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Influence of time of planting and spacing on yield and quality of turmeric (*Curcuma longa* L.) in *terai* region of West Bengal

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Abstract

The turmeric productivity in West Bengal is very low (2.5 t/ha) as compared to national productivity (4.7 t/ha) and this is mainly because of poor knowledge of the farmers about suitable production technology. The present field study was conducted to evaluate the performance of turmeric (Megha Turmeric-1) under different planting time and spacing combinations in *Terai* region of West Bengal. The experiment was laid out in split plot design with three replications. The observations were recorded for different parameters like plant height, number of leaves per plant, total rhizome weight, primary rhizome weight, primary rhizome length, primary rhizome girth, primary rhizome width, fresh rhizome yield per hectare and curcumin content. The highest total rhizome weight (229.4 g), primary rhizome weight (94.8 g), primary rhizome length (8.1 cm), primary rhizome girth (5.8 cm) and primary rhizome diameter (1.0 cm), fresh rhizome yield (18.6 t/ha) was recorded when planting was done on first fortnight of April. There was increasing trend of primary rhizome weight when spacing was increased. The highest primary rhizome weight (74.1 g) was observed when the rhizome was planted at a distance of 50×30 cm whereas in 30×30 cm spacing it was 55.0 g. However, highest fresh rhizome yield (19.2 t/ha) was observed in 30×30 cm spacing. All the morphological and yield parameters significantly varied with combined effect of time of planting and spacing. The highest yield (24.3 t/ha) was obtained in first fortnight of April planting with 30×30 cm spacing. Therefore, for obtaining higher yield and high cucumin, the first fortnight of April planting at 30×30 cm spacing can be recommended as suitable production technology for turmeric (Megha Turmeric-1) in *Terai* region of West Bengal.

Keywords: Turmeric, Planting time, Spacing, yield, Curcumin

Turmeric (*Curcuma longa* L.) is a crop of Indian sub-continent and South East Asia. It belongs to Zingiberaceae family. Curcumin has antioxidant, antibacterial, antifungal, antiparasitic and anti-inflammatory and anti-cancerous properties (Jang *et al.*, 2008; Pisano *et al.*, 2010; Liang *et al.*, 2009; Bahl *et al.*, 2014). Tremendous increase of consumption of turmeric was observed from the COVID-19 pandemic period as an immunity booster (Vardhini *et al.*, 2023).

India is the largest producer, consumer and exporter with an area of 3.24 lakh ha and annual production of 11.6 lakh tones. The varied agro-climatic condition of West Bengal especially the *Terai* region is very much suitable to grow turmeric. In fact some promising varieties of Meghalaya like Megha Turmeric-1 and Lakadong have good potential. The crop is grown in 0.18 lakh hectares with a production of 0.4 lakh tones in West Bengal. Unfortunately, the productivity in west Bengal is very low (2.5 t/ha) as compared to national productivity (4.7 t/ha) and this is mainly because of poor knowledge of the farmers about suitable production technology. Region specific standard time of planting, spacing guidelines is not available in West Bengal for turmeric cultivation. Turmeric is generally planted in 22-35 cm apart by the farmers of West Bengal at variable planting times which affect its yield and quality. So, the time of planting and spacing are the major factors influencing growth and yield of turmeric although not much work on standardization of these factors has so far been done for this region (Ghosh *et al.*, 2011). Therefore, the present investigation was carried out with the objectives to determine optimum time of planting and spacing of turmeric (Megha Turmeric-1) in *Terai* region of West Bengal.

