International Journal of Plant & Soil Science

Volume 35, Issue 20, Page 452-458, 2023; Article no.IJPSS.105840
ISSN: 2320-7035

Performance of Different Hybrids of Tomato (*Solanum lycopersicum* L.) for Growth and Yield under Prayagraj Agro-climatic Conditions

Anshik Sharma [a++*], Anita Kerketta [a#], Samir E. Topno [a#], Vishal Malik [a++] and Kanwar Singh [a++]

[a] Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh- 211007, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2023/v35i203826

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/105840

Original Research Article

Received: 11/07/2023
Accepted: 16/09/2023
Published: 23/09/2023

ABSTRACT

The research experiment was carried out at the Horticulture Research Field at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Rabi season 2022-2023 to investigate the growth and yield of different hybrids of tomato. The design of the experiment was RBD with three replications. The purpose of the study is to evaluate the plants in terms of various parameters such as plant height, number of branches, days to first flowering, days to 50% flowering, days to fruit setting, number of flowers cluster per plant, number of fruit set per cluster, number of fruits per plant, polar diameter, equatorial diameter, fruit weight, fruit yield/plant, and fruit yield/ha. The different hybrids (Gagan Plus, NS 585, Pukhraj, Hamilton, Beef Steak, Arka Rakshak,

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[++] *Research Scholar;*
[#] *Assistant Professor;*
**Corresponding author: E-mail: anshiksharma10@gmail.com;*

Arka Samrat and Shivani) have been taken in the study. The result of the study indicates that variety Arka Rakshak has a significantly improved growth and yield of tomato. The highest fruit weight and fruit yield were observed in the hybrid Arka Rakshak. Overall, the study suggests that the hybrid Arka Rakshak is the best for the growth and yield of tomatoes.

Keywords: Solanum lycopersicum; varieties; growth; fruit yield.

1. INTRODUCTION

Tomato, botanically known as *Solanum lycopersicum* L. or *Lycopersicon esculentum* Mill. Tomato is a horticulture crop belonging to the family Solanaceae. It originated from South America (Vavilov, 1935). Tomato is one of the most popular and widely grown vegetable crops throughout the world and is treated as "protective food" universally. Tomato is known as the poor man's apple (orange) in India and the love of apple in England [1]. Tomato is used to make soup, salad, pickles, ketchup, puree, sauces, tomato paste, tomato juice and other products. The pulp and juice of tomato fruit are digestible and a mild aperient, a promoter of gastric secretion and a blood purifier. It also contains a large quantity of water (%), calcium (%) and Niacin all of which are of great importance in the metabolic activities of man [1]. Tomato is a good source of vitamins A, C and E and minerals that are very good for the body and protect the body against diseases [2]. Tomato ranks second following potato in terms of area cultivated, but first as a processing crop [3,4]. India ranks second in tomato production producing 30.26% of the world's. Tomato production is first being China and is followed by Turkey ranking third in the world (FAOSTAT, 2020). The area under tomato production in India accounts for 46.72 thousand ha with a production of 34.29 million tonnes in the year 2019-20. Andhra Pradesh ranks first in area and production of tomatoes in the year 2019-20 followed by Madhya Pradesh and Karnataka. In Uttar Pradesh area under production is 0.20 lakh hectares while production is estimated to be 5.29 million tonnes for the year 2019-20 (Source: NHB, Ministry of Agriculture and Farmers Welfare, Government of India, 2020-21). The productivity of tomatoes is affected by several biotic and abiotic factors. For stable production, testing of new varieties/ hybrids must be adopted. Crop growth and yield are usually affected by varietal differences [5]. The development of hybrid tomato varieties having desirable characteristics has proven to be an effective strategy to increase tomato production. The yield of hybrid tomatoes is 20 to 25 % more as compared to open-pollinated [6] (Islam et al., 2012). The growth characteristics of crops such as plant height, leaf area, number of leaves or branches and fruit yield were influenced by genetic factors of different varieties [7,8].

