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Effect of date of sowing and crop geometry on growth, yield and quality of ajwain (*Trachyspermum ammi* 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 quality of ajwain crop as influenced by date of sowing and crop geometry. on growth, yield and quality of ajwain crop as influenced by date of sowing and crop geometry. 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. Crop sown at 45 cm x 10 cm on 20th October recorded significantly higher plant height, number of branches and umbels per plant as well as number of umbellates per umbel over rest of the treatments. Also, crop sown at 45 cm x 10 cm on 20th October recorded significantly highest seed yield (1431 kg/ ha^{-1}). The superior values of yield attributes noticed under optimum spacing may be attributed to better growth and development of individual plants under the density of less plant population, which resulted into better source to sink relationship due to availability of balanced and adequate nutrients and better light, space and moisture resulting in to higher seed yield. The quality attributes *i.e.* volatile oil remained unaffected due to different treatments of sowing date and crop geometry. The crop sown on 20th October at 45 cm row spacing confirmed higher net realization (Rs.59436/ ha^{-1}) and BCR (2,25) as compared to rest of the treatment combinations. Therefore, by adopting low cost technologies it is recommended that ajwain crop sown at 45 cm x 10 cm on 20th October recorded higher yield and net return, whereas quality parameter was not affected significantly.

Therefore, by adopting low cost technologies it is recommended that ajwain crop sown at 45 cm x 10 cm on 20th October recorded higher yield and net return, whereas quality parameter was not affected significantly.

Key words : Ajwain, sowing date, crop geometry, volatile oil, yield, BCR

Introduction

Ajwain also known as Bishop's weed, is an annual herbaceous plant belonging to family Apiaceae, high valued medicinally important seed spice crop. *Trachyspermum ammi* L. is a native of Egypt and is cultivated in Iraq, Iran, Afghanistan, Pakistan and India. In India it is grown in Gujarat, Rajasthan, Madhya Pradesh and Andhra Pradesh. It owes its characteristic odour and taste due to presence of an essential oil. Ajwain oil is principal source of thymol (Saxena *et al.,* 2024). Ajwain oil is also used in medicine as an antiseptic and aromatic carminative. Its characteristic aromatic smell and pungent taste is widely used as a spice in curries. More important use of ajwain is medicinal and it is a household remedy for indigestion. It is much valued for its antispasmodic, stimulant, tonic and aromatic carminative properties. It employed either alone or in mixture with other spices and condiments. In arid and semi-arid regions, ajwain cultivation has increased in recent past due to highly remunerative, non-risky crop and required less costly inputs *i.e.* irrigation, fertilizer *etc.* as compared to other *rabi* crops. The maximum exploitation of the factors available for growth of any crop can be achieved only when the plant population exerts maximum pressure on all the production factors. Under this situation individual plant remains under stress conditions because of inter/intra plant competition. Climate play an important role in production potential of any crop. Change in weather pattern during *kharif* or *rabi* and summer season, corresponding termination of these seasons and adversely affect the productivity of crop. Therefore, it is necessary to compensate the time of sowing with space available to achieve the targeted yield of ajwain in changing climatic condition. For field crop, it is most desirable and also essential to achieve the twin objective of maximum crop growth and seed yield simultaneously, and this could be achieved largely by managing non-monetary inputs *viz.*, geometry and sowing time. It is essential to provide optimum plant population density per unit area by adjusting the spacing levels in ajwain crop unlike in normal spacing, the plants grown in closer spacing exhibited more vertical growth but give less yield and poor quality seeds (Dhanraj *et al.*, 2001). Whereas, the plants grown in the wider spacing exhibit more horizontal and continuous vegetative growth due to less population pressure per unit area but, they also give less yield per unit area. However, plants grown under normal spacing will have optimum population density per unit area which provides optimum conditions for luxuriant crop growth and better plant canopy area due to maximum light interception, photosynthetic activity, assimilation and accumulation of more photosynthates into plant system and hence they produce more seed yield of best quality traits (Mazumdar *et al.*, 2007). The most optimum plant population per unit area at proper sowing could be provided by optimizing the spacing and timely sowing. Manipulation of agro-techniques particularly sowing time and spacing may help to protect the productivity in this situation. During recent past, temperature during October and November remained high, which affect the germination and establishment of sufficient plant population ultimately resulted in poor yield. Since little information is available on the effect of date of sowing and spacing on growth and yield of ajwain, therefore the present study was undertaken.