MATERIALS AND METHODS

The experiment was carried out at the research farm of ICAR-National Institute for Research on Commercial Agriculture, Research Station, Dinhata, West Bengal during 2022-23 and 2023-24. The experiment was laid out in split plot design with four planting time *i.e.,* D_1 (Second fortnight of March), D_2 (First fortnight of April), D_3 (Second fortnight of April), D_4 (First fortnight of May) as main plot and four spacing *i.e.,* S_1 (30×30 cm), S_2 (40×30

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cm), S_3 (50×30 cm), S_4 (60×30 cm) as subplot treatments, with three replications. The growth parameters like plant height, number of leaves per plant, were observed at 180 days after planting from three randomly selected plants in each plot. The rhizomes were dug out at maturity during neck-fall stage (270 days), physically cured by keeping under well ventilated-shade for a week and finally weighed to determine total rhizome weight (g), primary rhizome weight (g), primary rhizome length (cm), primary rhizome girth (cm), primary rhizome width (cm) and fresh rhizome yield (t/ha). The total curcumin content was measured as per standard procedure by using UV-VIS spectro-photometer (Motras, India) following the protocol given by Jansirani *et al.* (2014) after powdering the oven dried rhizome harvested from second season. The replicated mean data were subjected to statistical analysis of variance (ANOVA) using software available at https://www.kaugrapes.com/analysis-of-experiments/split-plot-analysis.

RESULTS AND DISCUSSION

Growth of plant and rhizome parameters as influenced by date of planting

The individual effect of time of planting on various growth and rhizome parameters are presented in Table 1. The plant height varied from 89.3 cm to 137.6 cm. The maximum plant height (137.6 cm) was observed when rhizomes are planted on first fortnight of April (D_2). Similar findings were recorded by Ponnuswamy and Muthuswami (1981). Significant variation was observed for number of leaves per plant as influenced by time of planting. The highest number of leaves per plant (12.9) was observed when planted on first fortnight of April (D_2). The highest total rhizome weight (229.4 cm), primary rhizome weight (94.8 cm), primary rhizome length (8.1 cm), primary rhizome girth (5.8 cm) and primary rhizome diameter (1.0 cm) was recorded when planting was done on first fortnight of April (D_2). It clearly depicts that planting date has great role in regulating rhizome parameters. As like plant height, the total rhizome weight and primary rhizome weight were also found to be significantly higher in first fortnight of April (D_2) planting time. On the contrary, the study of Singh *et al.* (2013) showed high fresh rhizome weight and total yield in last week of April in the same variety as used in the present study *i.e.*, Mega Turmeric-1. The difference in yield in both studies is due to the varied agro-climatic condition. The data of total fresh rhizome yield (t/ha) is presented in Fig. 1. During second fortnight of March (D_1), the total fresh rhizome yield was less (14.2 t/ha) then it was increased. The highest total fresh rhizome yield (18.6 t/ha) was observed at first fortnight of April planting (D_2). After that the yield had shown a reducing trend in delayed planting. Ishimine *et al.* (2004) had also presented a significant effect of planting dates on rhizome yield. Our study also corroborate the findings of Manhas *et al.* (2011) who reported the higher yield and yield attributes with April planting than May planting. As quality trait, curcumin content is presented as box plot in Fig. 2. The curcumin content (%) was maximum (5.1%) in rhizomes collected from first fortnight of April (D_2). The content drastically reduced in the later (D_3 and D_4) due to delay in planting. Singh *et al.* (2013) found maximum curcumin in Megha Turmeric-1 (7.0 %) during last week of April planting. Although Singh *et al.* (2013) reported about highest curcumin content in the second fortnight of April planting but, in current experiment, highest curcumin expression in the first fortnight of the April represents about effect of different climatic condition.

