



# **Effect of Time of Transplanting and Spacing on Tulsi (*Ocimum sanctum*)**

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## **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/JABB/2024/v27i5807

## **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/115855>

**Original Research Article**

**Received: 09/02/2024**

**Accepted: 13/04/2024**

**Published: 16/04/2024**

## **ABSTRACT**

An experiment investigating the impact of transplanting time and spacing on Tulsi (*Ocimum sanctum*) was conducted over three Kharif seasons from 2018-19 to 2020-21 at AICRP on Medicinal, Aromatic Plants and Betelvine. Twenty treatment combinations were arranged in a FRBD design. Transplanting times varied from June to August, with spacing options ranging from 60x45 cm to 75 x 60 cm. Recorded observations included plant height, primary branches per plant, fresh herbage yield, and dry herbage yield. Results indicated significant differences across all parameters based on transplanting time and spacing. Transplanting during the first fortnight of July (D3) resulted in the highest values for plant height (98.20 cm), branches per plant (16.63), fresh herbage yield (99.98 q/ha), and dry herbage yield (18.91 q/ha). The treatment of transplanting during the second fortnight of June (D2) showed comparable results. Among spacing options, 60 x 45 cm (S1) demonstrated the most favorable outcomes. Notably, the combined treatment of transplanting during the first fortnight of July with 60 x 45 cm spacing (D3S1) yielded the highest plant height (99.21 cm), fresh herbage yield (122.54 q/ha), and dry herbage yield (23.02 q/ha). Economically, this treatment also proved superior, with a net monetary return of ₹91453/- and a B:C ratio of 1.99.

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Overall, findings suggest that transplanting Tulsi seedlings between the second fortnight of June and the first fortnight of July, coupled with 60 x 45 cm spacing, maximizes productivity and economic returns.

**Keywords:** Tulsi, transplanting; spacing; dry herbage; FRBD; *Ocimum sanctum*.

## 1. INTRODUCTION

Tulsi (*Ocimum sanctum*) is native to India and Africa, an aromatic perennial plant of Lamiaceae family. In recent years the demand of medicinal plants is going on increasing not only within India but also in rest of the countries indicated by its export and import. The export of herbs and value-added extracts of medicinal herbs has been gradually increasing over years. In 2017-2018, India exported US\$ 330.18 million worth of herbs at a growth rate of 14.22% over the previous year. Also, exports of value-added extracts of medicinal herbs and herbal products in 2017-2018 stood at US\$ 456.12 million, recording a growth rate of 12.23% over the previous year. The demand for herbal/value-added extracts of medicinal herbs is gradually increasing in foreign countries, especially in European and other developed countries [1].

After the corona pandemic, the importance of various medicinal plant species has been medically proven. Among these plant species tulsi is one of them. Tulsi is called as “Queen of herb” for its restorative and spiritual properties. It has traditionally been used to support a healthy response to stress, natural detoxification & restore balance and harmony. Also, tulsi has been found to protect organs and tissues against heavy metals and physical stress from prolonged physical exertion. The main chemical constituents of Tulsi are: Oleanolic acid, Ursolic acid, Rosmarinic acid, Eugenol, Carvacrol, Linalool, and  $\beta$  caryophyllene, have been used extensively for many years in food products, perfumery, and dental and oral products. Phytochemical screening of the plant leaves reveals the presence of saponins, alkaloids, flavonoids, cardiac glycosides, steroids, phenols and tannins [2]. The farmer entering in the farming of tulsi plants. Moreover, tulsi plant leaves are also used for plant protection/ fungal growth suppression as plant extract for many Phytopathological diseases [3,4,5,6]. The yield and quality of produce is dependent upon the various factors like season, spacing and fertilizer requirements etc. The very limited research was conducted on standardization of package of

practices on it. Keeping this in mind, the present study on effect of transplanting time and spacing on yield and yield contributing characters of tulsi plant was conducted.