2. MATERIALS AND METHODS

The present investigation was conducted at the Horticulture Research Field, SHUATS College of Agriculture, Prayagraj, (U.P) during the Rabi season (2023). The experimental material comprised of eight hybrids, which were collected from the market. The hybrids were transplanted in loamy soil after 30 DAS in a randomized block design with three replications. Plants of each genotype were planted at a spacing of 60x45 cm. Standard cultural practices (Operations and Protection measures) were adopted to ensure healthy crop growth. The hybrids were evaluated for some important character viz., plant height (cm), number of branches per plant at final picking, days to flower initiation, days to fruit set, number of flower clusters per plant, number of fruit set per cluster, number of fruit per plant, average fruit weight (g), fruit yield per plant (kg), fruit yield per hectare (t/ha), polar diameter (mm), equatorial diameter (mm) using various equipment's such as vernier calliper, measuring tape and weighing scale. The data was analyzed as per the method given by [9].

3. RESULTS AND DISCUSSION

Data recorded on growth parameter observations and responses of eight hybrids is presented in Tables 1 and 2.

3.1 Plant Height (at 30, 60 and 90 DAT)

Due to the diverse genetic makeup of several tomato hybrids, plant height varied greatly among hybrids at the maturity stage. The plant height increased as the plant aged. The plant height at 30 DAT varied from 40.12 to 56.23 cm. H8 (Shivani) had the lowest plant height (43.21), while H6 (Arka Rakshak) recorded the maximum plant height (56.23). The plant height at 60 DAT

varied from 80.56 to 91.45 cm. H8 (Shivani) had the lowest plant height (80.56 cm), while H6 (Arka Rakshak) recorded the maximum plant height (91.45 cm). The plant height at 90 DAT varied from 125.45 to 142.32 cm. H8 (Shivani) had the lowest plant height (125.45 cm), while H6 (Arka Rakshak) recorded the maximum plant height (142.32 cm). Typically, plant height is a good indicator of plant vigour, which may lead to higher productivity. The hybrids' underlying genetic differences are thought to be the cause of the height variation. It supports the conclusions reached by Hazarika and Phookan [10].

3.2 Number of Primary Branches per Plant at Final Picking

Among the eight hybrids the maximum number of primary branches (10.9) was observed in H6 (Arka Rakshak) and the minimum number of primary branches (6.8) was observed in H8 (Shivani), while the remaining hybrids were moderate in their growth habitat. The suitability of a particular hybrid in agroclimatic conditions and the high growth characteristics of hybrids is to blame for the variation in the number of branches in tomato hybrids; similar findings were also reported by Alam et al. [11] from 4.3 to 6.7, Singh et al. [12] from 15.29 to 24.2, and Shankar et al. [13] from 5.33 to 10.60.

3.3 Days to Flower Initiation

The days it took for tomato hybrids to reach their first flowering were discovered after the data was statistically analyzed. The average number of days from transplanting to the start of the first blossom ranged from 38.56 to 49.43.

Among the eight hybrids, the maximum days to flower initiation (49.43) was recorded in H8 (Shivani) and the minimum (38.56) was recorded in H6 (Arka Rakshak), while the remaining hybrids are moderate in their growth habitat. Early and late flowering are considered genotypic traits that are moderately impacted by environmental factors, especially in growing locations. Since early flowering hybrids and varieties with high yields are typically sought after for commercial cultivation, it is also seen to be a commercially significant characteristic and so assumes prominence in crop development programming. Other studies have also reported similar findings regarding variations in flowering times among different tomato hybrids. According to Amarananjundeshwara et al. [14], different cultivars' flowering days after transplantation ranged from 25.00 to 30.25 days. Hussain et al. [15] have reported data of a similar nature regarding the number of days prior to the beginning of flowering on various tomato hybrids.

3.4 Days to 50 % Flowering

Among the eight hybrids, the maximum days to 50 % flowering (64.67) were recorded in H8 (Shivani) and the minimum (53.56) was recorded in H6 (Arka Rakshak), while the remaining hybrids are moderate in their growth habitat. The early maturity of the tomato hybrids accounts for the variation in days to 50% flowering; similar results were previously reported by Ali et al. (2012), Shankar et al. [13], Singh et al. [12], and Said et al. [16] in tomato.

3.5 Number of Flower Clusters per Plant

In terms of the number of flower clusters per plant, there were highly significant differences between the hybrids. Among the eight hybrids, the maximum number of flower clusters per plant (5.6) was recorded in H6 (Arka Rakshak) and the minimum (3.5) was recorded in H8 (Shivani), while the remaining hybrids are moderate in their growth habitat. Because different tomato varieties and hybrids have distinct genetic make-ups, those with the most blossom clusters also yield more. Wahundeniya et al. [17] also reported almost identical findings.

