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Evaluating the suitability of planting position of multiplier onion bulb for mechanized planting during the Kharif and Rabi season

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ABSTRACT

Aggregated or multiplier type onion is grown extensively in Southern states of India and is propagated through bulbs. The production of small onions is 12-16 tonnes/ha in a duration of 70 to 90 days. Presently Aggregatum onion manually planted the root portion oriented downwards as pressed into an irrigated field on the ridge and furrows system. In recent days farmers shifted to a raised bed method of cultivation to adopt a micro irrigation system. Manual planting of onion bulbs is highly labor-intensive due to the close plant geometry among the vegetable crops. Generally, about 80-100 man-days are required to plant one hectare of onion at a spacing of 15 cm with row to-row and plant to-plant spacing of 10 cm. Hence development of an onion bulb planter is required and in the case of a mechanical planter, there is a possibility of four planting positions of onion bulbs. Hence, an experiment was carried out at ICAR-Indian Institute of Horticultural Research, Bengaluru to evaluate the suitability of the planting position of multiplier onion bulbs for mechanized planting during the Kharif and Rabi seasons. A raised bed of 47 m in length and 0.9 m in width was formed manually, and onion bulbs were planted with row to-row spacing of 15 cm and plant to-plant spacing of 10 cm. The experiment has four treatments viz., a) root portion down, b) root portion up, c) horizontal and d) inclined with 5 replications, and a randomized block design was imposed. The growth parameters namely i) germination percentage at the 7th and 15th DAP (Days after planting), ii) Plant height at the 15th and 30th DAP, and yield were observed. The results were statistically analyzed. It was observed that the growth parameters were on par in all three treatments (a, c, and d) except in treatment (b).

Keywords: *Onion bulb planter, planting orientations, germination percentage, plant height and yield*

1. Introduction

In the world, India is the second largest producer of fruits and vegetables. In the last few years, India has witnessed a rise in horticulture production. The horticulture sector has grown by 2.6 per cent annum over the last decade and annual output has risen by 4.8 per-cent. India produces all varieties of onion *viz.*, common onion (red, yellow, and white), rose onion and multiplier onion. In India, multiplier onion is cultivated in an area of 7.56 lakh ha with a production of 12.16 Mt and productivity of 16.10 t/ha, respectively (Joslin, *et al.,* 2020). It is a hot and subtropical area crop that is tolerant to, hot and humid tropical climates, has greater pest and disease resistance, and has a longer storage life than the common onion (Ashok, 2003). In the southern states of India, Tamil Nadu, Andhra Pradesh, and South Karnataka as well as small parts of Orissa and Kerala, this form of onion is widely grown. Tamil Nadu accounted for 5 % of the area under onion cultivation in the country, of which 70 % of the area is cultivated with small onions (*A. cepa* var. *aggregatum*).

Multiplier onion bulb is used as food, spice, and seasoning of curries (Dabhi *et al.*, 2011). It is often used raw, sliced, mixed with soy sauce, and eaten with roasted meat. The multiplier onion is well known for its pungency and widely used in sambar, an important dish in South Indian kitchen preparation. Multiplier onion is commercially propagated through bulbs. In general, planting one ha of onion requires about 80-100 man-days by maintaining row to-row spacing of 15 cm and plant to-plant spacing of 10 cm (Madan, 2013). The cost of planting onion bulbs is very high, nearly Rs.7, 200/ha. As 6.7 lakhs hills per ha are to be planted, the labor requirement for planting is high, also laborers demand higher wages for onion bulb planting. This leads a to higher cost of cultivation. The capacity of manpower is very low about 0.05 ha/man/day and payment for planting is 11.90 % of the total cost of cultivation.

Therefore, keeping in view the above facts the present study has been undertaken to evaluate the suitability of the planting position of multiplier onion on growth parameters for mechanized planting during the Kharif and Rabi season.