## 2. MATERIALS AND METHODS

A field experiment entitled was conducted at AICRP on Medicinal, Aromatic Plants and Betelvine project in *Kharif* season from 2018-19 to 2020-21 for consecutive of three years. The geographical location of the study area is lie between 74.65' E longitudes and 19.35' N latitude with an average elevation of 511 m above mean sea level (msl). The average annual rainfall is about 621 mm. The Average minimum and maximum temperature during experimental period from June to September were ranged from 35.4<sup>o</sup> C to 25.0<sup>o</sup> C respectively. The soil of experimental field belongs to an inceptisol soil having soil pH was slightly alkaline in reaction pH (8.11), electric conductivity (0.19 dSm<sup>-1</sup>), low in organic carbon (0.21%), low in available nitrogen (157.67 kg ha<sup>-1</sup>), medium in available phosphorus (23.0 kg ha<sup>-1</sup>) and high in available potassium (238.00 kg ha<sup>-1</sup>). The experiment was laid out with FRBD design with twenty treatment combinations. The main factor consists of different transplanting times viz., D<sub>1</sub>: I fortnight of June, D<sub>2</sub>: II fortnight of June, D<sub>3</sub>: I fortnight of July, D<sub>4</sub>: II fortnight of July and D<sub>5</sub>: I fortnight of August and sub factor consists of different spacings S<sub>1</sub>: 60 x 45 cm, S<sub>2</sub>: 60 x 60 cm, S<sub>3</sub>: 75 x 45 cm and S<sub>4</sub>: 75 x 60 cm. All the cultural practices related to tulsi was done as per the requirement. The data recorded on the plant height number of primary branches per plant, fresh herbage yield and was statistically analyzed using software for the plant height and no. of primary branches, randomly five plants were selected and for fresh herbage yield per plot was taken and converted into hectore.

## 3. RESULTS AND DISCUSSION

Pooled data of three years, 2018-19, 2019-20, and 2020-21 and individual years results are summarized in Table No. 1 to 5. The data revealed that significant differences were

observed in respect of time of transplanting, spacing and their interaction for all the characters studied. However non- significant differences

were observed for number of branches per plant at different spacings. The pooled results are summarized head-wise as below.

**Table 1. Effect of time of transplanting and spacing on height of plant (cm) and no. of branches of Tulsi**

| Treatments                                       | Height of plant (cm) |         |         |             | No. of branches/ plant |         |         |             |
|--------------------------------------------------|----------------------|---------|---------|-------------|------------------------|---------|---------|-------------|
|                                                  | 2018-19              | 2019-20 | 2020-21 | Pooled mean | 2018-19                | 2019-20 | 2020-21 | Pooled mean |
| <b>A) Main factor (D): Time of Transplanting</b> |                      |         |         |             |                        |         |         |             |
| D <sub>1</sub> : I fort. of June                 | 92.55                | 90.55   | 93.53   | 92.23       | 17.00                  | 15.68   | 17.08   | 15.98       |
| D <sub>2</sub> : II fort. of June                | 92.05                | 94.05   | 95.16   | 93.75       | 15.68                  | 17.00   | 18.08   | 16.50       |
| D <sub>3</sub> : I fort. of July                 | 94.85                | 98.85   | 97.56   | 98.20       | 17.25                  | 17.25   | 17.15   | 16.63       |
| D <sub>4</sub> : II fort. of July                | 91.61                | 92.12   | 91.98   | 91.87       | 16.05                  | 16.05   | 16.58   | 15.59       |
| D <sub>5</sub> : I fort.t of Aug                 | 87.75                | 86.75   | 88.56   | 88.02       | 15.34                  | 15.34   | 16.42   | 15.21       |
| SE <sub>±</sub>                                  | 1.35                 | 1.44    | 1.05    | 1.04        | 0.61                   | 0.50    | 0.31    | 0.26        |
| CD at 5%                                         | 3.91                 | 4.17    | 3.03    | 3.62        | NS                     | 1.11    | 0.89    | 0.53        |
| <b>B) Sub-factor (S): Spacing</b>                |                      |         |         |             |                        |         |         |             |
| S <sub>1</sub> 60 x 45 cm                        | 94.76                | 93.53   | 97.58   | 94.29       | 14.98                  | 16.24   | 17.73   | 16.76       |
| S <sub>2</sub> 60 x 60 cm                        | 91.13                | 91.76   | 92.03   | 91.63       | 15.94                  | 15.94   | 17.13   | 16.33       |
| S <sub>3</sub> 75 x 45 cm                        | 92.34                | 92.06   | 94.46   | 92.91       | 16.2                   | 14.98   | 16.27   | 16.15       |
| S <sub>4</sub> 75 x 60 cm                        | 89.57                | 91.72   | 89.36   | 90.55       | 18.44                  | 18.44   | 15.42   | 16.30       |
| SE <sub>±</sub>                                  | 1.35                 | 1.44    | 0.94    | 1.04        | 0.55                   | 0.50    | 0.31    | 0.26        |
| CD at 5%                                         | 3.91                 | NS      | 2.71    | 3.62        | NS                     | 1.11    | 0.89    | 0.53        |
| SXD Int.                                         |                      |         |         |             |                        |         |         |             |
| SE <sub>±</sub>                                  | 2.72                 | 2.89    | 2.11    | 2.40        | 1.12                   | 1.12    | 0.69    | 0.99        |
| CD at 5%                                         | NS                   | NS      | 6.06    | 6.88        | NS                     | NS      | NS      | NS          |