Growth of plant and rhizome parameters as influenced by different spacing

The individual effect of spacing on various growths, rhizome parameters are presented in Table 1. Decreasing trend in plant height was observed when the spacing is increased. The highest plant height (157.8 cm) was observed in the closest spacing (30×30 cm) while the minimum plant height (98.5 cm) was recorded when plants are raised at 50×30 cm spacing. But the plant height again increased at widest spacing of 60×30 cm. Similar findings was reported by Ponnuswamy and Muthuswami (1981) and Ghosh *et al.* (2011). This may be discussed as in case of close spacing, the competition for light may be the reason for more height due to intra-row mutual shading takes (Ghosh *et al.*, 2011). Our result is also confirmed by previous study of Singh *et al.* (2000); Tirkey *et al.* (2022); Vidanapathirana *et al.* (2022). The spacing did not show any significant effect on number of leaves per plant and total rhizome weight. But spacing had significant role in other rhizome parameters like primary rhizome weight, primary rhizome length, primary rhizome girth and primary rhizome diameter. There was increasing trend of primary rhizome weight when spacing was increased. The highest primary rhizome weight (74.1 g) was found when the rhizome was planted at a distance of 50×30 cm (D_3). The effect of spacing on total fresh rhizome yield (t/ha) is presented in Fig. 1. The highest total fresh rhizome yield (19.2 t/ha) was observed in 30×30 cm although the primary rhizome weight was less in this spacing. Wider spacing showed significant reduction in total fresh rhizome yield per hectare which was due to less number plant accommodated per unit of area. Closer spacing might have impacted the growth

Table 1: Individual effect of time of planting and spacing on plant growth and rhizome traits of turmeric variety Megha Turmeric-1

Treatment	Plant height (cm)	Number of leaves per Plant	Total rhizome weight (g)	Primary rhizome weight (g)	Primary rhizome length (cm)	Primary rhizome girth (cm)	Primary rhizome diameter (cm)
D_1	89.3	11.2	178.6	57.6	7.3	5.7	0.9
D_2	137.6	12.9	229.4	94.8	8.1	5.8	1.0
D_3	135.1	11.5	197.3	58.3	7.5	5.5	0.8
D_4	131.3	9.1	159.9	52.3	6.8	5.2	0.8
SEm±	2.3	0.2	8.8	3.0	0.06	0.10	0.02
CD (P=0.05)	8.01	0.8	30.5	10.5	0.2	0.3	0.09
S_1	157.8	10.8	173.4	55.0	7.1	5.4	1.0
S_2	126.2	11.2	199.6	66.0	7.8	5.9	1.0
S_3	98.5	11.5	196.5	74.1	7.5	5.4	0.8
S_4	110.9	11.2	195.7	67.9	7.2	5.5	0.7
SEm±	2.03	0.2	7.5	2.9	0.1	0.08	0.02
CD at 0.05 (P=0.05)	5.9	NS	NS	8.54	0.3	0.2	0.08

(D_1: Second fortnight of March, D_2: First fortnight of April, D_3: Second fortnight of April, D_4: First fortnight of May, S_1: 30×30 cm, S_2: 40×30 cm, S_3: 50×30 cm, S_4: 60×30 cm)

