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Effect of planting time and variety on growth and yield attributes of tomato in semi-arid conditions of Rajasthan

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ABSTRACT

During the experimentation studied the effect of five planting time and three varieties of tomato during winter season of 2019-2020, 2020-21 and 2021-22. During the experiment three tomato variety viz. WS-1299 (V_1), Krishna (V_2) and Bavandar (V_3) were studied with five different dates of planting viz. 30 December (D_1), 15 December (D_2), 15 January (D_3), 30 January (D_4) and 15 February (D_5). In which the yield of tomato was significantly affected by different sowing dates and varieties. Among varieties and planting dates the variety Bavandar (V_3) planted on 15 January (D_3) produced significantly higher number of fruits/ plant (39.70), fruit weight (83.25 g) and fruit yield (727.20 q/ ha) with the maximum B:C ratio (4.05).

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most important and second largest cultivated vegetable crop and one of the most widely consumed vegetable crop in the world after potato, with cultivation covering an area of 5.03 million hectare and a production of about 180 million MT (FAO, 2022). It played an important role in human diet and known as protective food because of its special nutritive value (Boeing *et al.*, 2012 and Kibr, 2022).

In India, tomato crop occupies an area of 0.81 million ha with an annual production of 20.57 million MT (Anonymous, 2020). However, the production is far away from the requirement of the Indian population, if balanced diet is

provided to every individual. In Rajasthan state, tomato is an important vegetable crop that fetches great remuneration to the farmers and it is cultivated in open as well as in protected environment. In Rajasthan, total production of tomato is 2,32,864 Metric tons from an area of 20,504 hectares primarily under irrigated conditions with a productivity of 11.36 tons per hectare (Anonymous, 2021).

The commercial production of tomato particularly grown under open field conditions is severely affected by various weather parameters like temperature, rainfall and humidity etc., and ultimately affect the yield and quality of fruits. The temperature plays an important role in the growth and setting of the fruits in tomato crop (Yadav *et al.*, 2021). The fruits in tomato sets in certain varieties with temperature as low (7.2°C) and with temperature as high (26.6°C) had created

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more flexible situation in respect of the variety temperature interactions (Curme, 1992; Schaible, 1990).

Climate change is a major challenge for tomato growing farmers not only in India but all over the world also. The productivity of Tomato at particular location depends on the potential of the variety grown and timely availability of resources (Isah *et al.*, 2014). Considering the aforementioned background, the present study aims to identify a suitable planting date for a particular variety assess the impact of variety of tomato to increase production and economic return to the farmers under Rajasthan conditions.

Material and Methods

The field experiment was conducted at Horticulture Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Rajasthan) during 2019-2020, 2020-21 and 2021-22 from mid-April to the end of October. It is situated at 390 meter above mean sea level on latitude 26.50°N and longitude 75.47°E. The soil of the experimental field is characterized as a sandy-loam with pH (8.0), electrical conductivity (0.17 d Sm⁻¹), organic carbon (0.26%), available nitrogen (135 kg/ha), available phosphorus (48 kg/ha) and available potassium (90 kg/ha).

The experiment was laid out in factorial randomized block design replicated thrice with five dates of planting and three varieties. The planting dates comprised of 15 December (D₁), 30 December (D₂), 15 January (D₃), 30 January (D₄) and 15 February (D₅). The three varieties viz., WS-1299 (V₁), Krishna (V₂) and Bavandar (V₃) were included as sub treatments. A total of 15 treatment combinations were studied. Varieties were selected based on their adaptability to the environmental conditions of the experimental site, resistance to pests, and potential for higher net returns.

The 30 days old, seedlings raised in pro-trays following organic regulation were transplanted in the field at a spacing of 60 cm (RxR) x 50 cm (PxP). The recommended dose of nitrogen, phosphorus, and potassium was applied @ 120:80:80 kg per hectare, respectively. The full dose of phosphorus and potassium was applied as a basal dose, while nitrogen was applied in three equal split doses.