**Table 2. Effect of time of transplanting and spacing on fresh herbage and dry herbage yield of Tulsi**

| Treatments                                    | Fresh herbage yield (q/ha) |         |         |             | Dry herbage yield (q/ha) |         |         |             |
|-----------------------------------------------|----------------------------|---------|---------|-------------|--------------------------|---------|---------|-------------|
|                                               | 2018-19                    | 2019-20 | 2020-21 | Pooled mean | 2018-19                  | 2019-20 | 2020-21 | Pooled mean |
| <b>Main factor (D): Time of Transplanting</b> |                            |         |         |             |                          |         |         |             |
| D <sub>1</sub> : I fort. of June              | 87.63                      | 85.68   | 92.76   | 88.69       | 16.91                    | 15.54   | 17.79   | 16.08       |
| D <sub>2</sub> : II fort. of June             | 101.61                     | 95.00   | 103.33  | 98.91       | 19.61                    | 17.33   | 19.81   | 17.89       |
| D <sub>3</sub> : I fort. of July              | 99.29                      | 97.31   | 100.14  | 99.98       | 19.16                    | 18.78   | 18.21   | 18.91       |
| D <sub>4</sub> : II fort. of July             | 79.02                      | 78.2    | 83.16   | 80.12       | 15.25                    | 15.09   | 16.33   | 14.55       |
| D <sub>5</sub> : I fort.t of Aug              | 73.26                      | 71.91   | 75.94   | 73.70       | 14.13                    | 13.88   | 13.29   | 13.43       |
| SE <sub>±</sub>                               | 1.33                       | 1.19    | 1.18    | 0.72        | 0.26                     | 0.23    | 0.31    | 0.33        |
| CD at 5%                                      | 3.80                       | 3.41    | 3.39    | 2.02        | 0.74                     | 0.66    | 0.87    | 1.08        |
| <b>Sub-factor (S): Spacing</b>                |                            |         |         |             |                          |         |         |             |
| S <sub>1</sub> 60 x 45                        | 112.27                     | 108.61  | 114.58  | 111.82      | 21.67                    | 20.96   | 20.57   | 20.06       |
| S <sub>2</sub> 60 x 60                        | 97.42                      | 92.158  | 99.39   | 96.32       | 18.8                     | 17.79   | 16.93   | 17.17       |
| S <sub>3</sub> 75 x 45                        | 80.8                       | 80.37   | 82.26   | 81.84       | 15.59                    | 15.51   | 14.84   | 14.64       |
| S <sub>4</sub> 75 x 60                        | 62.16                      | 61.35   | 68.03   | 63.84       | 11.99                    | 11.84   | 11.81   | 11.88       |
| SE <sub>±</sub>                               | 1.33                       | 1.19    | 1.18    | 0.72        | 0.26                     | 0.23    | 0.31    | 0.33        |
| CD at 5%                                      | 3.80                       | 3.41    | 3.39    | 2.02        | 0.74                     | 0.66    | 0.87    | 1.08        |
| SXD Int.                                      |                            |         |         |             |                          |         |         |             |
| SE <sub>±</sub>                               | 2.97                       | 2.66    | 2.63    | 1.60        | 0.57                     | 0.52    | 0.67    | 0.56        |
| CD at 5%                                      | 8.51                       | 7.64    | 7.58    | 4.49        | 1.64                     | 1.47    | NS      | 1.94        |

