Growth analysis of coriander (*Coriandrum sativum* L.) as influenced by different dates of sowing and planting geometry under Chhattisgarh plains zone

ABSTRACT

An experiment was conducted to assess the effect of different sowing dates and planting geometry on coriander during the winter seasons of 2020-21 and 2021-22 at Instructional farm, College of Agriculture and Research Station, IGKV, Raigarh, Chhattisgarh. The experiment was laid out in split-plot design, comprised of four date of sowing *viz.*, D_1: 25th October, D_2: 10th November, D_3: 25th November and D_4: 10th December as main plot and four planting geometries *viz.*, S_1: 30 x 5 cm, S_2: 30 x 7.5 cm, S_3: 30 x 10 cm and S_4: 30 x 12.5 cm as sub-plot, and replicated trice. The result showed that the crop sown on 25th October registered significantly higher growth parameters *viz.*, plant height, number of branches, dry matter accumulation, crop growth rate and relative growth rate. Among planting geometry, sowing of coriander at 30 x 12.5 cm spacing produced significantly taller plants, higher number of branches plant^{-1}, dry matter accumulation plant^{-1}, crop growth rate and relative growth rate. Coriander sown on 25th October interacted with the 30 x 12.5 cm spacing and registered significantly higher dry matter accumulation.

Key words: Coriander, Date of sowing, Planting geometry

Introduction

Coriander (*Coriandrum sativum* L.), which belongs to the family of umbelliferae (Apiaceae) is one of the most important annual spice and medicinal herb, native to the Eastern Europe and Asia. It is grown as a field crop for its seeds commonly known as "*Dhania*" which has a fragrant odor and aromatic test. The dry seeds are said to have carminative diuretic, stomachic and aphrodisiac properties. On stem distillation, coriander seeds yield 0.2 to 1.2% essential oil. The major components of essential oil are linalool (67.7 %) followed by 1-pipen (10.5 %), 1-terpinin (9.0 %), geranyl acetate (4 %) and geraniol (1.9 %). The success of coriander production is influenced by genetic, weather and agronomic factors (Szemplinski and Nowak, 2015). The maximum ~~fruit~~ seed and essential oil yields are attained only when an appropriate combination of these factors are provided for the plant (Rangappa *et al.*, 1997;

Gill *et al*., 2001). Date of sowing is an important management factor for almost all seed spices including coriander. Coriander exploits the environment most favorably when it is sown at optimum time (Kuri *et al*., 2015), since sowing date significantly affects the photoperiodic response of plants and determines yields and qualities (Rassam *et al*., 2007). Change in sowing time leads to significant change in weather microclimate and subsequently the performance of the crop. In addition, the physical environment has profound influence on growth, partitioning and ultimately the yield of coriander. Temperature, humidity, rainfall and other meteorological factors may individually or collectively limit the plant growth and production. Establishment of an appropriate spacing for maintaining the optimum plant population per unit area is the main pre- requisite to obtaining maximum yields from any crop. Adequate planting geometry also render crop for a better growth and development of crop which ultimately reflects on higher production. To increase the productivity of local and improved varieties of coriander, it is important that farmers ~~by~~ adopt~~ion~~ ~~of~~ the recommended sowing date and planting geometry ~~is very important today~~.

Comment [Rr1]: This statement is not clear and, therefore, should be rephrased.

Material and methods

The experiment was laid out for two consecutive *Rabi* seasons of 2020-21 and 2021-22 at Instructional farm, College of Agriculture and Research Station, IGKV, Raigarh Chhattisgarh, which is situated at 21.9’ North latitude, 83.4’ East longitude and at an attitude of 215 meters above mean sea level. The experimental soil was loamy sand in texture, slightly acidic in reaction, low in organic carbon and available nitrogen, phosphorus, sulphur and zinc and medium in available potassium, having low moisture retention capacity. The experiment was carried out in ~~split~~ split-plot design with sixteen treatment combinations of main and ~~sub~~ sub-plots, replicated trice. Four Dates of sowing *viz.* D_1: 25th October, D_2: 10th November, D_3: 25th November and D_4: 10th December were arranged in main plot and four planting ~~geometris~~geometries *viz.*, S_1: 30 x 5 cm, S_2: 30 x 7.5 cm, S_3: 30 x 10 cm and S_4: 30 x 12.5 cm were taken as sub-plot treatments. Recommended dose of fertilizer of 80:60:40 N: P_2O_5: K_2O kg ha^{-1} was applied. ~~Influence of above treatments on crop was studied for~~Data on the growth behavior of coriander ~~cultivation and~~ were collected and analyzed statistically using *F*- test, the procedure given by Gomez and Gomez (1984). Critical difference (CD) values at *P*=0.05 were used to determine the significance of mean differences ~~of~~ between treatments.