3.6 Days to Fruit Setting, Number of Fruit Set per Cluster and Number of Fruits per Plant

Among the eight hybrids, the maximum number of fruit set per cluster (5.21) was observed in H6 (Arka Rakshak) and a minimum (4.5) was recorded in H8 (Shivani), while the remaining hybrids are moderate in their growth habitat. Among the eight hybrids, the maximum number of fruits per plant (33.34) was recorded in H6 (Arka Rakshak) and the minimum (24.75) was recorded in H8 (Shivani), while the remaining hybrids are moderate in their growth habitat. Among the eight hybrids, the maximum days to fruit setting (61.23) was observed in H8 (Shivani) and the minimum (48.78) was recorded in H6 (Arka Rakshak), while the remaining hybrids are moderate in their growth habitat. According to Pandey et al. [18], who observed a fruit set percentage ranging from 83.1 to 93.9%, this conclusion is consistent. The findings showed a

Table 1. Plant height (cm), number of primary branches per plant at final picking, days to flower initiation, days to fruit setting, and number of flower clusters per plant

S. NO.	Hybrids		Plant height (cm) at 30 DAT	Plant height (cm) at 60 DAT	Plant height (cm) at 90 DAT	Number of primary branches per plant at final picking	Days to flower initiation	Days to fruit setting	Number of flower clusters per plant
1	**H1**	Gagan Plus	43.21	84.32	130.6	7.7	46.45	58.45	5.7
2	**H2**	NS-585	50.54	88.56	138	9.1	42.38	52.23	6.2
3	**H3**	Pukhraj	52.43	89.43	139.9	10.3	40.23	50.43	6.3
4	**H4**	Hamilton	47.43	86.54	135.2	8.6	44.78	54.45	5.9
5	**H5**	Beefsteak	42.65	82.87	128.7	6.9	47.23	59.43	5.6
6	**H6**	Arka Rakshak	**56.23**	**91.45**	**142.32**	**10.9**	**38.56**	**48.78**	**6.4**
7	**H7**	Arka Samrat	45.32	85.76	133.21	8.2	45.54	55.45	5.8
8	**H8**	Shivani	**40.12**	**80.56**	**125.45**	**6.8**	**49.43**	**61.32**	**5.5**
		SEd±	**1.04**	**1.72**	**1.23**	**0.41**	**0.42**	**1.34**	**0.07**
		CD at 5 %	**2.21**	**3.79**	**4.43**	**0.95**	**1.23**	**0.67**	**0.25**

Table. 2 Number of fruit set per cluster, number of fruits per plant, average fruit weight (g), fruit yield per plant (kg), fruit yield per hectare (t/ha), polar diameter (mm), equatorial diameter (mm)

S. NO.	Hybrids		Number of fruit set per cluster	Number of fruits per plant	Fruit weight (g)	Fruit yield per plant (kg)	Fruit yield per ha (t/ha)	Polar diameter (mm)	Equatorial diameter (mm)
1	**H1**	Gagan Plus	4.82	27.474	69.99	1.92	71.11	**43.23**	53.87
2	**H2**	NS-585	5.01	31.062	72.11	2.24	82.96	55.46	**47.43**
3	**H3**	Pukhraj	5.11	32.193	72.33	2.33	86.3	47.23	**58.45**
4	**H4**	Hamilton	5	29.5	71.99	2.12	78.52	51.23	55.32
5	**H5**	Beefsteak	4.76	26.656	69.89	1.86	68.89	54.32	53.54
6	**H6**	Arka Rakshak	**5.21**	**33.344**	**72.45**	**2.42**	**89.63**	49.51	51.32
7	**H7**	Arka Samrat	4.99	28.942	70.99	2.05	75.93	**59.23**	54.32
8	**H8**	Shivani	**4.5**	**24.75**	**69.87**	**1.73**	**64.07**	54.21	48.65
		SEd±	**0.13**	**0.67**	**0.46**	**0.13**	**0.67**	**1.32**	**0.76**
		CD at 5 %	**0.38**	**1.34**	**1.39**	**1.38**	**1.34**	**2.71**	**1.76**

Number in bold represent maximum and minimum value

direct correlation between fruit output and fruit set percentage. The fruit yield would be greater the higher the fruit set. The early fruit setting and maturity of tomato hybrids cause variation in the days until first fruiting.

