



E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 477-480
Received: 19-06-2020
Accepted: 23-07-2020

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Evaluation of white onion (*Allium cepa* L.) genotypes for growth, yield and yield attributing characters

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Abstract

An experiment was conducted at College of Horticulture, Kolar District during *Rabi* season of 2016-17. In this study a total of 28 genotypes were collected from different parts of India and evaluated using randomized complete block design with two replications. The growth and yield parameters *viz.*, plant height(cm), leaf length(cm), number of leaves per plant, leaf width(cm), yield per plot (kg/plot), yield per hectare (t/ha), average bulb weight(g), ten bulb weight(g), polar and equatorial diameter(cm) were recorded during an experiment. The data indicated that out of 28 genotypes evaluated, Arka Swadistawas recorded maximum plant height (74.6cm) and leaf length (66.83cm). With respect to leaf width, ON-15-42 was indicated maximum leaf width of 2.25cm. However with respect to number of leaves, GJWO-3 was registered maximum leaves (11.20). Whereas, ON-14-09 and GJWO-3 were performed better and produced maximum bulb yield of 13.25 and 11.82kg/per plot. The minimum bulb yield was recorded in the genotype BSS-255 (6.29 kg/plot). The yield per hectare was revealed highest in the genotypes ON-14-09(44.12t/ha) and GJWO-3 (39.37 t/ha). Out of 28 genotypes, ON-14-09 and GJWO-3 were noticed maximum average bulb weight of 113.40 and 105.55g, respectively. The ten bulb weight was recorded highest in the genotypes ON-14-09 (968.75g) and GJWO-3 (902.45g). The polar diameter was indicated highest in the genotypes Bhima Safeda (6.91cm) and Pusa White Round(6.61cm). An equatorial diameter was recorded highest in the genotype ON-14-09 (7.36cm). Therefore from the study, it was concluded that the genotypes GJWO-3 and ON-14-09 were found better with respect to bulb yield production in *Rabi* season.

Keywords: White onion, evaluation, genotypes, growth, yield characters

Introduction

Onion (*Allium cepa* L.) is an important biannual bulbous vegetable crop belonging to the family Alliaceae in the order Asparagales. This crop is mainly grown for local consumption and export purposes, it is known by several vernacular names *viz.*, Pyaz in Hindi, Ullagaddi/Eerulli in Kannada and Venkayam in Tamil. It is an indispensable item in every kitchen as vegetable and spice cum condiment used to flavour many of the food stuffs. Therefore, onion is popularly referred as 'Queen of the Kitchen'. In India, it is grown in 13.20 lakh hectare area with a total production of 209.31 lakh tones and the productivity of 16.13 tonnes per hectare [1]. Maharashtra is the leading state and growing in an area of 0.44 million hectares with a production of 5.36 million tonnes. However, highest productivity is documented from Gujarat (25.43 t/ha). In Karnataka, crop is cultivated in an area of 1.86 million hectares with an annual production of 3.22 million tones and productivity of 17.26 tonnes per hectare [2]. White onion is a type of dry onion that has pure white skin and sweet, mild white flesh having 42 calories, 1.3g protein, 1.2g fibre, 100g vitamin-C and acts as anti-oxidants. However, dehydration industries demand for white onion varieties with globe shape of bulb and high TSS (>18°B), but Indian white onion genotypes are having TSS range from 11 to 13 °brix. Whereas, sulfur compounds are responsible for typical odour cum flavour and are also active anti-microbial agents, which supports the immune health.

The production and productivity are not only depends on cultural practices and location of cultivation, but high yielding genotypes which have good adoptability to the growing area. Hence, evaluation of white onion genotypes are very essential to study the performance of genotypes for adoptability, growth and bulb yield to identify a potential genotype.

Materials and Methods

An experiment was carried out during *Rabi* 2016-17 at Vegetable Research Block, Department of Vegetable Science, College of Horticulture, Kolar, Karnataka.