Materials and methods

To find out the effect of sowing time and crop geometry on growth, yield and quality of ajwain crop, an investigation was carried with an objective to ascertain the optimum sowing time and spacing and their interaction effect on ajwain 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 up to mid February. The disease pressure was moderate during the crop period. Ajwain crop was found almost free from the diseases and pests. 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 three dates of

sowing *viz*., .20th October, 5th November and 20th November and three crop geometry 30 cm x 10 cm, 45 cm x 10 cm and 60 cm x 10 cm, replicated thrice in factorial concept of randomized block design. A uniform fertilizer dose of 20 kg nitrogen and 10 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 at 35 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 and 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).

Results

Growth, yield and quality attributes:

All the growth and yield attributing characters (Table 1) were affected significantly due to date of sowing time except number of seeds per umballates. Crop sown on 20th October 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 except crop sown on 5th November. Significantly the highest test weight was achieved when crop sown on 20thOctober. Meena *et al.* (2013) reported that sowing of dill seed crop at 15th October exhibits higher values of plant height at various growth stages, days taken to branching, number of branches per plant, days taken to flower initiation, number of umbel per plant, number of umbellate per umbel, seeds per umbellate and test weight. These results are also in accordance with the findings of Malhotra (2002), Malhotra and Vijay (2004), Meena *et al.* (2020), Mehta (2013), Tiwari and Agarwal (2004) and Prem Nath (2008) for ajwain crop. The volatile oil was not influenced significantly due to different date of sowing treatments.

Crop geometry emerged significant effect on all the growth and yield attributes except, number of seeds per umballates (Table 1). Crop sown at 45 cm x 10 cm recorded significantly higher plant height, number of umbels per plant and number of umballates per umbel over rest of the treatments except, crop sown at 30 cm x 10 cm. Whereas, crop sown at spacing of 45 cm x 10 cm recorded significantly the highest number of branches per plant. Crop sown at wider spacing *i.e.* 60 cm apart

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

Treatments	Plant height (cm)	Number of branches	Number of umbels $plant^{-1}$	Number of umballates $umbel^{-1}$	Number of seed	Test weight (g)	Volatile oil (%)
Date of sowing							
20th October	116.1	8.2	11.4	23.4	17.8	0.96	2.45
5th November	114.3	7.8	11.1	22.8	17.2	0.89	2.43
20th November	109.9	7.5	10.3	21.9	17.1	0.87	2.43
5th December	105.6	6.9	9.6	20.5	17.0	0.86	2.42
S. Em.±	1.4	0.15	0.2	0.3	0.2	0.01	0.02
C. D. @5%	3.9	0.4	0.7	0.8	NS	0.03	NS
C.V.%	6.5	9.9	12.1	6.2	7.00	6.86	4.67
Crop geometry							
30 cm x 10 cm	112.6	7.4	10.7	22.2	17.0	0.87	2.42
45 cm x 10 cm	113.3	8.1	11.3	22.8	17.5	0.93	2.44
60 cm x 10 cm	108.5	7.2	9.8	21.5	17.3	0.84	2.43
S. Em.±	1.2	0.13	0.2	0.2	0.2	0.01	0.02
C. D. @5%	3.4	0.4	0.6	0.7	NS	0.03	NS
C.V.%	6.5	9.9	12.1	6.2	7.00	6.86	4.67
Y x T	NS	NS	NS	NS	NS	NS	NS

recorded lower values of all the growth and yield attributing characters. Significant increase in parameters at wider spacing might be due to less competition among plants for solar energy, water, nutrients and other growth factors. Variation in plant height was significantly influenced by different plant geometry. Higher plant height and number of branches were optimum at spacing of 45 cm ×15 cm. It may be ascribed to the better growth of plants under broader spacing and it exhibited better vegetative growth due to less plant population density and competition, which resulted in more horizontal growth and plant canopy area compared to those under narrow spacing. So the branch bearing capacity increased. The results are in agreement with 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. All the spacings did not emerge any significant effect on volatile oil.

Seed yield

Seed yield (Table 2) of ajwain was affected significantly due to various date of sowing during individual years as well as on pooled basis. Crop sown on 20th October recorded significantly the highest seed yield over rest of the treatments during individual years as well on pooled basis, except in the year 2017-18 where it remained at par when crop sown on 5th November. Optimum climatic condition during grand growth phase improve growth and yield attributes ultimately yield. Meena *et al.* (2013) reported that the best performance of growth parameters of dill crop with respect to yield attributes with 15th October sowing might be due to suitable climatic conditions, which facilitated better germination, crop establishment and less chances of occurrence of diseases and pest leading to higher seed yield as compared to other sowing times. The results are in line with the results reported by

Table 2. Seed yield of ajwain (Kg ha^{-1}) as influenced by different date of sowing and crop geometry (on pooled basis)