3.7 Average Fruit Weight (g)

Among the eight hybrids, the maximum fruit weight (72.45 g) was observed in H6 (Arka Rakshak) and the minimum fruit weight (69.87 g) was observed in H8 (Shivani), while the remaining hybrids are moderate in their growth habitat. Different tomato hybrids exhibit variations in fruit size, which can be attributed to their genetic makeup and the characteristics of cell size and intercellular space within the flesh. This observation has been supported by studies conducted by Shaw and Cautliffe [19], Rehman et al. [20], and Golani et al. [21] who found similar results regarding fruit size in tomato hybrids.

3.8 Fruit Yield per Plant (kg) and Fruit Yield per Hectare (t/ha)

The yield of fruit varied significantly between the hybrids. Among the eight hybrids, the maximum fruit yield per plant (2.42 kg) was recorded in H6 (Arka Rakshak) and the minimum fruit yield per plant (1.73 kg) was recorded in H8 (Shivani), while the remaining hybrids were moderate in their growth habitat. Among the eight hybrids, the maximum fruit yield per hectare (89.63 t/ha) was recorded in H6 (Arka Rakshak) and the minimum fruit yield per hectare (64.07 t/ha) was recorded in H8 (Shivani), while the remaining hybrids are moderate in their growth habitat. Moreover, Hussain et al. [22], Hussain et al. [15], and Mansour et al. [23] revealed similar genetic differences for marketable fruit yield and other plant features in other tomato genotypes. These results suggested that hybrids bearing large-sized but sparsely distributed fruits will likely yield less than those bearing medium-sized and large-number fruits per plant.

3.9 Polar Diameter and Equatorial Diameter (mm)

Among the eight hybrids, the maximum polar diameter (59.23 mm) was recorded in H7 (Arka Samrat) and the minimum polar diameter (44.23) was recorded in H1 (Gagan Plus), while the remaining hybrids are moderate in their growth habitat. The maximum equatorial diameter (58.45 mm) was recorded in H3 (Pukhraj) and the minimum equatorial diameter (47.23 mm) was recorded in H2 (NS 585), while the remaining hybrids are moderate in their growth habitat. The genetic make-up of cultivars is reportedly inter-varietal related to the diversity in fruit size in various tomato hybrids, which is influenced by the flesh's intercellular space and cell size. Similar findings about fruit size were also made by Rehman et al. [20], Shaw and Cautliffe [19], and Golani et al. [21]. The different shapes and sizes of tomato hybrids cause variation in their fruit's length, width, and diameter; previous studies by Ali et al. (2012) from 5.50 cm to 7.80 cm, Saleem et al. [24] from 4.04 cm to 6.75 cm, Shankar et al. [13] from 3.00 cm to 6.10 cm and Said et al. [16] from 3.9 cm to 6.5 cm also reported similar findings.

4. CONCLUSION

In conclusion, this research provides valuable insights into tomato cultivation under Prayagraj agro-climatic conditions. The exceptional performance of Arka Rakshak (H6) suggests its potential as a preferred hybrid for tomato cultivation in the region. The study aimed to evaluate various tomato hybrids across multiple parameters, and the results revealed significant insights into the performance of these hybrids. The central finding of this research is that the hybrid Arka Rakshak (H6) exhibited superior performance in terms of growth and yield compared to other hybrids included in the study. Arka Rakshak consistently outperformed its counterparts across multiple parameters, indicating its potential suitability for tomato cultivation in the Prayagraj region. Notably, it demonstrated the highest plant height, number of branches, number of fruit clusters, fruit weight, and overall fruit yield. From the above experimental finding, it may be concluded that the hybrid H6 (Arka Rakshak) was found to be best in terms of growth and yield. While the research points towards Arka Rakshak's superiority, there is always room for further investigation. Future research could delve deeper into understanding the specific genetic traits or environmental factors that contribute to its success. Furthermore, exploring the potential for hybrid combinations or agronomic practices that enhance overall tomato crop performance would be valuable.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/105840