An experimental materials were consisted of 28 genotypes (Table 1) collected from different institutions and local cultivated areas across the country. An experiment was laid out in Randomized Complete Block Design (RCBD) with two replications. The seedlings were transplanted to the plot size of 2.0 m x 1.5 m with a spacing of 15 cm x 10 cm. All agronomic practices *viz.*, application of recommended dose of fertilizers, irrigation, weeding, *etc.*, were carried out. Five

plants from each treatment was randomly tagged and observations were recorded on vegetative growth and yield characters such as plant height (cm), leaf length (cm), number of leaves per plant, leaf width (cm), polar and equatorial diameter (cm), average bulb weight (g), ten bulb weight (g), yield per plot (kg/plot) and yield per hectare (t/ha). The recorded data was statistically analyzed at 5 percent level of significance following the standard procedure.

Table 1: Onion genotypes and their source of collection

| Treatments | Genotypes | Source |
|------------|----------------------|-----------------------------|
| 1 | BhimaShweta | DOGR, Pune, Maharashtra |
| 2 | Bhima Shubra | DOGR, Pune, Maharashtra |
| 3 | BhimaSafeda | DOGR, Pune, Maharashtra |
| 4 | Pusa White Round | IARI, New Delhi |
| 5 | Pusa White Flat | IARI, New Delhi |
| 6 | BSS-255 | Bejosheetal, Maharashtra |
| 7 | KSP-1120 | Bejosheetal, Maharashtra |
| 8 | Pocha White | Pocha Private Company, H.P |
| 9 | GWO-1 | JAU, Gujarat |
| 10 | GJWO-3 | JAU, Gujarat |
| 11 | Akola Safeda | PDKV, Akola, Maharashtra |
| 12 | Telagi White | Dharwad District, Karnataka |
| 13 | Arka Swadista | IIHR, Bengaluru, Karnataka |
| 14 | ArkaSona | IIHR, Bengaluru, Karnataka |
| 15 | ON-14-09 | IIHR, Bengaluru, Karnataka |
| 16 | ON-15-01 | IIHR, Bengaluru, Karnataka |
| 17 | ON-15-06 | IIHR, Bengaluru, Karnataka |
| 18 | ON-15-27 | IIHR, Bengaluru, Karnataka |
| 19 | ON-15-29 | IIHR, Bengaluru, Karnataka |
| 20 | ON-15-42 | IIHR, Bengaluru, Karnataka |
| 21 | ON-16-22 | IIHR, Bengaluru, Karnataka |
| 22 | ON-16-25 | IIHR, Bengaluru, Karnataka |
| 23 | ON-16-27 | IIHR, Bengaluru, Karnataka |
| 24 | ON-16-29 | IIHR, Bengaluru, Karnataka |
| 25 | ON-16-30 | IIHR, Bengaluru, Karnataka |
| 26 | ON-16-32 | IIHR, Bengaluru, Karnataka |
| 27 | PhuleSafed | MPKV, Rahuri, Maharashtra |
| 28 | Bengaluru Rose Onion | Chikkaballapura, Karnataka |

Results and Discussion

Vegetative parameters

In general, growth of all the cultivars increased gradually as the days advanced and they were significantly differed (Table

2). The genotypes ArkaSwadista, Pusa White Flat, Bengaluru Rose Onion, ON-15-29 and BhimaShweta were vigorous in growth in terms of plant height. Whereas, ON-16-22 was recorded minimum plant height of 59.48cm.