**Table 3. Interaction effect of time of transplanting and spacing on height (cm) of Tulsi**

|                                   | <b>S<sub>1</sub></b><br><b>(60x 45 cm)</b> | <b>S<sub>2</sub></b><br><b>(60 x 60 cm)</b> | <b>S<sub>3</sub></b><br><b>(75 x 45 cm)</b> | <b>S<sub>4</sub></b><br><b>(75 x 60 cm)</b> | <b>Mean</b> |
|-----------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|-------------|
| D <sub>1</sub> : I fort. of June  | 93.33                                      | 91.89                                       | 91.88                                       | 92.31                                       | 92.23       |
| D <sub>2</sub> : II fort. of June | 98.65                                      | 93.57                                       | 90.07                                       | 90.82                                       | 93.75       |
| D <sub>3</sub> : I fort. of July  | 99.21                                      | 93.25                                       | 91.18                                       | 90.55                                       | 98.20       |
| D <sub>4</sub> : II fort. of July | 90.51                                      | 90.74                                       | 91.98                                       | 96.06                                       | 91.87       |
| D <sub>5</sub> : I fort.t of Aug  | 92.62                                      | 89.34                                       | 87.68                                       | 84.35                                       | 88.02       |
| Mean                              | 94.29                                      | 91.63                                       | 92.91                                       | 90.55                                       | 92.81       |
| SE ±                              | 2.40                                       |                                             |                                             |                                             |             |
| CD at 5%                          | 6.88                                       |                                             |                                             |                                             |             |

**Table 4. Interaction effect of time of transplanting and spacing on fresh herbage yield (q/ha) of Tulsi**

|                                   | <b>S<sub>1</sub></b><br><b>(60x 45 cm)</b> | <b>S<sub>2</sub></b><br><b>(60 x 60 cm)</b> | <b>S<sub>3</sub></b><br><b>(75 x 45 cm)</b> | <b>S<sub>4</sub></b><br><b>(75 x 60 cm)</b> | <b>Mean</b> |
|-----------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|-------------|
| D <sub>1</sub> : I fort. of June  | 111.42                                     | 98.04                                       | 81.42                                       | 63.86                                       | 88.69       |
| D <sub>2</sub> : II fort. of June | 118.94                                     | 110.18                                      | 95.51                                       | 66.68                                       | 98.91       |
| D <sub>3</sub> : I fort. of July  | 122.54                                     | 113.24                                      | 75.37                                       | 68.09                                       | 99.98       |
| D <sub>4</sub> : II fort. of July | 105.3                                      | 80.57                                       | 72.40                                       | 62.23                                       | 80.12       |
| D <sub>5</sub> : I fort. of Aug   | 100.9                                      | 74.55                                       | 61.01                                       | 58.34                                       | 73.70       |
| Mean                              | 111.82                                     | 96.32                                       | 81.84                                       | 63.84                                       | 88.28       |
| SE ±                              | 1.60                                       |                                             |                                             |                                             |             |
| CD at 5%                          | 4.49                                       |                                             |                                             |                                             |             |

