Effect of Different Planting Orientation of Onion Bulbs on Growth Parameters Relevant to Development of Raised Bed Onion Bulb Planter

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Authors’ contributions

This work was carried out in collaboration among all authors. Author BD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ACR, RVG and GSK managed the analyses of the study. Author AKD managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Multiplier onion is among the four groups of onions classified by horticulturists which is propagated through bulbs. Presently onion bulb planting is done manually by planting the root portion oriented downwards as pressed into an irrigated field. Generally about 80-100 man days are required to plant one hectare of onion at a spacing of 15 cm by 10 cm. The manual planting is labour intensive, highly drudgery involved and time consuming. There is need to develop an onion bulb planter possibly with four orientations. Therefore, an experiment was carried at ICAR-Indian Institute of Horticultural Research, Bengaluru to study the effect of different planting orientations of onion bulb on growth parameter. Onion bulbs were planted on raised bed 45 m long and 0.9 m width at 15 cm row spacing and 10 cm in-row spacing. The four treatments used were viz., T1) root portion up, T2) root portion down, T3) horizontal and T4) inclined. Experiment was laid as a randomized block
design with 5 replications. The growth parameters namely i) germination percentage at 7th and 15th days after planting, (DAP), ii) Plant height 15th and 30th DAP and yield. The results showed that the growth parameters were on par in all the three treatments (root portion down, horizontal and inclined) except in treatment root portion up.

**Keywords:** Onion bulb planter; planting positions; germination percentage; plant height; yield.

### 1. INTRODUCTION

India produced about 234.85 lakh MT (2017-18) of onion under the area of 12.63 lakh ha [1]. India has exported 19,49,482.67 MT of fresh onion worth of Rs. 2,85,782.13 lakhs (2017-18) (FAOSTAT, 2019) [2]. The area under onion production has increased 49.70% from 39.53% during 2006-07 to 2016-17. Maharashtra ranks first in onion production (5,786.40 thousand tons) followed by Madhya Pradesh (2,403.14 thousand tons.), Karnataka (1,995.62 thousand tons), Rajasthan (1,250.64 thousand tons.) and Gujarat (1,034.49 thousand tons.) [1].

Onion is not only for domestic market consumption but is also as highest foreign exchange earner among the fruits and vegetables. Aggregatum group onion is one of the onion types among others which include viz., common onion, small onion, potato onion, underground onion, shallots, multiplier onion, nesting onions and ever-ready onion. This makes it more similar to garlic than to common onions. It is a plant of tropical and subtropical region which tolerate hot and humid climate with better tolerance to insect pest and diseases. The onion has longer shelf life than common onion (Multiplier) [3,4]. This type of onion grown extensively in Southern states of India viz., Tamil Nadu, Andhra Pradesh, South Karnataka, small parts of Orissa and Kerala. Tamil Nadu accounted for five per cent of country’s area under onion cultivation and more than 70 per cent of the part is cultivated by small onion (A. cepa var. aggregatum) [5]. Around 90 per cent of country’s small onion is produced from Tamil Nadu and 10 per cent from Karnataka [6].

Traditionally multiplier onion has been cultivated on ridges and furrows system. Recently farmers are shifting to raised beds to adopt micro irrigation systems [7,8]. Multiplier type onion is propagated through bulbs and bulbs are planted manually. Manual planting of onion bulb is highly labour intensive due to the close plant spacing among the vegetable crops. Generally it requires about 80 to 100 man-days/ha for planting [9] (Fig. 1). The capacity of man power is very low about 0.05 ha./man/day and payment for planting is 11.9% of total cost of production [10]. Hence development of onion bulb planter would reduce the cost of cultivation and drudgery involved in this operation. However in case of mechanical planting there is a possibility that the onion bulb can be any position during the planting [11,12]. Hence, a field experiment was conducted to study the effect of planting position of onion bulb relevant to development of raised bed onion bulb planter.

**Fig. 1. Manual planting of onion bulbs**

### 2. MATERIALS AND METHODS

The field experiment was conducted at Block No-8 of Division of Vegetable crops at ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka.

The planting material for multiplier onion was small size bulbs called onion sets. A bed of 45 m length and 0.9 m width was prepared. Twenty plots, each having a length of 2 m were marked and partitioned. The experiment had four treatments of planting orientation viz., T1- Root portion up, T2-Root portion down, T3-Horizontal, and T4-Inclined with five replications. The design of experiment was Randomized Block Design (RBD). The onion bulbs were planted on 14
January 2019. The field layout (Figs. 2 and 3) shows the experimental field. The crop was raised by following standard package of practices. The following observations were recorded viz., percentage of germination at 7th and 15th days after planting (DAP), height of plant at 15th and 30th DAP and yield. The data were statistically analysed by using ICARGOA (http://ccari.res.in/waspnew.html).

3. RESULTS AND DISCUSSION

The results of effect of four planting orientations on onion plant growth parameters viz., germination percentage at 7th and 15th days after planting, plant height at 7th and 15th days after planting and yield are presented and discussed below.