Table 2: The vegetative parameters of different genotypes of white onion

| Sl. No. | Genotypes | Plant height (cm) | Number of leaves | Leaf length (cm) | Leaf width (cm) | Duration (Days) |
|---------|------------------|-------------------|------------------|------------------|-----------------|-----------------|
| 1 | BhimaShweta | 67.72 | 10.60 | 59.29 | 1.21 | 115.50 |
| 2 | Bhima Shubra | 66.62 | 10.40 | 59.35 | 1.97 | 103.00 |
| 3 | BhimaSafeda | 67.20 | 10.60 | 57.07 | 2.03 | 106.00 |
| 4 | Pusa White Round | 63.32 | 10.00 | 59.95 | 2.03 | 98.00 |
| 5 | Pusa White Flat | 71.53 | 9.80 | 58.00 | 1.96 | 101.00 |
| 6 | BSS-255 | 65.65 | 10.45 | 62.70 | 2.03 | 95.00 |
| 7 | KSP-1120 | 67.80 | 9.80 | 58.80 | 2.05 | 107.00 |
| 8 | Pocha White | 63.76 | 9.90 | 61.90 | 2.03 | 109.00 |
| 9 | GWO-1 | 63.31 | 10.70 | 59.37 | 2.02 | 113.00 |
| 10 | GJWO-3 | 65.47 | 11.20 | 59.72 | 1.99 | 91.50 |
| 11 | Akola Safeda | 66.40 | 9.10 | 58.30 | 1.63 | 111.00 |
| 12 | Telagi White | 67.10 | 10.70 | 55.28 | 2.09 | 103.00 |
| 13 | Arka Swadista | 74.60 | 10.50 | 63.34 | 1.70 | 128.00 |
| 14 | ArkaSona | 67.49 | 10.50 | 59.54 | 1.80 | 98.00 |
| 15 | ON-14-09 | 65.70 | 9.60 | 58.93 | 1.56 | 105.00 |
| 16 | ON-15-01 | 61.43 | 9.60 | 59.76 | 1.59 | 96.00 |
| 17 | ON-15-06 | 66.07 | 10.30 | 60.08 | 1.89 | 100.00 |
| 18 | ON-15-27 | 66.73 | 10.70 | 59.88 | 2.06 | 99.00 |
| 19 | ON-15-29 | 70.50 | 9.20 | 56.86 | 2.01 | 108.00 |
| 20 | ON-15-42 | 67.25 | 10.40 | 64.82 | 2.25 | 106.00 |

| | | | | | | |
|----|-----------------------------|-------|-------|-------|------|--------|
| 21 | ON-16-22 | 59.48 | 10.00 | 58.94 | 1.97 | 95.00 |
| 22 | ON-16-25 | 64.54 | 9.73 | 57.91 | 2.05 | 109.00 |
| 23 | ON-16-27 | 65.37 | 10.20 | 60.75 | 2.12 | 107.00 |
| 24 | ON-16-29 | 63.17 | 9.30 | 59.54 | 1.92 | 115.00 |
| 25 | ON-16-30 | 66.04 | 9.50 | 58.83 | 1.73 | 104.00 |
| 26 | ON-16-32 | 62.79 | 10.00 | 58.53 | 2.17 | 119.00 |
| 27 | PhuleSafed | 65.17 | 10.38 | 56.73 | 2.16 | 117.00 |
| 28 | Bengaluru Rose Onion(Check) | 71.10 | 10.30 | 60.98 | 1.48 | 80.00 |
| | Mean | 66.19 | 10.12 | 59.47 | 1.91 | 104.96 |
| | SEm± | 2.01 | 0.35 | 1.36 | 0.08 | 1.32 |
| | CD at5% | 5.84 | 1.02 | 3.96 | 0.24 | 3.83 |

The maximum number of leaves were recorded in the genotypes GJWO-3(11.20), TelagiWhite(10.70), ON-15-27(10.70),BhimaSafeda(10.60) and BhimaShweta (10.60). Whereas, least number of leaves were noticed in ON-15-29(9.20).The maximum leaf length was revealed in ON-15-42 (64.82cm), ArkaSwadista(63.34 cm) and BSS-255 (62.70 cm). While, minimum leaf length was recorded in PhuleSafed (56.73 cm). The maximum leaf width was noticed in ON-15-42 (2.25 cm), it was on par with ON-16-32 (2.17cm) and PhuleSafed (2.16 cm) and minimum leaf breadth was observed in BhimaShweta (1.21 cm).

Among all the evaluated genotypes, Bengaluru Rose Onion was taken minimum days to harvest (80.00 days). While, the maximum days to harvest was taken by Arka Swadista (128.00 days) followed by ON-16-32 (119.00 days) and PhuleSafed (117.00 days).The variation in the number of leaves, leaf length and leaf width might be due to the inherent genetic make-up of the genotypes, which is some way influenced these characters through the activity of endogenous growth hormones. Similar variation in plant height, number of leaves, leaf length and leaf width among the genotypes were also observed earlier in onion by Umamaheswarappa *et al.* [11], Utagi *et al.* [12], Lakshmipathi [5], Tripathy *et al.* [9], Suhas [8] and Ratan *et al.* [6].