**Table 5. Interaction effect of time of transplanting and spacing on dry herbage yield (q/ha) of Tulsi**

|                                   | <b>S<sub>1</sub></b><br><b>(60x 45 cm)</b> | <b>S<sub>2</sub></b><br><b>(60 x 60 cm)</b> | <b>S<sub>3</sub></b><br><b>(75 x 45 cm)</b> | <b>S<sub>4</sub></b><br><b>(75 x 60 cm)</b> | <b>Mean</b> |
|-----------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|-------------|
| D <sub>1</sub> : I fort. of June  | 21.10                                      | 18.58                                       | 15.68                                       | 12.96                                       | 16.08       |
| D <sub>2</sub> : II fort. of June | 22.38                                      | 20.08                                       | 17.97                                       | 13.18                                       | 17.89       |
| D <sub>3</sub> : I fort. of July  | 23.02                                      | 20.91                                       | 17.83                                       | 13.71                                       | 18.91       |
| D <sub>4</sub> : II fort. of July | 19.75                                      | 15.49                                       | 14.22                                       | 12.76                                       | 14.55       |
| D <sub>5</sub> : I fort. of Aug   | 19.02                                      | 14.32                                       | 12.52                                       | 11.86                                       | 13.43       |
| Mean                              | 20.06                                      | 17.17                                       | 14.64                                       | 11.88                                       | 16.17       |
| SE ±                              | 0.56                                       |                                             |                                             |                                             |             |
| CD at 5%                          | 1.94                                       |                                             |                                             |                                             |             |

**Table 6. Effect of time of transplanting and spacing on economics of Tulsi**

| <b>Treatments</b>             | <b>Dry leaf yield (q/ha)</b> | <b>Cost of cultivation (Rs/ha)</b> | <b>Gross monetary return (Rs/ha)</b> | <b>Net monetary return (Rs/ha)</b> | <b>B: C ratio</b> |
|-------------------------------|------------------------------|------------------------------------|--------------------------------------|------------------------------------|-------------------|
| D <sub>1</sub> S <sub>1</sub> | 21.10                        | 97742                              | 168800                               | 71537                              | 1.72              |
| D <sub>1</sub> S <sub>2</sub> | 18.58                        | 97113                              | 148640                               | 51527                              | 1.53              |
| D <sub>1</sub> S <sub>3</sub> | 15.68                        | 96483                              | 125440                               | 28956                              | 1.30              |
| D <sub>1</sub> S <sub>4</sub> | 12.96                        | 95854                              | 103680                               | 07826                              | 1.08              |
| D <sub>2</sub> S <sub>1</sub> | 22.38                        | 95224                              | 179040                               | 83815                              | 1.88              |
| D <sub>2</sub> S <sub>2</sub> | 20.08                        | 94595                              | 160640                               | 77245                              | 1.69              |
| D <sub>2</sub> S <sub>3</sub> | 17.97                        | 93965                              | 143760                               | 49794                              | 1.53              |
| D <sub>2</sub> S <sub>4</sub> | 13.18                        | 93336                              | 105440                               | 12104                              | 1.13              |
| D <sub>3</sub> S <sub>1</sub> | 23.02                        | 92706                              | 184160                               | 91453                              | 1.99              |
| D <sub>3</sub> S <sub>2</sub> | 20.91                        | 92077                              | 167280                               | 75603                              | 1.79              |
| D <sub>3</sub> S <sub>3</sub> | 17.83                        | 91447                              | 142640                               | 51192                              | 1.56              |