Data on different characters like plant height (cm), number of fruits/ plant, fruit weight (g), TSS (%), fruit length (cm), fruit girth (cm) and fruit yield (q/ha) were recorded on five randomly selected plants from each treatment. Net returns and the B:C ratio were calculated based on total variable cost and gross returns, following the methods suggested by Devasenapathy *et al.* (2008). The data were analyzed statistically using one-way ANOVA. Significant differences between treatments were determined using Duncan's test with a 95% confidence level ($p \leq 0.05$), employing SPSS software.

Results and Discussion

The analysis of the data presented in Table 1 revealed that the combined effect of planting date and variety had a significant impact on the growth, yield, and quality traits of tomato. The maximum plant height was recorded in Bavandar variety when planted on 30 December, which was at par with planting of 15 January. While it was lowest in the variety Bavandar planted on 15 February. Shrivika *et al.* (2020) reported the significant effect on growth parameters of among the tomato varieties and planting dates.

The maximum number of marketable fruits per plant (39.70) and fruit weight (83.25 g) were observed in variety 'Bavandar' with planting on 15 January which is at par with 30 December planting date with Bavandar (38.38 and 82.50 g) which were statistically significant compared to other planting dates. Shreejana (2021) also reported that the number of fruits showed a positive correlation for early and normally sown plants, while it decreased for late-sown plants.

In the present experiment, TSS of the tomato fruits varied from 2.20 to 3.04°Brix among the tomato varieties and planting dates (Table 1). The TSS of fruits was found to be influenced by all the planting dates and tomato varieties throughout the experiment. The maximum TSS was recorded in the 'Bavandar' variety for all planting dates, except for February 15. In contrast, the lowest TSS was observed in the 'Krishna' variety for all sowing dates, except for the planting on February 15. The results are in corroboration with the findings of Purkayastha and Mahanta (2011).

Among the tomato varieties and planting dates, significantly lengthy tomato fruits (5.55 cm) were observed in tomato variety 'Bavandar' when planted on 30 December, followed by the same variety when planted on 15 January as compare to the other treatments (Table 1). Similar results were also reported by Sahoo *et al.* (2021). The highest fruit girth (5.56 cm) was significantly higher in the variety Bavandar when planted on 30 December (D₁V₃) at par with the variety 'Krishna' (5.50) when planted on 15 January (D₃V₂).

The highly significant differences were observed among the varieties for marketable fruit yield. Among all tomato varieties, the maximum fruit yield was recorded in Bavandar variety (727.20 q/ha) planted on 15 January which was significantly superior over all other varieties followed by the same variety when planted on 30 December (704.31 q/ha).

The economics of the experiment presented in Table 2 & Figure 1, revealed a wide variation in gross return as well as net return obtained by the sale price of the tomatoes. Tomato variety 'Bavandar' earned comparatively higher net return of Rs. 8.0 Lakh/ha, Rs. 4.39 Lakh/ha, Rs. 8.75 Lakh/ha, and Rs. 6.21 Lakh/ha with the planting time of D₁, D₂, D₃ and D₄, respectively. 'Bavandar' variety recorded highest B:C ratio of 4.06 when planted on 15 January (D₃V₃) followed by 3.13 in Bavandar variety planted on 30 December.

Table 1. Effect of date of planting and different varieties on growth and yield parameters of tomato (3 years pooled data)