Yield and yield attributing traits

All yield and yield attributing traits were found to be significantly influenced by the different white onion genotypes (Table 3). The highest polar diameter of bulb was

noticed in genotype BhimaSafeda (6.91cm). Whereas, genotypes ON-14-09 (4.85cm) and Pusa White Flat (4.97cm) were recorded the lowest polar diameter of bulb. This may be due to combination of most of the morphological characters resulting in increasing the photosynthetic area and efficient translocation of food.The highest equatorial diameter of bulb was recorded in genotype Pocha White (7.56cm), which was on par with ON-14-09 (7.36cm), Pusa White Flat (7.18 cm) and Pusa White Round (7.17 cm).Whereas, Bengaluru Rose Onion (4.58 cm) and BhimaShweta (5.70cm) were noticed the least equatorial diameter of bulb. Similar finding was also reported byKhar *et al.* [4], Sharma [7], Yadav *et al.* [13], Hosmani *et al.* [3], Trivedi and Dhumal [10], Umamaheswarappa *et al.* [11], Tripathy *et al.* [9] and Lakshmipathi [5].

The maximum single bulb weight was registered in ON-14-09(113.40g) followed by GJWO-3 (105.55g). However, lowest average bulb weight was noticed in Bengaluru Rose Onion (24.45g).The maximum single bulb weight may be due to genotypic character, photosynthetic activity and nutrient availability to the plant, which directly influence on the bulb yield. The ten bulb weight was registered maximum in ON-14-09 (968.75g) followed by GJWO-3 (902.15g). While, lowest ten bulb weight was recorded in Bengaluru Rose Onion (209.25g) and Arka Swadista (445.74g) The variation in ten bulb weight among different genotype might be due to difference in the weight and size of individual bulb and this might be due to genetic character of genotype.The results were similar to Lakshmipathi [5] and Suhas [8].

Table 3: The yield parameters of different genotypes of white onion

| Sl. No | Genotypes | Polar diameter (cm) | Equatorial diameter (cm) | Average bulb weight (g) | Ten bulb weight (g) | Bulb yield (kg/plot) | Un-marketable bulb yield (t/ha) | Total bulb yield (t/ha) |
|--------|------------------|---------------------|--------------------------|-------------------------|---------------------|----------------------|---------------------------------|-------------------------|
| 1 | BhimaShweta | 6.29 | 5.70 | 63.38 | 553.60 | 8.18 | 5.00 | 27.22 |
| 2 | Bhima Shubra | 6.38 | 6.37 | 75.44 | 727.80 | 10.54 | 1.57 | 35.11 |
| 3 | BhimaSafeda | 6.91 | 5.91 | 100.60 | 839.15 | 11.37 | 1.30 | 37.85 |
| 4 | Pusa White Round | 6.61 | 7.17 | 66.27 | 702.95 | 10.01 | 1.84 | 33.32 |
| 5 | Pusa White Flat | 4.97 | 7.18 | 70.12 | 690.35 | 6.87 | 1.82 | 22.88 |
| 6 | BSS-255 | 6.18 | 6.70 | 51.95 | 512.45 | 6.29 | 4.24 | 20.93 |
| 7 | KSP-1120 | 5.34 | 6.55 | 78.30 | 546.60 | 8.61 | 2.64 | 28.68 |
| 8 | Pocha White | 6.20 | 7.56 | 61.35 | 822.95 | 7.42 | 1.28 | 24.72 |
| 9 | GWO-1 | 5.41 | 6.28 | 93.05 | 766.05 | 8.47 | 1.20 | 28.20 |
| 10 | GJWO-3 | 6.16 | 7.01 | 105.55 | 902.15 | 11.82 | 2.07 | 39.37 |
| 11 | Akola Safeda | 6.00 | 6.37 | 66.75 | 604.75 | 8.37 | 1.08 | 27.89 |
| 12 | Telagi White | 6.25 | 6.21 | 70.97 | 835.05 | 9.30 | 1.38 | 30.96 |
| 13 | Arka Swadista | 6.13 | 5.20 | 50.10 | 445.74 | 7.57 | 2.06 | 25.19 |
| 14 | ArkaSona | 5.70 | 6.12 | 56.85 | 576.20 | 9.15 | 1.34 | 30.48 |
| 15 | ON-14-09 | 4.85 | 7.36 | 113.40 | 968.75 | 13.25 | 4.50 | 44.12 |
| 16 | ON-15-01 | 5.65 | 6.20 | 70.60 | 792.75 | 8.90 | 1.23 | 29.62 |
| 17 | ON-15-06 | 6.33 | 6.29 | 59.35 | 500.25 | 6.71 | 2.37 | 22.33 |
| 18 | ON-15-27 | 5.77 | 5.95 | 65.80 | 713.15 | 7.57 | 4.16 | 25.20 |
| 19 | ON-15-29 | 6.70 | 6.37 | 90.00 | 510.15 | 8.55 | 1.31 | 28.47 |
| 20 | ON-15-42 | 6.21 | 7.02 | 96.00 | 882.48 | 10.75 | 0.80 | 35.80 |
| 21 | ON-16-22 | 5.57 | 6.60 | 72.80 | 777.85 | 6.77 | 0.95 | 22.55 |
| 22 | ON-16-25 | 5.78 | 6.05 | 88.05 | 839.15 | 7.04 | 0.71 | 23.46 |

