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Effect of sowing time and spacing on growth, yield and economics of cumin (*Cuminum cyminum* L.)

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Abstract

A field experiment was conducted during 2015-16 to 2017-18 at Seed Spice Research Station, S.D. Agricultural University, Jagudan on growth, yield and economics of cumin crop as influenced by date of sowing and spacing. The soil was loamy sand in texture, neutral in soil reaction, with low in organic carbon, medium in available phosphorus and potash. There were four treatments of sowing date and three spacings were replicated thrice in factorial concept of randomized block design. Sowing of cumin on 5th November recorded significantly the higher values of number of branches per plant, plant height, number of umbellate per umbel, umbels per plant and test weight (g). Cumin sown at recommended distance *i.e.* 30 cm apart gave significantly the highest values of all the growth and yield parameters over rest of the treatments *i.e.* broadcasting and 15 cm between two rows. Crop sown at 30 cm apart on 5th November recorded significantly higher plant height, number of branches and umbels per plant as well as number of umballates per umbel over rest of the treatments. Similarly highest seed yield (600 kg ha^{-1}) of cumin crop achieved when crop sown at 30 cm apart on 5th November. The superior values of yield attributes noticed under optimum spacing and proper sowing time may be attributed to better growth and development of individual plants. The crop sown at 30 cm apart on 5th November recorded higher net realization (Rs.56,600 ha^{-1}) and BCR (1.7) as compared to rest of the treatment combinations. The volatile oil did not affect due to different sowing time and spacing. Thus, to avail the benefits of no cost technology and to generate the higher income and net realization, cumin crop should be sown at 30 cm row distance on 5th November.

Key words: Cumin, sowing date, crop geometry, yield

Introduction

Cumin (*Cuminum cyminum* L.) is a member of Apiaceae and a plant originated in Egypt and East Mediterranean. But it is widely cultivated in Iran, Japan, China and Turkey. Cumin has a long history of use as food flavors, perfumes and medicinal values. Seeds are used as an

essential ingredient in soup, sausages, cheese, cakes and candies (Meena *et al.,* 2022). India is the home of spice and hold a premium position in export, productivity, production of seed spices. Arid and semi arid regions of country are well known for quality production of seed spices. The cumin crop is grown mainly in two states of India *viz*., Gujarat and Rajasthan. The Rajasthan state covers largest area 6.72 lakh ha under cumin cultivation whereas; Gujarat state has highest production 3.19 MT of cumin crop in the year 2018-19 (Indiastat, 2020). Cumin is an important export-oriented highly remunerative but risky commodity. Effect of climate change on agriculture is well known.

During recent past in the month of November, the temperature remained high, which affect the germination and establishment of crop adversely, ultimately on yield also. So, it is necessary to accentuate the sowing time with the geometry for the sustainability in yield of cumin crop under changing climatic condition. The productivity of cumin is severely affected by diseases, time of sowing and plant population. The early sown crop, though gets favorable climatic conditions for growth and productivity, faces more disease incidence. Late sown crop escapes disease incidence conditions, but hasten climatic maturity. Similarly, reduces too dense plant population is more vulnerable to disease incidence, while, too low plant densities do not give good yield. The number of plants in area unit has the most important role among yield components. Probably, deficiency of plant density was partially compensated by the number of umbels and seed per plant but in low plant densities, it is not sufficient (Kafi.M., 1990). Grain yield loss of fennel and black cumin (*Nigella sativa* L.) due to unfavourable sowing time and improper spacings was reported in Bangladesh, found that closer row spacing (15 cm) and early sowing were the best for higher seed yield of black cumin and fennel. Shortening of the growing cycle decreases the amount of radiation intercepted during the growing season and thus total dry weight of plant. With delayed sowing, development is accelerated because the crops encounter higher temperatures during the vegetative growth (Damato *et al.*,1994). Manipulation of agro-techniques particularly sowing time and spacing may help to sustain the productivity in this situation. This study aimed at the determination of the optimum sowing date and plant density of cumin for achievement of maximum seed yields under the conditions semi-arid region.

Materials and methods

An investigation was carried with an objective to ascertain the optimum sowing time and spacing and their interaction effect on growth, yield and economics of cumin crop at Seed Spices Research Station, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, during *rabi* 2015-16 to 2017-18. During the course of investigation, rainfall remained average (>550 mm). Rabi season of was normal during all the years. At the time of sowing, the temperature was moderate which was favourable to the germination of seeds. Over all crop condition was good but disease infestation of blight found moderate to severe during the crop period. Proper plant protection measures were adopted to control the blight disease. Soil texture was loamy sand in nature with low in organic carbon (0.18 %) and low in nitrogen (135 kg N ha^{-1}) as well as medium in available phosphorus (36 Kg P_2O_5 ha^{-1}) and potassium (285 kg K_2O ha^{-1}). The treatments comprised of four dates of sowing *viz*., 5th November, 20th November, 5th December and 20th December and three geometry broadcasting, 30 cm between row and 15 cm between row were replicated thrice in factorial concept of randomized block design. A uniform fertilizer dose of 40 kg nitrogen and 15 kg phosphorus / ha was applied in all the treatments. Whole amount of phosphorus and half dose of nitrogen were drilled at the time of sowing and the remaining quantity of nitrogen was top dressed equally at 12 and 30 days after sowing. Pendimethalin @ 1.0 kg ha^{-1} was applied as pre-emergence to control weeds. All the recommended cultural practices were adopted in time as when required. Yield and growth parameter were recorded in five plants of each plot and average was worked out. Statistical analysis was done through procedure prescribed by (Panse and Sukhatme, 1985).