2. Materials and Methods

The experiment was carried out in both seasons (Khariif and Rabi) at Block No-8 of the Division of Vegetable crops at ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka. The experiment was 47 m in length and 0.9 m in width on a raised bed with plant to-plant spacing of 10 cm and row to-row spacing was 15 cm. The experiment had four treatments of planting positions *viz.,* T_1- Root portion up, T_2-Root portion down, T_3-Horizontal, T_4-Inclined and five replications. Each treatment had a 2.2 m length and 0.9 m width of bed, 88 bulbs were planted in each treatment (Totally 1760 bulbs). The design of the experiment was Randomized Block Design (RBD) having four treatments and five replications. The observations were recorded *viz.*, percentage of germination on

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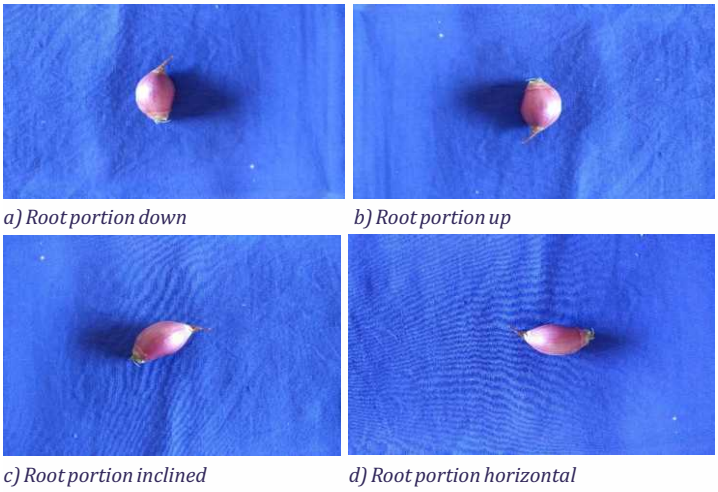
7th and 15th days after planting (DAP), height of plant 15th and 30th DAP, and yield. The data was statistically analyzed. The field layout is shown in (Fig Kharf (3) and Rabi (4)).



a) Root portion down b) Root portion up

c) Root portion inclined d) Root portion horizontal

Fig 1. Different orientations of onion bulbs

a) Planting of onion bulbs b Weeding

c) Spraying d) Germination counting

a) Plant height measurement b) Harvesting

c) De- topping d) Grading

Fig.2. Different operations performed in the cultivation of onion crops in the rabi season