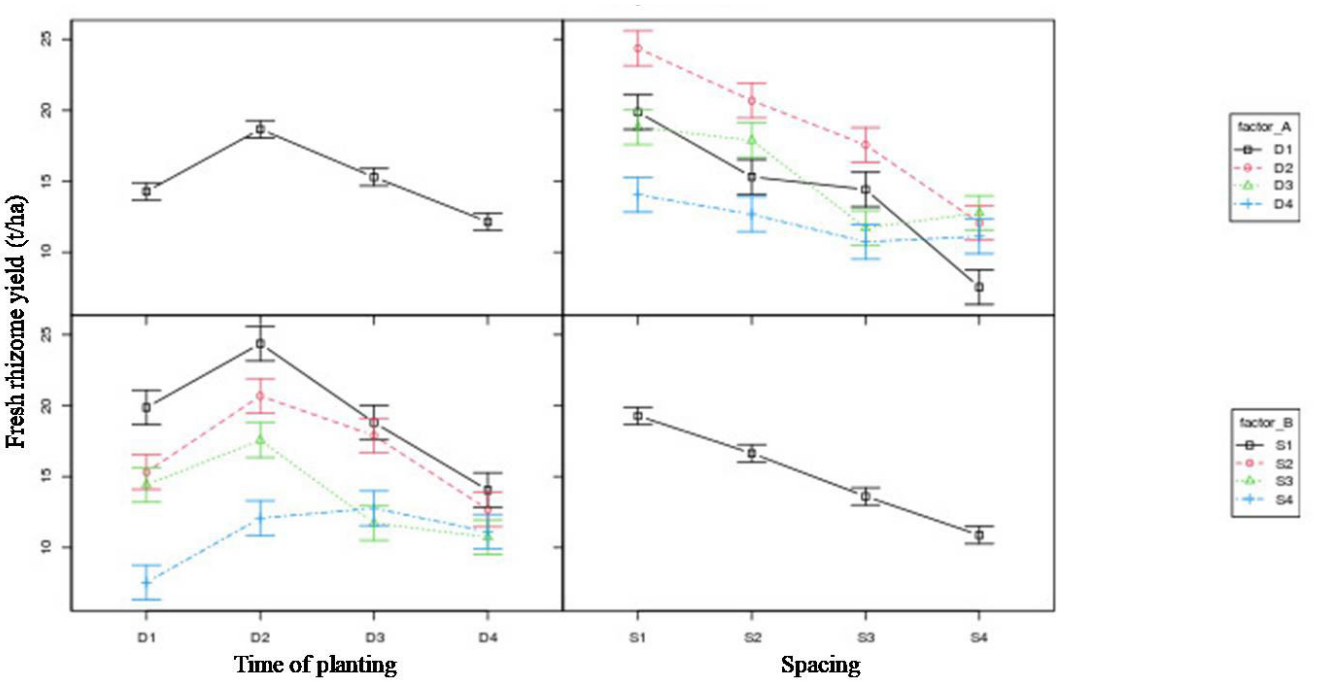

Fig. 1. Effect of time of planting, spacing and their interaction on yield of turmeric variety Megha Turmeric-1 (Factor A: Time of planting; Factor B: Spacing; D_1: Second fortnight of March, D_2: First fortnight of April, D_3: Second fortnight of April, D_4: First fortnight of May, S_1: 30×30 cm, S_2: 40×30 cm, S_3: 50×30 cm, S_4: 60×30 cm)

and development of primary rhizome due to competition among the plants for nutrition and light available per unit area. It is pertinent to discuss here that in wider spacing, there will be less population, less utilization of the land and thereby the yield might have been reduced (Rajput *et al.* (1982); Philip (1985); Singh and Kar (1991).

The individual effect of spacing on curcumin content is presented in Fig. 3. There was no significant difference between the spacing which can affect the curcumin content. But, highest curcumin (3.9%) was obtained in closest spacing (30×30 cm).