Results and discussion

CorianderThe date of sowing, sown on 25^{th} October sown crop recorded significantly higher plant population in both the yearseasons, which is mutually at parwere not significantly different from those recorded with the 10^{th} November and 25^{th} November sowing crop during both the yearseasons as well as on mean basis. Sowing of coriander on 25^{th} October produced significantly taller plants, higher number of branches plant^{-1} (Table 1), dry matter plant^{-1} (Table 2), crop growth rate (Fig. 1) and relative growth rate (Fig. 2) and minimum was observed when coriander was sown on 10^{th} December at all the crop growth stages during both the yearseasons and pooled analysis (Table 1 and 2). In early growing season, coriander resulted in to healthy crop growth. Sufficient availability of moisture and nutrition due to that luxurious crop growth, efficient utilization of moisture and nutrients, more light interception, maximum absorption of PAR, more synthesis of photosynthates and that's why growth was increased. The significant decreases in growth with delay in sowing can be related to higher temperature at the late sowing dates experienced which limited their growth period. The plant did not have optimum opportunity for photosynthesis. The results are in agreement with Khoja (2005), Meena *et al.* (2006), Nath *et al.* (2008) in fennel and Moniruzzaaman *et al.* (2013) in coriander.

Comment [Rr2]: What is this referring to?

Comment [Rr3]: Data on soil moisture and nutrient content, PAR and temperature were not collected in this study. Therefore inferences cannot be based on these parameters.
If such data were collected, the same should be reported in this manuscript

The Coriander sown with the planting geometry 30 x 5 cm recorded significantly more higher plant population as well asand taller plants followed by 30 x 7.5 cm, 30 x 10 cm and 30 x 12.5 cm during both the yearseasons of experimentation and on mean basis. Sowing of coriander with 30 x 12.5 cm spacing, produced significantly higher number of branches plant^{-1} (Table 1), dry matter plant^{-1} (Table 2), crop growth rate (Fig. 1) and relative growth rate (Fig. 2) and minimum was observed when crop was sown at 30 x 5 cm at all the crop growth stages during both the years and on mean basis (Table 1 and 2). Tallest plants under closer spacing may be attributed due to more competition for light amongst the plants significant increase in plant height right from early stage of crop growth under closer spacing seem to be due to mutual shading because of dense population. As also recorded by Meena *et al.* (2013) and Kiran (2018) in black cumin. Increased growth under 30 x 12.5 cm spacing might be attributed to more space plant^{-1}, available under wider spacing. The larger canopy development, associated with profuse branching, has most likely increased interception,

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Comment [Rr5]: This statement is incomplete.

absorption and utilization of solar energy resulting in formation of higher photosynthates and finally dry matter plant^{-1}, which has resulted in better growth and development of coriander. The results are in line with Kiran *et al*. (2019)~~ in Nigella~~, Bhapkar *et al*. (2019) and Nethravathi (2019).

Plant population and growth parameters of coriander i.e., plant height, number of branches plant^{-1}, crop growth rate and relative growth rate were found to be differed non-significantly due to the interaction effect of date of sowing and planting geometry, however, aforesaid parameters were numerically maximum under the interactions of 25th October sowing date along with 30 x 12.5 cm spacing, except plant height which was maximum under 25th Octoer sowing with ~~30 x~~ 30 x 5 cm spacing. Dry matter accumulation of coriander was recorded significantly maximum when sowing was done on 25th October at 30 x 12.5 cm, which was at par with 25th October sowing with 30 x 10 cm spacing during both the years and on mean basis (Table 3). These results are in conformity with those reported by Meena *et al*. (2015) and Haq *et al*. (2015).