| Treatments                    | Dry leaf yield (q/ha) | Cost of cultivation (Rs/ha) | Gross monetary return (Rs/ha) | Net monetary return (Rs/ha) | B: C ratio |
|-------------------------------|-----------------------|-----------------------------|-------------------------------|-----------------------------|------------|
| D <sub>3</sub> S <sub>4</sub> | 13.71                 | 90818                       | 109680                        | 18862                       | 1.21       |
| D <sub>4</sub> S <sub>1</sub> | 19.75                 | 90188                       | 158000                        | 67811                       | 1.75       |
| D <sub>4</sub> S <sub>2</sub> | 15.49                 | 89559                       | 123920                        | 34361                       | 1.38       |
| D <sub>4</sub> S <sub>3</sub> | 14.22                 | 88929                       | 113760                        | 24830                       | 1.28       |
| D <sub>4</sub> S <sub>4</sub> | 12.76                 | 88300                       | 102080                        | 13780                       | 1.17       |
| D <sub>5</sub> S <sub>1</sub> | 19.02                 | 87670                       | 152160                        | 64489                       | 1.74       |
| D <sub>5</sub> S <sub>2</sub> | 14.32                 | 87041                       | 114560                        | 27519                       | 1.32       |
| D <sub>5</sub> S <sub>3</sub> | 12.52                 | 86411                       | 100160                        | 13748                       | 1.16       |
| D <sub>5</sub> S <sub>4</sub> | 11.86                 | 85782                       | 94880                         | 09098                       | 1.11       |

**Market price:** Rate of dry herbage of Tulsi: Appro. Rs. 80/kg

### 3.1 Height of Plant

Among all the transplanting times, the significantly maximum plant height (98.20 m) was recorded by the treatment D<sub>3</sub> i.e seedlings transplanted in first fortnight of July. The plant height at this transplanting time also showed significantly maximum values (94.85, 98.85 and 97.56 cm) at individual year i.e. 2018-19, 2019-20, 2020-21, respectively. In case of spacings effect on plant height, the significantly maximum plant height (94.29 cm) was observed in S<sub>1</sub> i.e 60 x 45 cm spacing. However, the spacing S<sub>3</sub> (75 x 45 cm), S<sub>2</sub> (60 x 60 cm) were statistically at par with S<sub>1</sub> (60 x 45 cm) which recorded plant height of 92.91 cm 91.63 cm respectively. As regards the interaction effect of time of transplanting and spacing both treatment D<sub>3</sub>S<sub>1</sub> i.e seedlings transplanted in first fortnight of July with spacing of 60 x 45 cm showed significantly maximum height (99.21 cm) among all the interactions. However, an interactions D<sub>2</sub>S<sub>1</sub> and D<sub>1</sub>S<sub>1</sub> were statistically at par with interaction D<sub>3</sub>S<sub>1</sub>. The D<sub>2</sub>S<sub>1</sub> and D<sub>1</sub>S<sub>1</sub> recorded plant height of 98.65 cm and 93.53 cm, respectively. The maximum plant height was recorded when the tulsi seedling where transplanting on July reported by Kumar et al. [7]. The same results reported by Desai et al. [8,9,10] in the Ashwagandha.

### 3.2 Number of Branches

The data regarding number of primary branches per plant revealed that both Factor A ie time of transplanting influenced the number of primary branches on the plant. Among factor A treatment D<sub>3</sub> i.e transplanting of seedlings in first fortnight of July showed significantly maximum number of branches (16.63). However, D<sub>2</sub> i.e transplanting of seedlings in second fortnight of June was found statistically at par with treatment D<sub>3</sub>. The treatment D<sub>2</sub> recorded 16.50 branches per plant.

The factor B i.e. different spacing did not shown significant differences. But among different spacings, the highest (16.76) number of primary branches was recorded by 60 x 45 cm (S<sub>1</sub>) spacing. This might be due to competition for different nutrient space and sunlight. The similar results were found by Raina et al. [11,12,13,7] in different *Ocimum spp.*

### 3.3 Fresh Herbage Yield (q/ha)

The results of fresh herbage yield also showed significant differences among the time of transplanting. The results indicated that the transplanting in first fortnight of July showed significantly maximum fresh herbage yield (99.98 q/ha) which was at par with the time of transplanting in second fortnight of June (98.91 q/ha). The spacing had the significant effect on fresh herbage yield. The significantly maximum (118.82q/ha) herbage yield was recorded with 60 x 45 cm spacing. Minimum fresh herbage yield (68.03 q/ha) was obtained with wider spacing of 75 x 60 cm. The interaction between time of planting and spacing had the significant effect on fresh herbage yield. The transplanting of seedlings in first fortnight of July with spacing 60 x 45 cm showed significantly higher fresh herbage yield (122.54 q/ha) which was statistically at par with D<sub>2</sub>S<sub>1</sub> (118.94 q/ha) i.e transplanting of seedlings in second fortnight of June with spacing 60 x 45 cm. The fresh leaves yield was significantly influenced by spacing reported by Kalita et al. [14]. Similar results are obtained are similar to those reported by Patel and Kushwaha [15,7,16].

