar sprays along with water and no spray check viz., DMSO (78 ml ha^{-1}), H_2SO_4 (0.1%), Thiourea 500 ppm, Salicylic acid 100 ppm that are replicated thrice. 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 phosphorous 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 percent 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 hours 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 comparison 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 (2004) and Reddy *et al.,* (2007). 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 favourable 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 per cent and 27.5 per cent observed in 5th August date of sowing. Similar conclusions are drawn also by Reddy *et al.,* (2007).

Application of H_2SO_4 (0.1 %) resulted in higher leaf area index and showed substantial effect followed by DMSO (78 ml ha^{-1}) compared to other chemical foliar sprays at 25th February. This may be due to the increase in water soluble carbohydrate and protein status of the plants that have strong influence on cryoprotection phenomenon (Volger and Heber, 1975). Our findings are similar with Levitt *et al.,* (1962); Porwal *et al.,* (1986); Rao and Sahu (1991) also reported that application of H_2SO_4 and DMSO was effective in cryoprotection of the chickpea.

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 (2005) 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 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.,* (2007) and Nagabhushanam and Raghavaiah (2005). Application of H_2SO_4 (0.1%) resulted in substantially higher number of spikes plant^{-1} as compared to than chemical foliar sprays during both the crop seasons. This could be due to increase in water soluble carbohydrate and protein status of the plants. Similar findings are reported by Levitt *et al.,* (1962), Porwal *et al.,* (1986) and Rao and Sahu (1991).

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 3). 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 per cent when compared to early sowing date. The increase

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

Treatments	Plant height (cm) at 120 DAS		Leaf area index		Dry matter 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**

Table.2 Yield attributes 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	
	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**
5th July	**62.3**	**59.5**	**79.1**	**79.2**	**16.6**	**17.2**	**29.4**	**29.2**
20th July	**68.6**	**59.5**	**80.6**	**81.6**	**15.9**	**16.5**	**30.7**	**31.8**
5th August	**74.9**	**71.3**	**82.2**	**83.1**	**12.6**	**15.6**	**31.7**	**32.2**
SEm±	**0.7**	**1.2**	**0.4**	**1.2**	**0.4**	**0.1**	**0.2**	**0.1**
CD(P=0.05)	**2.7**	**4.4**	**1.5**	**4.4**	**1.3**	**0.4**	**0.7**	**0.5**

Table.3 Seed yield, Stalk yield and Biological yield of castor as influenced by various dates of sowing and chemical foliar sprays

Treatments	Seed yield (kg ha^{-1})			Stalk yield (kg ha^{-1})			Biological Yield (kg ha^{-1})		
	2013	**2014**	**Pooled data**	**2013**	**2014**	**Pooled data**	**2013**	**2014**	**Pooled data**
Dates of sowing									
20th June	**5,157**	**5,412**	**5,285**	**7,625**	**8,129**	**7,877**	**12,782**	**13,541**	**13,162**
5th July	**5,094**	**5,264**	**5,179**	**7,542**	**7,946**	**7,744**	**12,636**	**13,210**	**12,923**
20th July	**4,410**	**4,558**	**4,484**	**6,665**	**6,822**	**6,743**	**11,075**	**11,380**	**11,227**
5th August	**3,572**	**3,787**	**3,680**	**5,478**	**5,683**	**5,580**	**9,050**	**9,470**	**9,260**
SEm±	**34**	**47**	**19**	**42**	**59**	**46**	**76**	**98**	**79**
CD(P=0.05)	**122**	**165**	**67**	**149**	**207**	**164**	**268**	**344**	**279**
Chemical foliar sprays									
DMSO (78 ml/ha)	**4,673**	**4,851**	**4,762**	**6,953**	**7,269**	**7,111**	**11,626**	**12,120**	**11,873**
Sulphuric acid (0.1%)	**4,703**	**4,869**	**4,786**	**7,089**	**7,278**	**7,184**	**11,792**	**12,147**	**11,970**
Thio-urea (500 ppm)	**4,549**	**4,859**	**4,704**	**6,811**	**7,257**	**7,034**	**11,360**	**12,116**	**11,738**
Salicylic acid (100 ppm)	**4,537**	**4,739**	**4,638**	**6,802**	**7,131**	**6,967**	**11,339**	**11,870**	**11,605**
Water spray	**4,466**	**4,666**	**4,566**	**6,681**	**7,004**	**6,842**	**11,147**	**11,670**	**11,408**
Control	**4,420**	**4,548**	**4,484**	**6,630**	**6,782**	**6,706**	**11,049**	**11,330**	**11,190**
SEm±	**32**	**41**	**27**	**52**	**42**	**31**	**79**	**70**	**49**
CD(P=0.05)	**93**	**119**	**78**	**148**	**121**	**89**	**225**	**201**	**141**

Table.4 Economics of castor as influenced by various dates of sowing and chemical foliar sprays

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)	-	-	-	-	-	-	-	-
Chemical foliar sprays								
DMSO (78 ml/ha)	**1,84,584**	**54,565**	**1,30,019**	**3.38**	**1,94,040**	**54156**	**1,39,884**	**3.58**
Sulphuric acid (0.1%)	**1,85,769**	**55,010**	**1,30,759**	**3.39**	**1,96,080**	**54601**	**1,41,479**	**3.59**
Thio-urea (500 ppm)	**1,79,686**	**55,167**	**1,24,519**	**3.26**	**1,93,000**	**54758**	**1,38,242**	**3.52**
Salicylic acid (100 ppm)	**1,79,212**	**55,617**	**1,23,595**	**3.22**	**1,87,600**	**54207**	**1,33,393**	**3.46**
Water spray	**1,76,407**	**54,480**	**1,21,927**	**3.20**	**1,86,280**	**54071**	**1,32,209**	**3.43**
Control	**1,74,590**	**53,080**	**1,21,510**	**3.18**	**1,84,280**	**52671**	**1,31,609**	**3.40**
SEm±	-	-	-	-	-	-	-	-
CD(P=0.05)	-	-	-	-	-	-	-	-

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.,* (2007) and Nagabhushanam and Raghavaiah (2005).