Treatment	Plant height (cm)	No. of fruits/ plant	Fruit weight (g)	TSS (%)	Fruit length (cm)	Fruit girth (cm)	Fruit yield (q/ ha)
D ₁ V ₁	55.00	32.14	76.47	2.62	4.86	4.78	387.01
D ₁ V ₂	54.42	32.41	76.85	2.20	4.41	5.26	458.99
D ₁ V ₃	64.46	38.38	82.50	3.04	5.55	5.56	704.31
D ₂ V ₁	51.22	29.53	71.32	2.35	4.09	5.04	307.19
D ₂ V ₂	46.38	30.57	75.05	2.29	4.57	5.11	302.81
D ₂ V ₃	54.41	31.64	76.25	2.55	4.46	5.05	463.17
D ₃ V ₁	56.70	34.81	78.10	2.58	5.09	4.87	468.23
D ₃ V ₂	60.73	35.21	79.69	2.82	5.32	5.50	591.08
D ₃ V ₃	62.83	39.70	83.25	2.96	5.40	5.30	727.20
D ₄ V ₁	44.64	33.34	77.15	2.37	4.54	5.04	432.09
D ₄ V ₂	49.04	34.08	79.39	2.26	4.54	5.06	474.03
D ₄ V ₃	56.24	35.71	81.11	2.84	5.28	5.18	558.32
D ₅ V ₁	43.02	23.96	69.35	2.38	4.44	5.04	344.18
D ₅ V ₂	47.85	26.89	68.94	2.48	4.43	4.70	305.94
D ₅ V ₃	40.80	28.59	69.20	2.28	4.21	4.49	303.85
SEm±	2.50	0.69	0.76	0.08	0.33	0.70	7.24
CD at 5%	7.23	2.00	2.21	0.22	0.97	2.03	20.96
CV (%)	8.23	3.68	1.73	5.28	1.22	2.39	2.75

Table 2. Effect of date of planting and different varieties on net returns and B:C ratio of tomato (3 years pooled data)

Treatments	Cost of cultivation (Rs. in Lakh/ ha)	Gross returns (Rs. In Lakh /ha)	Net returns (Rs. in Lakh/ ha)	B:C Ratio
D ₁ V ₁	2.56	5.80	3.24	1.27
D ₁ V ₂	2.56	6.89	4.33	1.69
D ₁ V ₃	2.56	10.56	8.00	3.13
D ₂ V ₁	2.56	6.14	3.58	1.40
D ₂ V ₂	2.56	6.06	3.50	1.36
D ₂ V ₃	2.56	6.95	4.39	1.71
D ₃ V ₁	2.16	7.02	4.86	2.25
D ₃ V ₂	2.16	8.87	6.71	3.11
D ₃ V ₃	2.16	10.91	8.75	4.06
D ₄ V ₁	2.16	6.48	4.32	2.00
D ₄ V ₂	2.16	7.11	4.95	2.29
D ₄ V ₃	2.16	8.37	6.21	2.88
D ₅ V ₁	2.16	5.16	3.00	1.39
D ₅ V ₂	2.16	4.59	2.43	1.12
D ₅ V ₃	2.16	4.56	2.40	1.11

Conclusion

In conclusion, the study revealed that the tomato yield for the Bavandar variety was significantly overestimated based on different planting dates. It was observed that transplanting

tomatoes between December 30 and January 15 proved beneficial. This timing helps avoid harsh environmental conditions, reduces pest and disease attacks, and ultimately enhances total production. Therefore, adjusting the planting dates within this window can lead to better yield and net return.

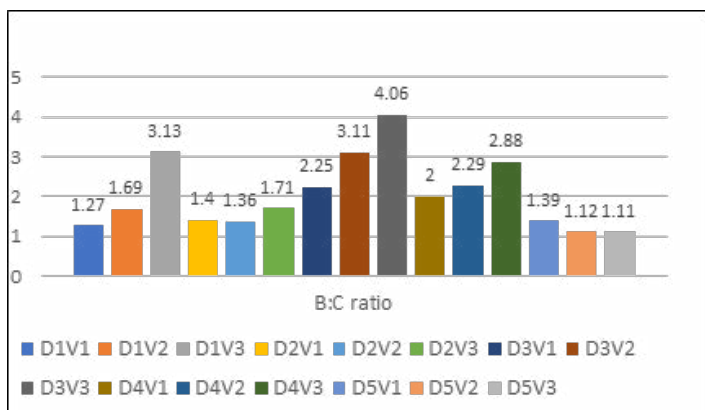


Fig. 1. Effect of planting date and varieties on B:C ratio

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Conflict of Interest

The authors have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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