### 3.4 Dry Herbage Yield (q/ha)

The results for the dry herbage yield indicated that the dry herbage yield shown the same trend as fresh herbage yield for both the factors. The dry herbage yield was significantly highest in D<sub>3</sub> (18.91 q/ha) ie transplanting in first fortnight of

July which was spastically at par with D<sub>2</sub> (transplanting in second fortnight of June) which recorded 17.89 q/ha dry herbage yield. the highest dry herbage yield (20.06 q/ha) was recorded by 60 x 45 cm spacing and superior than other spacing. The interaction between time of transplanting and spacing also had significant effect on dry herbage yield among all the interactions. the D<sub>3</sub>S<sub>1</sub> transplanting in first fortnight of July with spacing 60 x 45 cm showed significantly highest dry herbage yield (23.02q/ha) which was statistically at par with D<sub>2</sub>S<sub>1</sub> and D<sub>1</sub>S<sub>1</sub> which recorded 22.38 and 21.10 q/ha dry herbage yield. The dry root yield was significantly influenced by different spacing in Ashwagandha reported by Desai et al. [8] and the number of berries per plant, dry root yield and seed yield influenced by spacing reported by Agarwal, [17,18,19] in Ashwagandha and [8] in Tulsi.

### 3.5 Monetary Returns

The transplanting of tulsi in the first fortnight of July at 60 x 45 cm spacing accommodating 37037 plants per hector recorded higher gross return (₹ 1,84,160), net monetary returns (₹ 91453) and benefit cost ratio (1.99).

### 4. CONCLUSION

Based on present study it can be concluded that transplanting of tulsi during first fortnight of July with a spacing of 60 X 45 cm was found to be effective to obtained maximum plant height, fresh herbage yield and dry herbage yield with maximum monetary returns. So, it can be recommended as best practice to can be adopted.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

### REFERENCES

1. Anonymous; 2021. Available:<https://pib.gov.in/Pressreleaseshared.aspx?PRID=1558955>.
2. Naik Srinivas, Shyam P, Poul Marx, Baskari Srinivas, Venkata Ramana Devi. Antimicrobial activity & Phytochemical analysis of *Oscimum tenuiflorum* leaf extract. Int. Jr. of Pharm Tech Research. 2015;8(1):88-95.