Growth of plant and rhizome parameters as

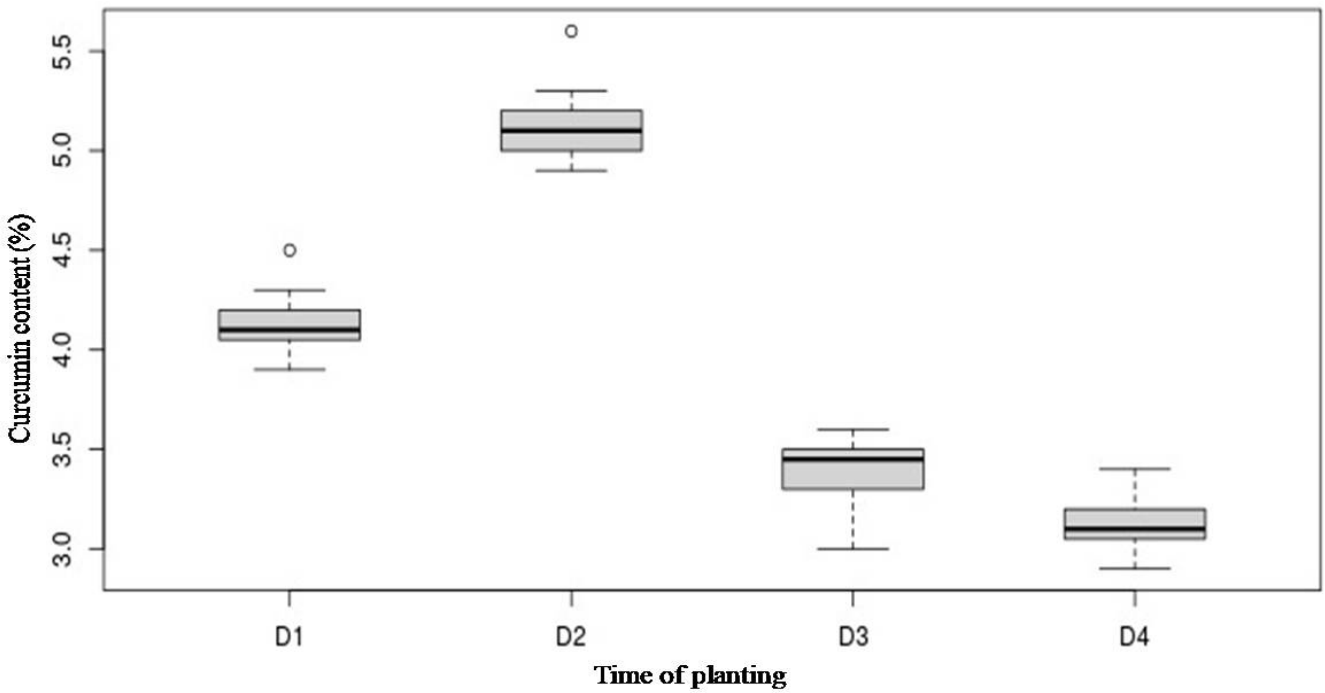

Fig. 2. Box plot depicting the effect of time of planting on curcumin content (%) of turmeric variety Megha Turmeric-1 (D_1: Second fortnight of March, D_2: First fortnight of April, D_3: Second fortnight of April, D_4: First fortnight of May)

influenced by interaction effect of different time of planting and spacing

The interaction effects are presented in Table 2. The highest plant height (184.6 cm) was observed in D_2S_1 (First fortnight of planting with 30×30 cm spacing). The highest total rhizome weight (248.1 g), highest primary rhizome length (8.9 cm), primary rhizome girth (6.4 cm) were observed when the planting was done during the first fortnight of April with a spacing of 40×30 cm (D_2S_2). The total yield per hectare (Fig. 1) and curcumin content (Fig. 4) were higher in case of interaction than the individual effect of time of planting and spacing. The highest total fresh rhizome yield (24.3 t/ha) was obtained in D_2S_1 (First fortnight of planting with 30×30 cm spacing). The lowest total fresh rhizome yield (7.5 t/ha) was measured in D_1S_4 (Second fortnight of March with 60×30 cm). Similar observations were also reported by Bandopadhyay *et al.* (2005) and Kandiannam and Chandaragir (2006). Interestingly the curcumin content was also highest (5.3%) in these treatment combinations might be due to lower yield.

CONCLUSION

Standardization of production technology for time of planting and spacing is very much important aspects to follow in turmeric cultivation for getting higher yield and quality of the crop. Based on the findings from the present experiment, it is concluded that for achieving higher yield and high curcumin content, first fortnight of April planting with 30×30 cm spacing can be recommended as suitable production technology for growing turmeric variety Megha Turmeric-1 in *Terai* region of West Bengal.

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Table 2: Effect of interaction of time of planting and spacing on plant growth and rhizome traits of turmeric variety Megha Turmeric-1