Comment [Rr6]: The discussion here seems to be based on trends, not on statistical analysis.

Comment [Rr7]: This statement is not clear and should be rephrased.

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Conclusion

Based on the two year experiments it has been concluded that crop sown on 25th October and 30 x 12.5 cm spacing resulted in significantly better growth and developments of coriander.

Comment [Rr9]: The abstract refers to **two seasons**

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Table 1. Growth of coriander as influenced by different date of sowing and planting geometry

Treatment	Plant population (No. m^{-2})						Plant height (cm)												Number of branches plant^{-1}					
	20 DAS			At harvest			30 DAS			60 DAS			90 DAS			At harvest			60 DAS			At harvest		
	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean
Date of sowing																								
25th October	42.62	43.03	42.82	39.92	40.33	40.12	11.13	11.63	11.38	30.19	34.66	32.42	90.77	96.24	93.50	114.40	121.41	117.90	5.83	6.39	6.11	8.32	8.69	8.50
10th November	41.69	42.64	42.17	38.99	39.94	39.47	9.74	10.23	9.98	27.93	30.82	29.37	85.68	90.04	87.86	105.89	111.80	108.84	5.27	5.82	5.50	7.73	7.98	7.85
25th November	40.78	41.48	41.13	38.08	38.78	38.43	8.80	9.20	9.00	24.89	26.55	25.72	80.12	83.68	81.90	90.98	95.15	93.06	4.72	5.12	4.92	7.26	7.47	7.37
10th December	38.61	40.06	39.34	35.91	37.36	36.64	8.13	8.49	8.31	22.77	24.07	23.42	74.83	77.68	76.26	81.04	84.51	82.78	4.38	4.74	4.56	6.72	6.88	6.80
SEm±	0.71	0.54	0.61	0.63	0.53	0.57	0.17	0.21	0.18	0.72	0.92	0.70	2.49	2.21	2.22	2.86	2.84	3.01	0.15	0.13	0.12	0.17	0.23	0.19
CD (*P*=0.05)	2.47	1.86	1.76	2.13	1.81	1.93	0.60	0.72	0.63	2.23	3.18	2.41	8.61	7.63	7.69	9.88	9.82	9.36	0.51	0.44	0.42	0.59	0.79	0.65
Planting geometry																								
30 cm x 5 cm	63.37	65.65	64.51	59.37	61.65	60.51	10.37	10.78	10.58	31.05	34.53	32.79	87.86	93.13	90.49	105.47	112.18	108.82	4.25	4.55	4.39	6.58	6.86	6.72
30 cm x 7.5 cm	43.24	43.77	43.51	40.24	40.77	40.51	9.94	10.38	10.16	28.80	31.55	30.18	85.36	90.15	87.76	103.58	108.45	106.02	4.82	5.17	4.98	7.22	7.38	7.30
30 cm x 10 cm	31.68	32.22	31.95	29.38	29.92	29.65	9.04	9.49	9.27	24.75	26.99	25.87	81.47	85.19	83.33	94.08	99.22	96.65	5.46	6.03	5.73	7.98	8.24	8.11
30 cm x 12.5 cm	25.40	25.58	25.49	23.90	24.08	23.99	8.44	8.89	8.66	21.18	23.03	22.11	76.71	79.17	77.94	89.18	93.02	91.10	5.68	6.32	5.98	8.25	8.55	8.40
SEm±	0.47	0.45	0.21	0.47	0.45	0.21	0.19	0.13	0.15	0.52	0.61	0.38	1.74	1.64	1.47	2.12	1.48	1.51	0.16	0.15	0.15	0.20	0.16	0.16
CD (*P*=0.05)	1.38	1.31	0.61	1.38	1.31	0.61	0.57	0.39	0.48	1.52	1.77	1.12	5.09	4.80	4.30	6.18	4.32	4.40	0.45	0.44	0.43	0.58	0.46	0.47
Interaction																								
CD (*P*=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Growth of coriander as influenced by different date of sowing and planting geometry