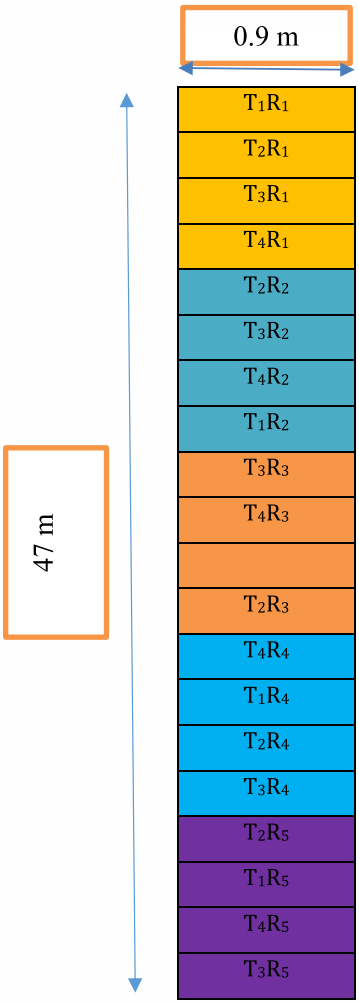


Fig 3. Field layout of Kharif season

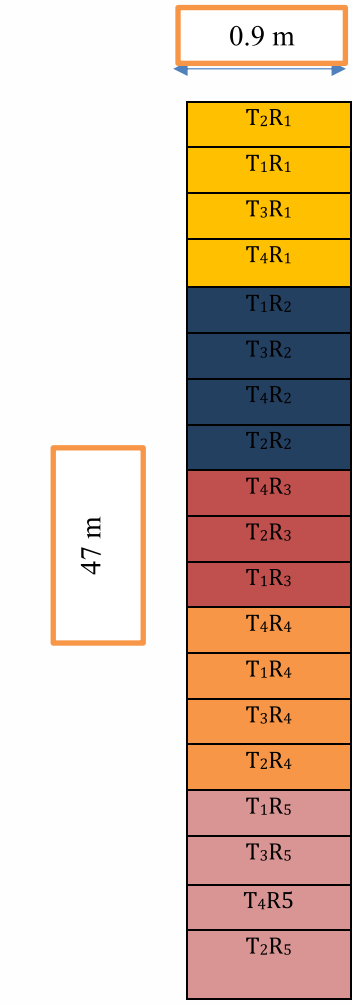
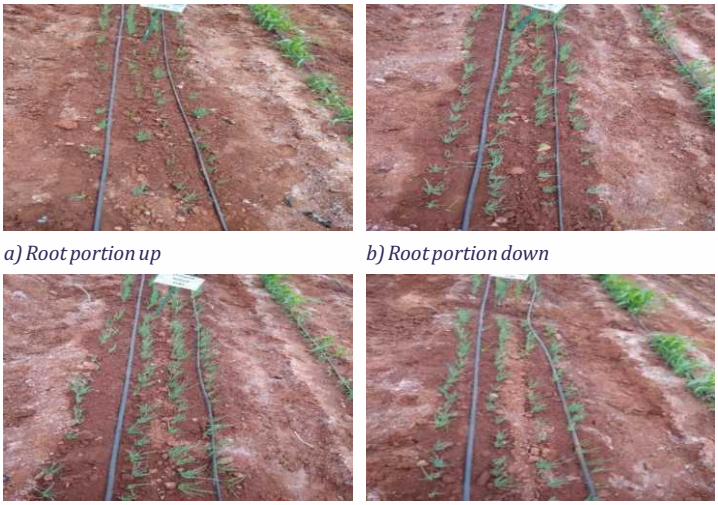


Fig 4. Field layout of Rabi season

Fig 5. Germination of root portion up



a) Root portion up b) Root portion down

c) Horizontal d) Inclined

Fig 6. Growing of onion crop in different orientation

3. Results and discussions

The data of both the seasons (Kharif and Rabi) of plant growth parameters *viz*., germination percentage (7 DAP and 15 DAP), plant height (7 DAP and 15 DAP), and yield were statistically analyzed and results were presented in Table 6.

a. Effect on germination of onion bulbs

The germination of onion bulbs was recorded on 7 DAP. From Fig. 7. It was observed that 7 days after planting, Treatment T_2 had the highest germination efficiency (89.83 %) followed by T_4 (89.06 %), T_3 (86.54 %) and Treatment T_1 had the lowest germination efficiency (61.13 %). However, when means of treatment were compared by the LSD method, it was observed that Treatments T_2, T_4 and T_3 had the highest germination efficiency and were at par. The treatment T_1 had the lowest germination efficiency (Table 1 and 6).

Table. 1. ANOVA on Germination at 7 DAP (Days after planting)

Source of variation	DF	SS	MS	F-calculated	PROB
Season	1	194	194.0	4.791	0.0386 *
Treatment	3	5667	1889.1	46.638	3.64e-10 ***
Season x Replication	8	369	46.2	1.140	0.3734
Season x Treatment	3	395	131.7	3.251	0.0394*
Residuals	24	972	40.5		

The germination of onion bulbs was recorded on 15 DAP. From Fig 7. It was observed that 15 days after planting, Treatment T_2 had the highest germination efficiency (91.45 %) followed by T_4 (90.75 %), T_3 (89.57 %), and Treatment T_1 had the lowest germination efficiency of (65.23 %). However, when means of treatment were compared by LSD method, it was observed that Treatments T_2, T_3, and T_4 had the highest germination efficiency and were at par, the Treatment T_1 had the lowest germination efficiency (Tables 2 and 6).