Treatment	Plant height (cm)	Number of leaves per Plant	Total rhizome weight (g)	Primary rhizome weight (g)	Primary rhizome length (cm)	Primary rhizome girth (cm)	Primary rhizome diameter (g)
D_1S_1	98.7	10.0	178.8	52.4	6.3	5.4	1.1
D_1S_2	80.8	11.6	183.7	51.3	7.8	6.3	1.0
D_1S_3	86.9	11.3	216.2	86.1	7.6	5.3	0.8
D_1S_4	90.9	11.9	135.7	40.8	7.4	5.8	0.7
D_2S_1	184.6	12.3	219.2	75.9	7.9	5.9	1.2
D_2S_2	142.7	12.8	248.1	99.4	8.9	6.4	1.1
D_2S_3	96.8	12.9	232.9	113.2	7.8	5.5	1.0
D_2S_4	126.3	13.5	217.3	90.6	7.8	5.5	0.8
D_3S_1	178.4	11.3	169.2	44.5	7.8	5.4	1.1
D_3S_2	142.4	11.4	214.5	67.4	7.5	5.9	0.8
D_3S_3	105.4	12.8	175.7	42.6	7.7	5.4	0.7
D_3S_4	114.1	10.6	229.8	78.7	7.1	5.4	0.5
D_4S_1	169.6	9.8	126.4	47.3	6.4	4.9	0.8
D_4S_2	138.7	9.1	152.1	45.8	7.1	5.2	1.0
D_4S_3	104.8	9.1	161.0	54.4	7.0	5.5	0.8
D_4S_4	112.2	8.6	200.1	61.7	6.5	5.3	0.8
SEm±	4.0	0.4	15.0	5.8	0.2	0.1	0.0
CD (P=0.05)	13.0	1.3	43.9	17.0	0.7	0.5	0.1

(D_1: Second fortnight of March, D_2: First fortnight of April, D_3: Second fortnight of April, D_4: First fortnight of May, S_1: 30×30 cm, S_2: 40×30 cm, S_3: 50×30 cm, S_4: 60×30 cm)