Treatment	Ajwain seed yield (Kg ha^{-1})			
	2015 -16	2016 -17	2017 -18	Pooled
Date of sowing				
20th October	1203	1271	1291	1255
5th November	958	972	1060	997
20th November	648	666	760	691
5th December	554	551	647	584
S. Em. ±	70	65	67	23
C. D. @5%	243	224	233	64
C.V.%	15.23	12.89	12.04	13.36
Crop geometry				
30 cm x 10 cm	795	817	876	829
45 cm x 10 cm	1047	1065	1144	1085
60 cm x 10 cm	681	713	799	731
S. Em. ±	61	56	58	20
C. D. @5%	211	194	202	55
C.V.%	15.23	12.89	12.04	13.36
Interaction	-	-	-	S
Y x T	-	-	-	NS

Randhawa and Singh (19981988), Singh and Randhawa (1991) and Sudesh *et al*., (2001) for dill seed and Meena *et al*., (2011) for nigella. Crop sown at 45 cm x 10 cm recorded significantly the highest seed yield during individual years as well as on pooled basis. The superior values of yield attributes noticed under optimum spacing may be attributed to better growth and development of individual plants under the density of less plant population which resulted into better source to sink relationship due to availability of balanced and adequate nutrients and better light, space and moisture resulting in to higher seed yield. These results are in accordance with the findings of Tiwari & and Agarwal (2004), PremNath (2008), Naruka *et al.* (2012), Mehta *et al.* (2013), Muvel *et al.* (2015) and Meena *et al.* (2020).

Interaction effect

The interaction effect between sowing date and spacing emerge significant effect on seed yield of ajwain. Crop sown on 20th October with different spacing proved better than November and December sowings at different spacings. Similarly, 45 cm spacing found better under all the sowing dates. The crop sown 20th October at 45 cm apart resulted in significantly the highest seed yield of ajwain (Table 3).

Economics

Ajwain crop sown on 20th October resulted in higher gross realization (Rs.75,900/-), net realization (Rs. 49,503/-) and BCR value (1.9) as compared to other sowing dates (Table 4). In case of spacing, crop sown at 30 cm apart recorded higher values of gross realization (Rs 65,280/-), net realization (Rs.38,883/-) and BCR value (1.5).

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

Treatments	Ajwain seed yield (Kg ha^{-1})			
	Date of sowing			
Spacing	20th October	5th November	20th November	5th December
30 cm between two row	1161	1092	528	536
45 cm between two row	1431	1192	998	720
60 cm between two row	1173	706	549	496
S. Em. ±		39		
C. D. @5%		111		
C.V.%		13.36		
Y x T		NS		

Table 4. Economics of ajwain as influenced by different treatments

Treatment	Yield (Kg ha^{-1})	Gross realization (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net realization (Rs. ha^{-1})	BCR
Date of sowing					
20th October	1265	75900	26397	49503	1.9
5th November	1001	60060	26397	33663	1.3
20th November	693	41580	24597	16983	0.7
5th December	585	35100	24597	10503	0.4
Spacing					
30 cm between two row	839	50340	26397	23943	0.9
45 cm between two row	1088	65280	26397	38883	1.5
60 cm between two row	731	43860	25997	17863	0.7

Table 5. Economics of ajwain as influenced by different treatment combinations of sowing and spacings

Treatments		Net realization and BCR			
		Date of sowing			
Spacing		20th October	5th November	20th November	5th December
30 cm between two row	Net realization	43270	39136	6163	6650
	BCR	1.64	1.48	0.24	0.26
45 cm between two row	Net realization	59436	45103	34363	17703
	BCR	2.25	1.71	1.35	0.69
60 cm between two row	Net realization	44190	16176	7630	4462
	BCR	1.69	0.62	0.30	0.18

Among different sowing time and spacing combinations, crop sown on 20th October at 45 cm row spacing confirmed higher net realization and BCR as compared to rest of the treatment combinations (Table 5). Which was closely followed when crop sown on 5th November at 45 cm spacing. The best performance growth parameters of dill crop with respect to yield attributes and seed yield with 20th October sowing might be due to suitable climatic conditions, which facilitated better germination, crop establishment and less chances of occurrence of diseases and pest leading to higher gross return, net return and BCR as compared to other sowing times. Randhawa and Singh (1988) as well as Singh and Randhawa (1991) and Sudesh *et al*., (2001) recorded similar results in dill, Meena *et al*., (2013) in nigella and Meena *et al.,* (2020) in ajwain.

Conclusion

In view of the results obtained from the investigation, it is suggested that higher seed yield, net return and BCR of ajwain can be achieved by adopting no cost technologies as seeds were sown on 20th October at 45 cm apart. In such a case, crop avail longer growth duration and thus the growth and development correspond with favorable environmental conditions and produce more photosynthetic assimilates. While delay in planting and narrow rows decrease the yield and yield attributing traits that consequently affect the yield of ajwain.

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

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