Application of H_2SO_4 (0.1 %) resulted in higher seed yield and showed substantial effect followed by 78 ml ha^{-1} DMSO among chemical foliar sprays. This may be due to the increase in water soluble carbohydrate and protein status of the plants that have strong influence on cryo protection phenomenon (Volger and Heber, 1975). Dashora (1980) also reported that low temperature injury in potato plants treated with H_2SO_4 had significantly higher water soluble carbohydrates and protein contents by 22.77 and 18.18 per cent over control and tuber yield was increased by 50.42 per cent over no spray check. The present findings are similar with those of Levitt *et al.,* (1962); Porwal *et al.,* (1986); Rao and Sahu (1991) who reported that application of H_2SO_4 and DMSO were effective in cryo protection of the chickpea.

Application of chemical foliar sprays showed substantial effect over varied dates of sowings Application of H_2SO_4 (0.1 %) followed by DMSO (78 ml ha^{-1}) registered more relative water content, Higher water potential and chlorophyll index among the different chemical foliar sprays. Reduced membrane injury also observed with application of H_2SO_4 (0.1 %) and proved to be better chemical foliar spray under low temperature stress during both the years.

Economics

Economic analysis of various sowing dates under test showed that the maximum gross returns (Rs. 203702 and 216480 ha^{-1}) and net returns (Rs. 150622 ha^{-1} and 163809 ha^{-1}) are noticed highest with 20th June sowing when compared other dates of sowing (Table 4). 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 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.,* (2013).

The gross returns, net returns as well as B: C ratio improved with application of chemical foliar sprays over the no spray check. Application of H_2SO_4 (0.1%) registered highest gross returns, net returns and B: C ratio among all the chemical foliar sprays. This might be attributed to better control of cold injury compared to other chemical foliar sprays. Similar findings were made by Porwal *et al.,* (1986), Rao and Sahu (1991) and Manohar Lal (2013).

In economic analysis of two year data, profitability of castor in terms of returns was substantially high in 20th June date of sowing and H_2SO_4 (0.1 %) chemical foliar spray showed substantial effect on cold injury under various sowing dates and chemical foliar sprays.

From the present investigation, it may be concluded that 20th June date of sowing is found to be better suitable time for growing of castor with respect to growth, yield and agro-physiological traits as compared to other sowing dates. H_2SO_4 (0.1 %) is found be best management practice to avoid cold injury in castor with respect to growth, yield and agro-physiological traits. Sowing of castor in 20th June date of sowing and application of H_2SO_4 (0.1 %) found to be a better profitable system under various sowing dates and chemical foliar sprays to avoid cold injury in Western Haryana region.

References

Cheema, NM., Farroq, U., Shabbir, G., Shah, MKN and Musa, M., 2013. Prospects of castor bean cultivation in rainfed tract of Pakistan. *Pak. J. Bot.,* 45: 219-224.

Dashora, S.S., 1980. Prevention of low temperature injury in potato (*Solanum tuberosum* L.) by chemical means. *M. Sc. Thesis*, Department of Agronomy, University of Udaipur.

FAOSTAT., 2013. Food and Agriculture Organization of the United Nations (FAO) statistical databases. Rome, Italy. http://www.fao.org.

INDIASTAT., 2013. http://www. Indiastat.com

Levitt, J., 1962. A sulfhydral disulphide hypothesis of frost injury and resistance in plants. *J. Theo. Bio.*, 3: 335-391.

Manohar Lal, 2013. Physiological and biochemical responses to low temperature in chickpea (*Cicer arientinum* L.). *M. Sc. (Ag.) Thesis*, CCS Haryana Agricultural University, Hisar, Haryana.

Nagabhushanam, U and Raghavaiah, CV., 2005. Seeding date and irrigation effects on the productivity and oil quality of post monsoon grown castor (*Ricinus communis* L.) in Alfisols. *J. Oilseeds. Res.*, 22: 206-208.

Porwal, B.L., Singh, H.G. and Mathur, P.N., 1986. Metabolic changes associated with chemical cryoprotection in gram (*Cicer arietinum* L.). *Biochemie und Physiologie Pflanzen*, 181: 659-664

Rao, S.S. and Sahu, M.P., 1991. Effect of sulphur and foliar-applied chemicals on cold tolerance in chickpea (*Cicer arientinum* L.). *J. Agro. Crop Sci.*, 167: 320-325.

Reddy, UVB., Reddy, GP and Reddy, DS., 2007. Effect of seeding time on productivity of castor (*Ricinus communis* L.) cultivars in southern agro-climatic zone of Andhra Pradesh. *J. Oilseeds. Res.*, 24: 280-282.

Sreedhar, C and Yakadri M., 2004. Sowing date and genotype effects on performance of rabi castor (*Ricinus communis* L.) in alfisols. *J. Res., ANGRAU* 32: 90-92.

Volger, H.G. and Heber, U., 1975. Protective leaf protein. *Biochemica et. Biophysica Acta*, 412: 335-349.

How to cite this article:

John Daniel, P.S., J.S. Yadav, Jagdev Singh and Sharma, K.D. 2018. Effect of Sowing Date and Chemical Foliar Sprays on Productivity and Cold Injury Management of Castor (*Ricinus communis L.*) in Western Haryana region. *Int.J.Curr.Microbiol.App.Sci.* 7(11): 2447-2454.
doi: https://doi.org/10.20546/ijcmas.2018.711.279