Table. 2. ANOVA on Germination at 15 DAP (Days after planting)

Source of variation	DF	SS	MS	F-calculated	PROB
Season	1	170	169.9	27.067	2.49e-05 ***
Treatment	3	4843	1614.4	257.189	2e-16 ***
Season x Replication	8	66	8.3	1.315	0.283
Season x Treatment	3	494	164.8	26.249	9.41e-08 ***
Residuals	24	151	6.3		

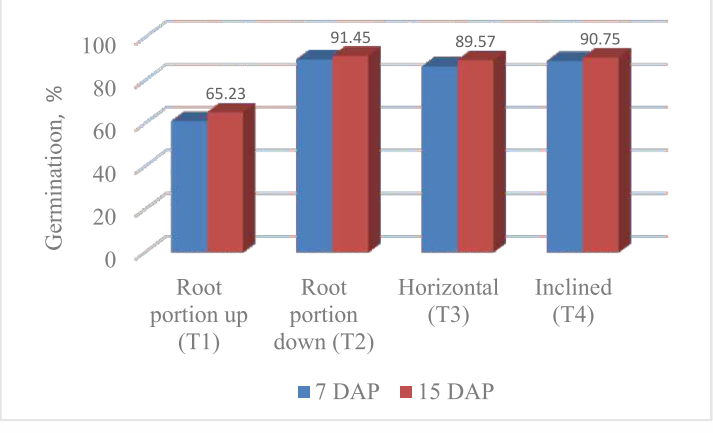


Fig 7. Effect on germination of onion bulbs on 7DAP and 15 DAP

b. Effect on plant height of onion bulbs

The height of onion plants was recorded on 15 DAP. From Fig. 8, it was observed that, Treatment T_2 had the highest plant height (33.18 cm) followed by T_4 (32.12 cm), T_3 (31.23 cm) and Treatment T_1 had the lowest plant height of (30.19 cm). However, when means of treatment were compared by the LSD method, it was observed that Treatment T_2 had the highest plant height followed by Treatment T_4 and were at par. Further, this was followed by Treatment T_3, and Treatments T_4 and T_3 were at par. Treatment T_1 had the lowest plant height and was at par with Treatment T_3 (Tables 3 and 6).

Table. 3. ANOVA on Plant Height at 15 DAP ((Days after planting)

Source of variation	DF	SS	MS	F-calculated	PROB
Season	1	27.31	27.308	14.359	0.000896***
Treatment	3	48.62	16.206	8.522	0.000498***
Season x Replication	8	37.17	4.646	2.443	0.043246*
Season x Treatment	3	1.95	0.651	0.342	0.794969
Residuals	24	45.64	1.902		

The height of onion plants was recorded on 30 DAP. From Fig. 8, it was observed that, Treatment T_2 had the highest plant height (38.74 cm) followed by T_4 (37.76 cm) and were on par. This was followed by T_3 (36.49) and Treatments T_3 and T_4 were on par. Treatment T_1 had the lowest plant height of (35.25 cm) and was at par with T_3 (Table 4 and 6).

Table. 4. ANOVA on Plant Height at 30 DAP (Days after planting)

Source of variation	DF	SS	MS	F-calculated	PROB
Season	1	23.56	23.562	9.471	0.005158**
Treatment	3	69.02	23.008	9.248	0.000302***
Season x Replication	8	27.12	3.390	1.363	0.262154
Season x Treatment	3	0.31	0.103	0.042	0.988420
Residuals	24	59.71	2.488		