Treatment	Dry matter accumulation (g plant^{-1})											
	30 DAS			60 DAS			90 DAS			At harvest		
	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean	20-21	21-22	Mean
Date of sowing												
25th October	0.33	0.37	0.35	3.40	3.69	3.54	11.68	12.18	11.93	13.98	15.19	14.58
10th November	0.31	0.35	0.33	3.10	3.33	3.22	10.85	11.37	11.11	12.31	13.54	12.92
25th November	0.29	0.32	0.31	2.74	2.92	2.83	9.98	10.57	10.28	10.81	11.70	11.25
10th December	0.26	0.29	0.27	2.17	2.29	2.23	8.94	9.22	9.08	9.31	9.93	9.62
SEm±	0.01	0.01	0.01	0.06	0.05	0.05	0.37	0.30	0.32	0.28	0.33	0.23
CD (*P*=0.05)	0.03	0.02	0.02	0.22	0.17	0.16	1.28	0.92	0.98	0.97	1.14	0.79
Planting geometry												
30 cm x 5 cm	0.20	0.22	0.21	1.77	1.87	1.82	5.02	5.40	5.21	5.62	6.43	6.03
30 cm x 7.5 cm	0.25	0.28	0.27	2.41	2.59	2.50	8.52	9.17	8.85	9.55	10.66	10.10
30 cm x 10 cm	0.35	0.39	0.37	3.53	3.75	3.64	13.29	13.70	13.49	14.78	15.73	15.25
30 cm x 12.5 cm	0.39	0.43	0.41	3.70	4.02	3.86	14.63	15.08	14.85	16.46	17.54	17.00
SEm±	0.01	0.01	0.01	0.09	0.09	0.08	0.23	0.18	0.14	0.27	0.30	0.24
CD (*P*=0.05)	0.03	0.03	0.03	0.25	0.27	0.22	0.68	0.51	0.40	0.79	0.86	0.69
Interaction												
CD (*P*=0.05)	NS	NS	NS	S	S	S	S	S	S	S	S	S

Table 3. Interaction effects between different sowing dates and planting geometry on dry matter accumulation of coriander

Dry matter accumulation (g plant^{-1}) at 60 DAS

Spacing \ Sowing date	2020-21 D_1	2020-21 D_2	2020-21 D_3	2020-21 D_4	2020-21 D_1	2020-21 D_2	2020-21 D_3	2020-21 D_4	Mean D_1	Mean D_2	Mean D_3	Mean D_4
S_1	2.41	1.51	0.70	0.55	2.61	1.60	0.95	0.65	2.51	1.56	0.83	0.60
S_2	2.92	2.44	1.68	0.86	3.16	2.59	2.00	0.96	3.04	2.52	1.84	0.91
S_3	4.05	3.75	3.37	1.54	4.36	3.98	3.10	1.88	4.21	3.87	3.24	1.71
S_4	4.20	3.91	3.57	1.71	4.63	4.11	3.62	2.05	4.42	4.01	3.60	1.88
SEm±	**0.10**				**0.09**				**0.07**			
CD (P=0.05)	**0.28**				**0.25**				**0.22**			

Dry matter accumulation (g plant^{-1}) at 90 DAS

Spacing \ Sowing date	2020-21 D_1	2020-21 D_2	2020-21 D_3	2020-21 D_4	2020-21 D_1	2020-21 D_2	2020-21 D_3	2020-21 D_4	Mean D_1	Mean D_2	Mean D_3	Mean D_4
S_1	6.8	4.8	2.5	2.0	6.5	4.7	3.7	2.2	6.6	4.7	3.1	2.1
S_2	10.6	9.1	6.8	4.6	9.9	9.1	7.9	5.1	10.2	9.1	7.4	4.9
S_3	16.0	14.2	12.1	7.9	15.5	14.1	12.4	8.2	15.7	14.1	12.2	8.1
S_4	17.4	15.3	13.5	9.2	16.8	15.3	13.5	10.1	17.1	15.3	13.5	9.7
SEm±	**0.70**				**0.44**				**0.27**			
CD (P=0.05)	**2.05**				**1.29**				**0.79**			