3. Naik SC, Narute TK, Narute TT and Khaire PB. In vitro efficacy of plant extract (botanicals) against *Alternaria solani* (early blight of tomato). Journal of Pharmacognosy and Phytochemistry; 2020;9(5): 614-617. Available:[https://www.researchgate.net/publication/348884330\\_In\\_vitro\\_efficacy\\_of\\_plant\\_extract\\_botanicals\\_against\\_Alternaria\\_solani\\_early\\_blight\\_of\\_tomato](https://www.researchgate.net/publication/348884330_In_vitro_efficacy_of_plant_extract_botanicals_against_Alternaria_solani_early_blight_of_tomato)
4. Naik SC, Narute TK, Narute TT and Khaire PB. Effects of selected biological control agents and plant extracts on early blight disease management and yield of cherry tomato. Journal of Pharmacognosy and Phytochemistry. 2020; 9(5): 587-592. Available:[https://www.researchgate.net/publication/348884009\\_Effects\\_of\\_selected\\_biological\\_control\\_agents\\_and\\_plant\\_extraacts\\_on\\_early\\_blight\\_disease\\_management\\_and\\_yield\\_of\\_cherry\\_tomato](https://www.researchgate.net/publication/348884009_Effects_of_selected_biological_control_agents_and_plant_extraacts_on_early_blight_disease_management_and_yield_of_cherry_tomato)
5. Pudake SP, Hingole DG, Ghante PH, Khaire PB, Swami CS. In-vitro evaluation of Phyto-extracts and bio-agent against *Aspergillus niger*. Int J Chem Stud. 2019;7(2):434-438.
6. Khaire PB, Hingole DG and Padvi SA. Efficacy of different phytoextracts against *Macrophomina phaseolina*. J Pharmacogn Phytochem. 2018;7(3):1124-1126.
7. Kumar Udit, Singh AK, Jha PK and Pushpam Pate. Effect of planting time and spacing on plant growth, yield and oil yield of tulsi (*Ocimum sanctum*) Bulletin of Environment, Pharmacology & Life science. 2017;6(1):305-309.
8. Desai CD, Patel MM, Mehta VS, Mehta ND and Senapati AK. Effect of spacing and fertilizer level on growth, yield and quality of Ashwagandha (*Withania somnifera* Dunal) cv. JA-20. Int. Jr. of Minor Fruits, Medicinal & Aromatic Plants. 2017;3(2):8-10.
9. Patel DH, Vpadyaya PN, Patel KV, Patel JB and Patel BK. Effect of Method of Sowing, time of harvesting & nitrogen application on dry root yield of Ashwagandha (*Withania somnifera* Dunal) Jr Medicinal Aromatic Plant Science. 2004; 26:288-292
10. Saravanan SS, Deepak Lal, Vijay Bahadur and Sanjeev Kumar. Reponse of different levels of plant spacing on Vegetative growth and yield attributes of Ashwagandha (*Withania somnifera* var. Pashita & Sarpagandha. (*Rauvolfia*

- sarpentina*. Benth) var. Sheel under open Environment and orchard conditions.2019 Int. Jr. Curr. Microbiol. App. Sci. 2019;8(7):2065-2074.
11. Raina NS, Rafiq M, Sood KK, Bali AS, Gupta SK and Sehgal S. Growth and yield of *Ocimum sanctum* in response to integrated nutrient management and plant spacing. Indian Journal of Agronomy. 2013;58(1):129-132.
  12. Arabaci O, Bayram E. The effect of Nitrogen fertilization and different plant densities on some agronomic and technological characteristics of (*Ocimum basilicum* L.) Journal of Agronomy. 2004; 3(4):255-262.
  13. Ram M, Ram D, Naqvi AA and Kumar S. Effect of plant density and harvesting time on the yield and the quality of essential oil in *Ocimum* species. Journal of Medicinal and Aromatic Plant Science. 2002;24:393-96.
  14. Kalita BP, Gogoi PK, Sarma A, Barua IC and Neog B. Effect of Integrated Nutrient Management and Different Plant Spacing on Tulsi. Int.J.Curr.Microbiol.App.Sci. 2018;7(02):1352-1361.
  15. Patel K, Kushwaha NK. Studies on influence of species, nitrogen and spacing on parameters of plant growth at various stages of basil. Int. J of Pharma. & Life Sci. 2013;4(10):3028-3034.
  16. Kubsad VS, Palled YB, Mansur CP and Alagundagi SC. Influence of spacing and fertilizer levels on growth and dry matter production in Ashwagandha. Madras Agric. J. 2008;97(7-9):212-215.
  17. Agarwal MK. Effect of sowing time and spacing on growth and yield of Ashwagandha (*Withania somnifera* Dunal) cv. Jawahar Ashwagandha-20, M. Sc. Thesis, S. K. N. College of Agriculture, Jobner (RAU, Bikaner); 2003.
  18. Desai PB. Effect of planting dates on seed yield and quality of Ashwagandha (*Withania somnifera* Dunal), M Sc. (Agri). Thesis submitted to MPKV, Rahuri, Maharashtra; 2003.
  19. Kapur LT, Sutariya KK and Zala SU. Effect of spacing on yield attributes and yield of Ashwagandha. Int. Jr. of Forestry & Crop Improvement. 2010;1(2):123-126.

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