Growth and yield attributes

Growth and yield attributes of cumin (Table 1) were influenced significantly due date of sowing and

spacing, except number of seeds per umbellate and quality parameter *i.e.* volatile oil. Sowing of cumin on 5th November recorded significantly the highest values of number of branches per plant, umbels per plant and test weight (g). Further sowing on the same date also recorded higher values of plant height and number of umbellate per umbel was remained at par with cumin sown on 20th November. Lower values of all the growth and yield parameters were recorded when cumin sown on 20th December. HeidariZolleh *et al.* (2009) reported that early sowing dates resulted in higher seed yields that can be explained by higher aboveground biomass, the number of umbels per plant, the number of seed per umbellate and plant height. In consideration of the sensitivity of cumin to climatic factors especially to photo period and temperature, it is essential that sowing of this plant be done on time so that there is enough time to have vegetative growth. Delayed sowing resulted in insufficient vegetative growth and plant immediately responded to photo period so the number of umbels per plant and plant height may reduce. These results are also in accordance with the findings of Bhati *et al.* (1994) and Rathore *et al.* (2004) in cumin as well as Meena *et al.* (2020) in ajwain.

Cumin sown at recommended distance *i.e.* 30 cm a part gave significantly the highest values of all the growth and yield parameters over rest of the treatments *i.e.* broadcasting and 15 cm between two rows. HeidariZolleh *et al.* (2009) found that under optimum plant density, plants have efficient use of environmental conditions such as water, light and nutrient while under high plant density, there is competition among plants. Because seed set depends on providing the sufficient nutrients and environmental conditions at stage of changing from vegetative to reproductive and at the later stage after it, increasing plant densities result in limitation of nutrients, light and water so the number of reproductive units decrease, or at the later stage, with increasing competition for environmental conditions (light, nutrients, water), some reproductive units were removed. At last, seed number reproduction decreases. The results are in agreement with Bhati *et al* (1994) and Rathore *et al* (2004) in cumin, Mehta *et al*. (2011) in fennel, Meena *et al.* (2020), Naruka *et al.* (2012) and Muvel *et al*. (2015) in ajwain, Kumar *et al*. (2015) in fenugreek and Sharma *et al*. (2016) in coriander. The volatile oil was not influenced significantly due to different date of sowing treatments.

Table 1. Growth and yield attributes of cumin as influenced by date of sowing and spacing (Pooled data of three years)

Treatments	Plant height (cm)	Number of branches Plant^{-1}	Number of umbels plant^{-1}	Number of umbellate umbel^{-1}	Number of seeds umbellate^{-1}	Test weight (g)	Volatile oil (%)
Date of sowing							
5th November	27.5	6.1	24.0	6.1	5.0	4.5	5.14
20th November	27.1	5.7	22.0	5.8	4.9	4.1	5.14
5th December	25.7	5.5	21.4	5.5	4.9	4.1	5.10
20th December	20.1	5.3	20.5	5.2	4.8	3.9	5.10
S. Em±	0.6	0.1	0.4	0.1	0.1	0.1	0.05
C. D. @5%	1.7	0.3	1.2	0.3	NS	0.2	NS
C.V.%	12.29	8.46	10.45	8.46	6.7	10.52	2.87
Spacing							
Broadcasting	24.3	5.5	21.2	5.5	4.8	4.1	5.12
15 cm between two row	24.6	5.5	21.2	5.5	4.9	3.9	5.14
30 cm between two row	26.4	6.0	23.6	6.0	5.0	4.4	5.17
S. Em.	0.5	0.1	0.4	0.1	0.1	0.1	0.04
C. D. @5%	1.5	0.2	1.1	0.2	NS	0.2	NS
C.V.%	12.29	8.46	10.45	8.46	6.7	10.52	2.87
Y x T	NS	NS	NS	NS	NS	NS	NS

Seed yield

Cumin seed yield (Table 2) was affected significantly due to different sowing date and spacing. Crop sown on 5th November recorded significantly the highest seed yield over rest of the sowing dates during individual years as well as on pooled basis. These might be due to positive effect of climate on growth and development of plant ultimately seed yield. Lower seed yield values were recorded when crop was sown on 20th December. The late sown insist shorten growth period and ultimately affect the growth and yield adversely. The results are in line with the results reported by Bhati *et al.* (1994) and Rathore *et al.* (2004) in cumin, Meena *et al.* (2020) in ajwain. Randhawa and Singh (1998), Singh and Randhawa (1991) and Sudesh *et al.* (2001) for dill seed and Meena *et al.* (2011) in nigella.

