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## Drymatter production and Nitrogen uptake of *kharif* tomato influenced by different dates of planting and cultivars

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### Abstract

Crop nutrient uptake is primarily driven by biomass accumulation dynamics throughout the growing season. To identify the optimal planting window and cultivar for maximizing tomato productivity, a field study was conducted during the 2019 *kharif* season at the Agricultural Research Institute, PJTSAU, Hyderabad. The experiment utilized a split-plot design, evaluating eight planting dates (ranging from 02 July to 13 September) and two cultivars (US 440 and TO-3251). Results indicated that the 02 July planting achieved the highest dry matter production (79.4 g plant<sup>-1</sup>), N uptake (48.5 kg ha<sup>-1</sup>), and fruit yield (69.5 t ha<sup>-1</sup>), performing comparably to the 13 September and 12 July dates. While differences between cultivars were not statistically significant, US 440 consistently outperformed TO-3251 in dry matter, N uptake, and yield (45.8 vs. 41.0 t ha<sup>-1</sup>).

**Keywords:** Tomato, dates of planting, cultivars, drymatter production, nitrogen uptake

### 1. Introduction

The tomato (*Solanum lycopersicum* L.) is one of the most important and widely cultivated vegetable crops in the world, ranking second only to the potato in global production. Tomato can play an important role in human diet and known as protective food because of its special nutritive value.

Often referred to as a "protective food" due to its exceptional nutritive value, it plays a vital role in human nutrition. Nationally, India cultivates tomatoes across 0.63 million hectares, producing 12.43 million tonnes annually at a productivity rate of 19.60 t ha<sup>-1</sup> (Cheena *et al.*, 2018) [1]. In Telangana, the crop is grown primarily under irrigated conditions on 47,070 hectares, achieving a higher productivity of 26.09 t ha<sup>-1</sup> (Horticultural Statistics at a Glance, 2016) [3].

Vegetable crops production during the wet/rainy season is becoming increasingly attractive for cash generation for farmers, but the productivity of tomato is low due to various constraints. Commercial tomato production in open-field systems is highly vulnerable to environmental fluctuations. Variability in temperature, rainfall, and humidity can significantly compromise both fruit yield and quality. Favourable growing environment alone can't significantly boost up tomato productivity, also depends on the cultivars or genotype and management practices like optimum date of planting. Tomato productivity at a given location depends on the potential of the genotype used and timely availability of resources (Isah *et al.*, 2014) [4].

As yield is a complex character, it depends on plant characters. The knowledge of the relationship among yield and other plant characters like dry matter production and nitrogen uptake and their relative contribution to yield is very useful.

In light of these considerations, the current study was undertaken to evaluate the influence of planting dates and cultivars on dry matter production, nitrogen uptake, and fruit yield in tomato.

### 2. Materials and Methods

The research took place at the Agricultural Research Institute, Rajendranagar, Hyderabad (17°19' N, 78°23' E; 542.3 m AMSL). A split-plot design with three replications was employed, featuring eight planting dates (ranging from 02 July to 13 September) as main plots and two

cultivars (US 440 and TO-3251) as sub-plots. The experimental site consisted of neutral sandy loam soil with high available potassium, but low nitrogen and phosphorus levels. All other cultivation practices followed standard regional recommendations.

Plant samples of tomato were collected for dry matter estimation at first flower, 50% flowering, fruit initiation, first picking and last picking stages from different treatments and the same were utilized for chemical analysis. Nitrogen content in the plant sample was estimated by modified Microkjeldhal method (Piper, 1966) [6]. Nitrogen content analyzed from dried samples was multiplied by dry matter for calculating uptake and recorded in kg ha<sup>-1</sup>. Data on different characters viz., growth and yield attributes and yield, were subjected to analysis of variance procedures as outlined for split plot design (Gomez and Gomez, 1984) [2]. Statistical significance was tested by F-value at 0.05 level of probability and critical difference was worked out where ever the effects were significant. Total N uptake was determined by using following formulae

$$\text{Nitrogen uptake (kg ha}^{-1}\text{)} = \frac{\% \text{ N in drymatter} \times \text{drymatter production (kg ha}^{-1}\text{)}}{100}$$

### 3. Results and Discussion

#### 3.1 Drymatter production (g plant<sup>-1</sup>)

Based on the analysis of variance (Table 1) dates of planting had a significant effect on drymatter production. During the study drymatter production was increased as the age of crop advanced up to first picking afterwards increase in drymatter production was marginal. The timing of planting had a profound impact on biomass accumulation across all growth stages. The 02 July planting achieved the maximum dry matter production,

maintaining statistical parity with the 12 July and 13 September plantings. Furthermore, the 12 July planting was on par with the 03 September treatment; both were significantly superior to all other planting dates. In contrast, the 02 August planting consistently recorded the significantly lowest dry matter production throughout the crop cycle.