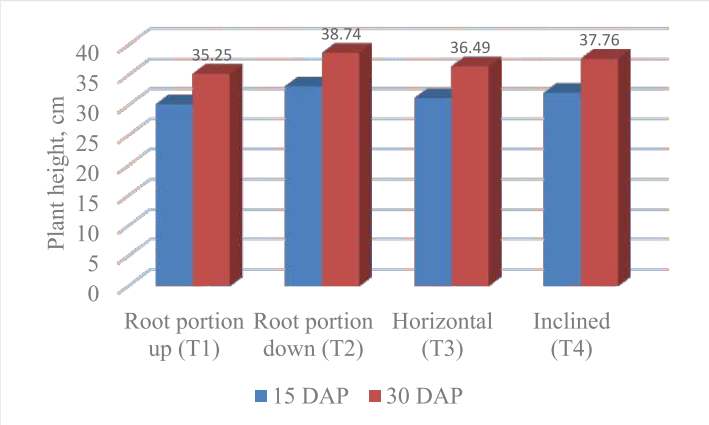


Fig 8. Effect on plant height of onion bulbs on 15 DAP and 30 DAP

c. Effect of different onion bulb planting Positions on yield

The yield of the onion crop was recorded on 90 DAP (Days after planting). From Fig. 9, it was observed that, the Treatment T_2 had the highest yield of 16.04 t/ha followed by T_4 (15.39 t/ha), T_3 (14.42 t/ha) and Treatment T_1 had the lowest yield of 11.12 t/ha. However, when means of treatment were compared by the LSD method, it was observed that Treatments T_2 had the highest yield followed by Treatment T_4, and were on par. This was followed by Treatment T_3 and Treatments T_4 and T_3 were at par (Tables 5 and 6).

Table. 5. ANOVA on Yield

Source of variation	DF	SS	MS	F-calculated	PROB
Season	1	333.3	333.3	142.050	1.44e-11 ***
Treatment	3	143.5	47.8	20.382	8.72e-07 ***
Season x Replication	8	114.5	14.3	6.097	0.000254***
Season x Treatment	3	10.4	3.5	1.480	0.245105
Residuals	24	56.3	2.3		

Table 6. Effect of data of both seasons on different orientations of onion bulb planting on different parameters

Treatment	Germination, % (7 DAP)	Germination, % (15 DAP)	Plant height, cm (15 DAP)	Plant height, cm (30 DAP)	Yield, (t/ha)
T_1 (Root portion up)	61.13	65.23	30.19	35.25	11.12
T_2 (Root portion down)	89.83	91.45	33.18	38.74	16.04
T_3 (Horizontal)	86.54	89.57	31.23	36.49	14.42
T_4 (Inclined)	89.06	90.75	32.12	37.76	15.39
F-Value	**	**	**	**	**
SEm	2.33	0.722	0.481	0.483	0.402
CD (p = 0.01)	10.104	3.119	2.077	2.086	1.735

From the above results, 3.1 to 3.3, it was clear that onion planting positions root portion down, horizontal and inclined had the highest growth parameters and were at par.

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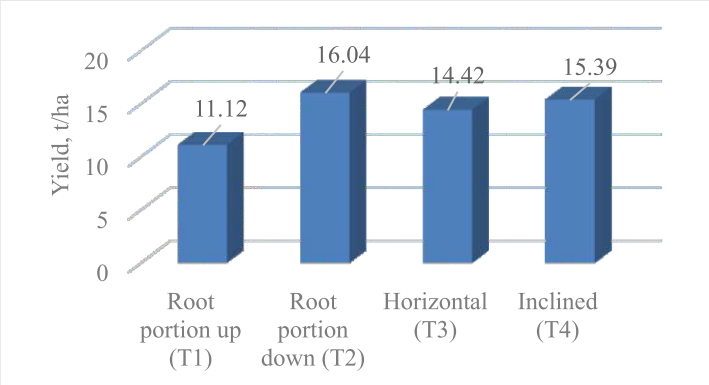

Fig. 9. Effect of different planting position on yield

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