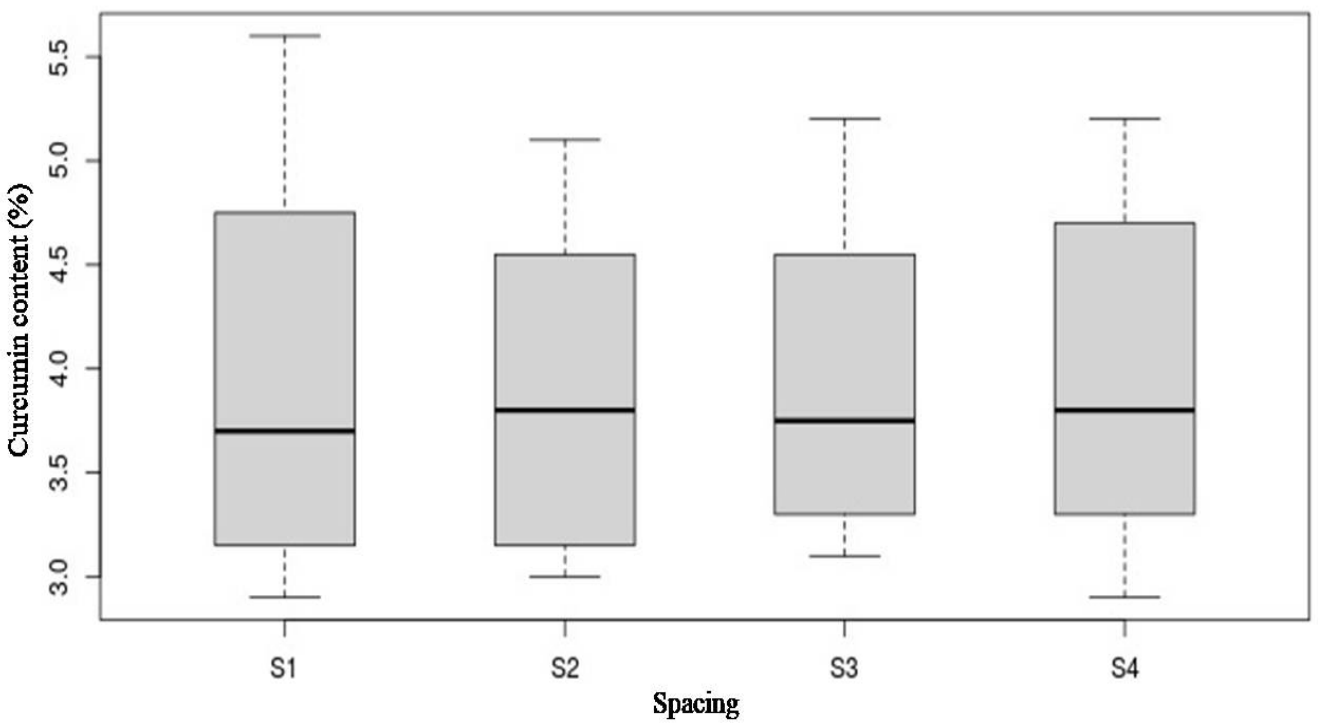

Fig. 3. Box plot depicting the effect of spacing on curcumin content (%) of turmeric variety Megha Turmric-1 (S_1: 30×30 cm, S_2: 40×30 cm, S_3: 50×30 cm, S_4: 60×30 cm)

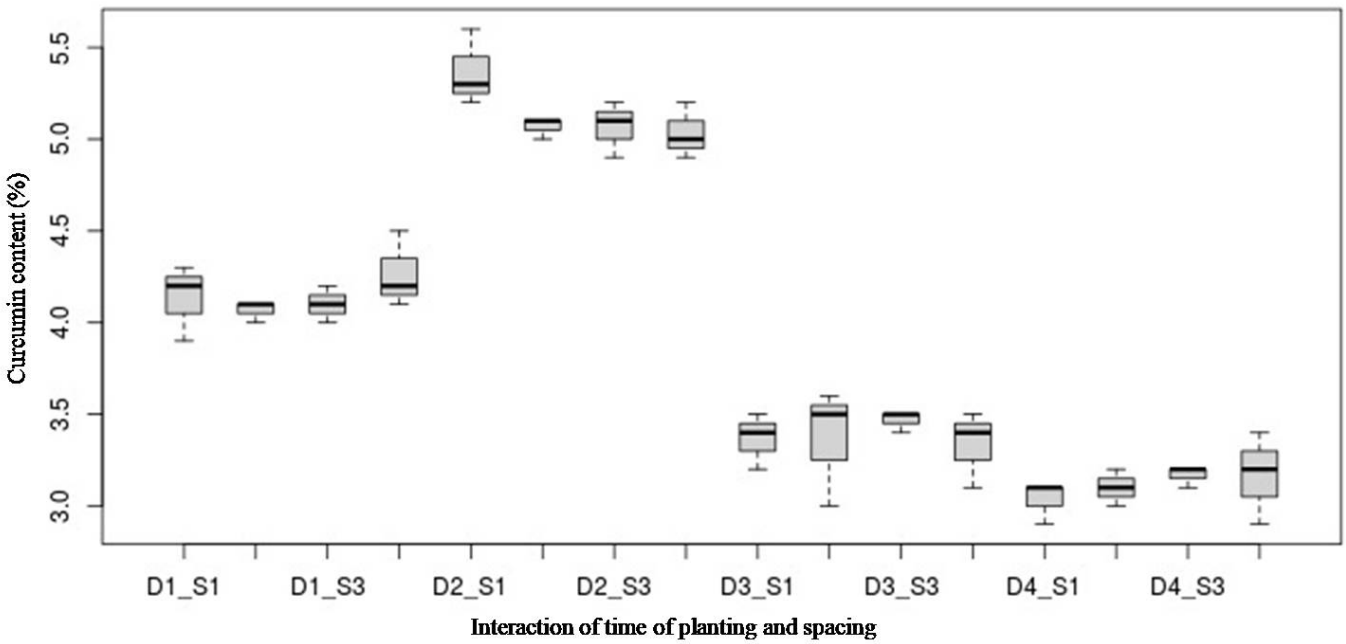

Fig. 4. Box plot depicting the interaction effect of date of planting and spacing on curcumin content (%) of turmeric variety Megha Turmeric-1 (D_1: Second fortnight of March, D_2: First fortnight of April, D_3: Second fortnight of April, D_4: First fortnight of May, S_1: 30×30 cm, S_2: 40×30 cm, S_3: 50×30 cm, S_4: 60×30 cm)

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