#### 3.2. Nitrogen uptake (kg ha<sup>-1</sup>)

Planting dates significantly influenced nitrogen (N) uptake at all crop growth stages (Table 2). The 02 July planting recorded the highest N uptake, remaining statistically on par with the 13 September and 12 July plantings. Furthermore, the 12 July planting was on par with the 03 September treatment; both were significantly superior to the remaining planting dates. Conversely, the significantly lowest N uptake was recorded in the 02 August planting. This increased uptake is attributed to higher dry matter production at the respective growth stages. Regarding cultivars, no significant differences in N uptake were observed throughout the crop cycle.

#### 3.3 Fruit yield (t ha<sup>-1</sup>)

The 02 July planting date recorded significantly higher fruit yield (Table 3), remaining statistically on par with the 13 September and 12 July plantings. Furthermore, the 12 July planting was on par with the 03 September planting, both of which were significantly superior to the remaining dates. Conversely, the 02 August planting resulted in the significantly lowest fruit yield. The yield increases observed in this study are attributed to the positive correlation between growth and yield attributes. These findings align with earlier reports by Srivastava *et al.* (2013) [7] and Mohanty (2003) [5]. Regarding the cultivars, no significant differences were observed in fruit yield.

**Table 1:** Dry matter production (g plant<sup>-1</sup>) of tomato at various growth stages under different dates of planting and cultivars

| Treatments                           | First flower      | 50% flowering      | Fruit initiation   | First picking      | Last picking       |
|--------------------------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
| <b>Date of planting</b>              |                   |                    |                    |                    |                    |
| 02 Jul                               | 7.1 <sup>a</sup>  | 15.4 <sup>a</sup>  | 36.7 <sup>a</sup>  | 79.4 <sup>a</sup>  | 54.5 <sup>a</sup>  |
| 12 Jul                               | 6.3 <sup>ab</sup> | 14.6 <sup>ab</sup> | 34.2 <sup>ab</sup> | 73.4 <sup>ab</sup> | 48.8 <sup>ab</sup> |
| 22 Jul                               | 5.0 <sup>c</sup>  | 11.8 <sup>c</sup>  | 29.0 <sup>c</sup>  | 58.4 <sup>c</sup>  | 40.7 <sup>c</sup>  |
| 02 Aug                               | 1.9 <sup>d</sup>  | 6.7 <sup>d</sup>   | 21.8 <sup>b</sup>  | 39.1 <sup>d</sup>  | 31.4 <sup>d</sup>  |
| 11 Aug                               | 3.2 <sup>d</sup>  | 8.3 <sup>d</sup>   | 22.5 <sup>d</sup>  | 44.0 <sup>d</sup>  | 33.1 <sup>d</sup>  |
| 23 Aug                               | 4.7 <sup>c</sup>  | 11.5 <sup>c</sup>  | 26.4 <sup>c</sup>  | 53.9 <sup>c</sup>  | 39.3 <sup>c</sup>  |
| 03 Sep                               | 5.4 <sup>bc</sup> | 13.6 <sup>b</sup>  | 32.2 <sup>b</sup>  | 69.3 <sup>b</sup>  | 46.8 <sup>b</sup>  |
| 13 Sep                               | 6.9 <sup>a</sup>  | 14.8 <sup>a</sup>  | 35.3 <sup>a</sup>  | 76.9 <sup>a</sup>  | 50.9 <sup>a</sup>  |
| S.Em <sub>±</sub>                    | 0.3               | 0.5                | 0.9                | 1.9                | 1.9                |
| CD (P=0.05)                          | 0.9               | 1.5                | 2.8                | 6.0                | 5.8                |
| <b>Cultivars</b>                     |                   |                    |                    |                    |                    |
| US 440                               | 5.1               | 12.0               | 30.6               | 62.4               | 43.9               |
| TO-3251                              | 5.0               | 12.2               | 29.0               | 61.2               | 42.5               |
| S.Em <sub>±</sub>                    | 0.2               | 0.4                | 0.4                | 1.1                | 1.3                |
| CD (P=0.05)                          | NS                | NS                 | 1.1                | NS                 | NS                 |
| <b>Interaction (D X V)</b>           |                   |                    |                    |                    |                    |
| <b>Factor(V) at same level of D</b>  |                   |                    |                    |                    |                    |
| S. Em <sub>±</sub>                   | 0.4               | 0.7                | 1.3                | 2.8                | 2.7                |
| CD (P=0.05)                          | NS                | NS                 | NS                 | NS                 | NS                 |
| <b>Factor (D) at same level of V</b> |                   |                    |                    |                    |                    |
| S. Em <sub>±</sub>                   | 0.5               | 0.9                | 1.2                | 2.9                | 3.3                |
| CD (P=0.05)                          | NS                | NS                 | NS                 | NS                 | NS                 |