3.1 Effect of Onion Bulb Planting Orientation on Germination Percentage

It was observed that, the treatment T2 had the highest germination percentage (87.50%) followed by T4 (86.50%), T3 (85.50%) and the treatment T1 had the lowest germination percentage of (69.37%) at 7 days after planting (DAP). The same trend was observed 15 days after planting (Fig. 5). When means of treatment were compared by LSD method, it was observed that the treatments T2, T3 and T4 had the highest germination percentage and were on par. The Treatment T1 had the lowest germination percentage (Tables 1 and 2).

3.2 Effect of Onion Bulb Planting Orientation on Plant Height

From Fig. 6, it was observed that, at 15 days after planting, the treatment T2 had the highest plant height (33.85 cm) followed by T4 (32.98 cm), T3 (31.83 cm) and the treatment T1 had the lowest plant height (30.45 cm). The same trend was observed for 30 days after planting (Fig. 7). However, in case of 15 DAP, when means of treatment were compared by LSD method, it was observed that the treatments T2, T3 and T4 had the highest plant height percentage and were on par. The Treatment T1 had the lowest plant height (Table 4).

3.3 Effect of Onion Bulb Planting Orientation on Yield

From Fig. 8, it was observed that, the Treatment T2 had the highest yield of 19.46 t/ha followed by T4 (18.69 t/ha), T3 (17.01 t/ha) and the treatment T1 had the lowest yield of 13.26 t/ha. However, when means of treatment were compared by LSD method, it was observed that the treatments T2, T4 and T3 had the highest yield and were on par. The Treatment T1 had the lowest yield (Table 5).

| Source of variation | Degrees of freedom | Mean sum of squares | F calculated |
|---------------------|--------------------|--------------------|-------------|
| Replications        | 4                  | 8.594              | 2.426       |
| Treatments          | 3                  | 375.286 **         | 105.963     |
| Error               | 12                 | 3.542              | -           |
| Total               | 19                 | -                  | -           |

Coefficient of Variation = 2.290
Treatment found Significant at 1% and 5% level of significance
Coefficient of Determination (0.01) = 3.636
Coefficient of Determination (0.05) = 2.594
Table 2. ANOVA for: Germination at 15 DAP

| Source of variation | Degrees of freedom | Mean sum of squares | F calculated |
|---------------------|--------------------|---------------------|--------------|
| Replications        | 4                  | 65.508              | 1.161        |
| Treatments          | 3                  | 535.286**           | 9.483        |
| Error               | 12                 | 56.445              | -            |
| Total               | 19                 | -                   | -            |

Coefficient of Variation = 9.458
Treatment found Significant at 1% and 5% level of significance
Coefficient of Determination (0.01) = 14.516
Coefficient of Determination (0.05) = 10.354

Table 3. ANOVA for: Plant height at 15 DAP

| Source of variation | Degrees of freedom | Mean sum of squares | F calculated |
|---------------------|--------------------|---------------------|--------------|
| Replications        | 4                  | 6.366               | 2.090        |
| Treatments          | 3                  | 10.844*             | 3.560        |
| Error               | 12                 | 3.046               | -            |
| Total               | 19                 | -                   | -            |

Coefficient of Variation = 5.407
Treatment found Significant at 5% level of significance
Coefficient of Determination (0.05) = 2.405

Fig. 3. Experimental field

Fig. 4. Effect of different planting orientation on germination percentage (7 DAP)
Fig. 5. Effect of different planting orientation on germination percentage (15 DAP)

Fig. 6. Effect of different planting orientation on plant height (15 DAP)

Fig. 7. Effect of different planting orientation on plant height (30 DAP)
Table 4. ANOVA for: Plant height at 30 DAP

| Source of variation | Degrees of freedom | Mean sum of squares | F calculated |
|---------------------|--------------------|---------------------|--------------|
| Replications        | 4                  | 4.519               | 1.527        |
| Treatments          | 3                  | 11.463*             | 3.873        |
| Error               | 12                 | 2.959               | -            |
| Total               | 19                 | -                   | -            |

Coefficient of Variation = 4.548
Treatment found Significant at 5% level of significance Coefficient of Determination 0.05) = 2.371

Fig. 8. Effect of different planting position on yield

Table 5. ANOVA for: Yield

| Source of variation | Degrees of freedom | Mean sum of squares | F calculated |
|---------------------|--------------------|---------------------|--------------|
| Replications        | 4                  | 0.879               | 7.414        |
| Treatments          | 3                  | 1.236**             | 10.419       |
| Error               | 12                 | 0.119               | -            |
| Total               | 19                 | -                   | -            |

Coefficient of Variation = 11.166
Treatment found Significant at 1% and 5% level of significance Coefficient of Determination (0.01) = 0.665 Coefficient of Determination (0.05) = 0.475

4. CONCLUSION

It was concluded that the treatments, T2) root portion down, T3) horizontal and T4) inclined had highest germination percentage and plant height at both 7 DAP (days after planting) and 15 DAP. The treatment T1) Root portion up had lowest germination percentage and plant height at both 7 DAP (days after planting) and 15 DAP. The highest yield was observed in T2, T3 and T4. The lowest yield was observed in Treatment T1.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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