Similar trend was also observed for spacing as observed in sowing time. Crop sown at 30 cm apart recorded significantly the highest seed yield of cumin during individual years as well as on pooled basis (Table 2). These results are in accordance with the findings of Bhati *et al.* (1994) and Rathore *et al.* (2004) in cumin, Meena *et al.* (2020), Naruka *et al.* (2012) and Muvel *et al.* (2015) in ajwain, Kumar *et al.* (2015) in fenugreek and Sharma *et al.* (2016) in coriander.

Table 2. Yield of cumin (Kg ha^{-1}) as influenced by different date of sowing and spacing on pooled basis

Treatment	Cumin seed yield (Kg ha^{-1})			
	2015-16	2016-17	2017-18	Pooled
Date of sowing				
5th November	490	489	514	497
20th November	389	309	334	344
5th December	222	233	258	238
20th December	220	221	246	229
S. Em ±	28	25	25	13
C. D. @5%	98	87	87	41
C.V.%	14.16	15.05	13.94	14.37
Spacing				
Broadcasting	305	286	311	301
15 cm between two row	287	281	306	292
30 cm between two row	398	372	397	389
S. Em ±	25	22	22	12
C. D. @5%	85	76	76	36
C.V.%	14.16	15.05	13.94	14.37
Interaction	S	S	S	S
Y x T	-	-	-	NS

Interaction effect

Crop sown during first week of November *i.e.* 5th November under different spacing proved significantly better. Likewise, crop sown at 30 cm row spacing found remarkably better in all sowing conditions. Significantly the highest seed yield was recorded when crop sown on 5th November at distance of 30 cm row apart (Table 3).

Economics

Cumin crop sown on 5th November fetching higher gross realization (Rs.74,550/-), net realization (Rs.41,150/-) and BCR value (1.2) as compared to other sowing dates. In case of spacing, crop sown at 30 cm apart recorded higher values of gross realization (Rs.58,350/-), net realization (Rs.24,950/-) and BCR value (0.7) (Table 4).

Among different treatments of sowing time and spacing, crop sown on 5th November at 30 cm apart recorded higher net realization (Rs.56,600/-) and BCR (1.7) value as compared to rest of the treatment combinations (Table 5). Randhawa and Singh (1988) as well as Singh and Randhawa (1991) and Sudesh *et al.* (2001) recorded similar results in dill, Meena *et al.* (2011) in nigella and Meena *et al.* (2020) in ajwain.

Table 3. Interaction effect of different date of sowing and spacings on yield of cumin (Kg ha^{-1}) on pooled basis

Treatments	Cumin seed yield (Kg ha^{-1})			
	Date of sowing			
Spacing	5th November	20th November	5th December	20th December
Broadcasting	433	357	206	206
15 cm between two row	459	295	220	193
30 cm between two row	600	380	287	288
S. Em.		23		
C. D. @5%		71		
C.V.%		14.37		
Y x T		NS		

Table 4. Economics of cumin as influenced by sowing time and spacing

Treatment	Yield (Kg ha^{-1})	Gross realization (Rs.)	Cost of cultivation	Net realization (Rs ha^{-1})	BCR
Date of sowing					
5th November	497	74,550	33,400	41,150	1.2
20th November	344	51,600	33,400	18,200	0.5
5th December	238	35,700	31,600	4,100	0.1
20th December	229	34,350	31,600	2,750	0.1
Spacing					
Broadcasting	301	45,150	33,800	11,350	0.3
15 cm between two row	292	43,800	33,800	10,000	0.3
30 cm between two row	389	58,350	33,400	24,950	0.7

Table 5. Economics of cumin as influenced by different sowing time and spacing treatment combinations

Treatments		Net realization BCR			
		Date of sowing			
Spacing		5thNovember	20thNovember	5thDecember	20thDecember
Broadcasting	Net realization	31400	20000	-1800	-1853
	BCR	0.9	0.6	-0.1	-0.1
15 cm between	Net realization	35178	10650	300	-3700
two row	BCR	1.0	0.3	0.0	-0.1
30 cm between	Net realization	56600	23617	10583	10750
two row	BCR	1.7	0.7	0.3	0.3

Conclusion

Cumin is a plant which is sensitive to plant density and sowing date. Timely sowing *i.e.* first week of November produced remarkably higher seed yield, whereas, delayed sowing up to 20th December resulted in to lower yield. Optimum plant density of cumin in this study can be maintained by sowing crop at 30 cm apart. While broadcasting of cumin seed may lead to sever diseases and pest infestation resulted in to drastic loss of yield. However, the relatively small absolute differences in seed yield between some plant densities demonstrate the remarkable compensation capacity of cumin between the different yield components. Thus it is advisable to grow cumin crop during first week of November at 30 cm row spacing for securing higher yield, net return and BCR.

Conflicts of Interest : The authors declare no conflicts of interest.

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