**Table 2:** Nitrogen uptake (kg ha<sup>-1</sup>) of tomato at various growth stages under different dates of planting and cultivars

| Treatments                          | First flower      | 50% flowering      | Fruit initiation   | First picking      | Last picking       |
|-------------------------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
| <b>Date of planting</b>             |                   |                    |                    |                    |                    |
| 02 Jul                              | 4.7 <sup>a</sup>  | 14.9 <sup>a</sup>  | 28.5 <sup>a</sup>  | 48.5 <sup>a</sup>  | 22.2 <sup>a</sup>  |
| 12 Jul                              | 4.2 <sup>ab</sup> | 14.1 <sup>ab</sup> | 26.6 <sup>ab</sup> | 46.2 <sup>ab</sup> | 19.9 <sup>ab</sup> |
| 22 Jul                              | 2.8 <sup>c</sup>  | 11.4 <sup>c</sup>  | 22.6 <sup>c</sup>  | 34.7 <sup>c</sup>  | 16.6 <sup>c</sup>  |
| 02 Aug                              | 1.3 <sup>d</sup>  | 6.5 <sup>d</sup>   | 17.3 <sup>d</sup>  | 23.2 <sup>d</sup>  | 12.8 <sup>d</sup>  |
| 11Aug                               | 1.9 <sup>d</sup>  | 8.0 <sup>d</sup>   | 17.4 <sup>d</sup>  | 26.1 <sup>d</sup>  | 13.5 <sup>d</sup>  |
| 23 Aug                              | 2.7 <sup>c</sup>  | 11.1 <sup>c</sup>  | 21.5 <sup>c</sup>  | 31.9 <sup>c</sup>  | 16.0 <sup>c</sup>  |
| 03 Sep                              | 3.6 <sup>b</sup>  | 13.1 <sup>b</sup>  | 25.1 <sup>b</sup>  | 44.9 <sup>b</sup>  | 19.1 <sup>b</sup>  |
| 13 Sep                              | 4.5 <sup>a</sup>  | 14.3 <sup>a</sup>  | 28.1 <sup>a</sup>  | 47.0 <sup>a</sup>  | 20.7 <sup>a</sup>  |
| S.Em+                               | 0.2               | 0.5                | 0.7                | 1.1                | 0.8                |
| CD (P=0.05)                         | 0.6               | 1.5                | 2.2                | 3.5                | 2.4                |
| <b>Cultivars</b>                    |                   |                    |                    |                    |                    |
| US 440                              | 3.3               | 11.6               | 23.8               | 37.7               | 17.9               |
| TO-3251                             | 3.1               | 11.7               | 23.0               | 37.9               | 17.3               |
| S.Em+                               | 0.1               | 0.3                | 0.3                | 0.7                | 0.5                |
| CD (P=0.05)                         | NS                | NS                 | NS                 | NS                 | NS                 |
| <b>Interaction (D X V)</b>          |                   |                    |                    |                    |                    |
| <b>Factor(V)at same level of D</b>  |                   |                    |                    |                    |                    |
| S. Em+                              | 0.3               | 0.7                | 1.0                | 1.6                | 1.1                |
| CD (P=0.05)                         | NS                | NS                 | NS                 | NS                 | NS                 |
| <b>Factor (D)at same level of V</b> |                   |                    |                    |                    |                    |
| S. Em+                              | 0.3               | 0.8                | 0.9                | 1.7                | 1.3                |
| CD (P=0.05)                         | NS                | NS                 | NS                 | NS                 | NS                 |

**Table 3:** Fruit yield of tomato under different dates of planting and cultivars

| Treatments                          | Fruit yield (t ha <sup>-1</sup> ) |
|-------------------------------------|-----------------------------------|
| <b>Date of planting</b>             |                                   |
| 02 Jul                              | 69.5 <sup>a</sup>                 |
| 12 Jul                              | 61.5 <sup>ab</sup>                |
| 22 Jul                              | 34.2 <sup>c</sup>                 |
| 02 Aug                              | 12.3 <sup>d</sup>                 |
| 11Aug                               | 16.8 <sup>d</sup>                 |
| 23 Aug                              | 32.3 <sup>c</sup>                 |
| 03 Sep                              | 53.5 <sup>b</sup>                 |
| 13 Sep                              | 66.8 <sup>a</sup>                 |
| S.Em+                               | 3.9                               |
| CD (P=0.05)                         | 11.8                              |
| <b>Cultivars</b>                    |                                   |
| US 440                              | 45.8                              |
| TO-3251                             | 41.0                              |
| S.Em+                               | 2.2                               |
| CD (P=0.05)                         | NS                                |
| <b>Interaction (D X V)</b>          |                                   |
| <b>Factor(V) at same level of D</b> |                                   |
| S. Em+                              | 5.4                               |
| CD (P=0.05)                         | NS                                |
| <b>Factor (D)at same level of V</b> |                                   |
| S. Em+                              | 5.9                               |
| CD (P=0.05)                         | NS                                |

#### 4. Conclusion

Based on research results, it is concluded that, to obtain higher dry matter with increased nutrient uptake optimum planting time for tomato would be from 02 Jul to 12 Jul and 13 Sep to get fruit yield in Semi-Arid environment.

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