Dry matter accumulation (g plant^{-1}) at harvest

Spacing \ Sowing date	2020-21 D_1	2020-21 D_2	2020-21 D_3	2020-21 D_4	2020-21 D_1	2020-21 D_2	2020-21 D_3	2020-21 D_4	Mean D_1	Mean D_2	Mean D_3	Mean D_4
S_1	7.4	4.9	2.7	2.1	8.5	5.7	4.0	2.6	8.0	5.3	3.4	2.3
S_2	11.5	9.5	7.3	5.0	12.8	10.2	8.6	5.7	12.2	9.9	8.0	5.3
S_3	17.8	15.0	12.3	8.3	19.2	16.2	13.4	8.8	18.5	15.6	12.9	8.5
S_4	19.9	16.5	14.0	9.7	21.4	18.5	14.5	10.5	20.7	17.5	14.2	10.1
SEm±	**0.463**				**0.49**				**0.33**			
CD (P=0.05)	**1.351**				**1.42**				**0.96**			

D_1: 25th October, D_2: 10th November, D_3: 25th November, D_4: 10th December,

S_1: 30 cm x 5 cm, S_2: 30 cm x 7.5 cm, S_3: 30 cm x 10 cm, S_4: 30 cm x 12.5 cm

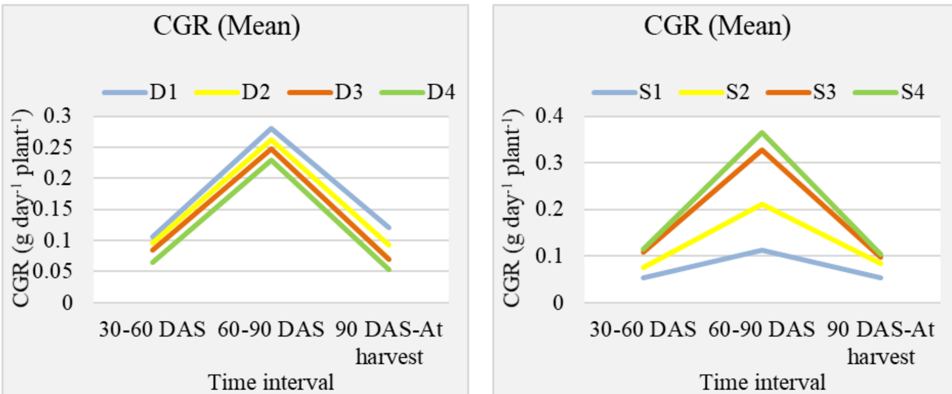

Fig. 1: Crop growth rate of coriander as influenced by different date of sowing and planting geometry

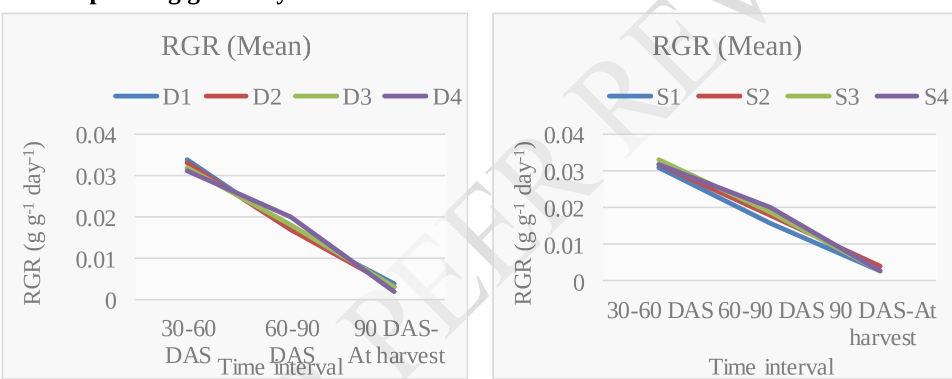

Fig. 2: Relative growth rate of coriander as influenced by different date of sowing and planting geometry