| | | | | | | | | |
|----|-----------------------------|------|------|-------|--------|-------|------|-------|
| 23 | ON-16-27 | 6.02 | 6.56 | 72.40 | 600.35 | 8.83 | 1.88 | 29.41 |
| 24 | ON-16-29 | 6.23 | 6.49 | 92.10 | 716.10 | 9.39 | 1.26 | 31.28 |
| 25 | ON-16-30 | 5.86 | 6.53 | 67.80 | 853.70 | 6.03 | 5.96 | 20.09 |
| 26 | ON-16-32 | 6.54 | 6.45 | 88.60 | 775.75 | 10.81 | 0.82 | 35.99 |
| 27 | PhuleSafed | 6.52 | 6.20 | 50.65 | 458.80 | 6.89 | 2.34 | 22.94 |
| 28 | Bengaluru Rose Onion(Check) | 4.36 | 4.58 | 24.45 | 209.25 | 5.63 | 0.85 | 20.42 |
| | Mean | 5.96 | 6.39 | 73.67 | 683.01 | 8.61 | 2.07 | 28.73 |
| | SEm± | 0.21 | 0.23 | 7.17 | 25.84 | 0.83 | 0.28 | 2.73 |
| | CD at 5% | 0.61 | 0.67 | 20.80 | 74.98 | 2.24 | 0.80 | 7.92 |

The bulb yield per plot was found to be highest in genotype ON-14-09 (13.25 kg/plot), which was on par with GJWO-3 (11.82 kg/plot) followed by BhimaSafeda (11.37 kg/plot), Whereas, Bengaluru Rose Onion (5.63 kg/plot) and BSS-255 (6.29 kg/plot) were recorded the lowest yield. The variation in the bulb yield per plot could be attributed from weight and size of different onion genotypes this might be contributed towards the production of higher bulb yield per plot. Similar finding was also reported by Khar *et al.* [4], Sharma [7], Lakshmipathi [5] and Suhas [8].

The minimum un-marketable tuber yield was registered in ON-16-25 (0.71 t/ha) followed by ON-15-42 (0.80 t/ha). However, maximum un-marketable bulb yield was documented in BhimaShweta (5.00 t/ha). The highest un-marketable bulb yield in BhimaShweta is due to its genetical character and smaller size bulb production, damaged and rotten bulbs, which indirectly contributed on production of marketable bulb yield. The results are in accordance with the findings of Lakshmipathi [5], Suhas [8] and Ratan *et al.* [6].

Among white onion genotypes, ON-14-09 recorded the maximum estimated total bulb yield per hectare (44.12t/ha), which was on par with GJWO-3 (39.37 t/ha) followed by BhimaSafeda (37.85 t/ha). While, Bengaluru Rose Onion and BSS-255 were registered the minimum total bulb yield of 20.41 and 20.93 t/ha, respectively. A significant difference may be due to genetical character of individual cultivars. The highest bulb yield production per hectare might be due to genetic yield potential of the variety. This may also be contributed by higher individual bulb weight and size which might resulted in highest bulb yield. The results are in accordance with findings of Umamaheswarappa *et al.* [11], Tripathy *et al.* [9], Utagi *et al.* [12], Lakshmipathi [5] and Suhas [8].

Conclusion

In the present investigation, the results showed a significant difference among the genotypes for all the traits. The genotype ArkaSwadista recorded maximum plant height and leaf length. Whereas, ON-14-09 and GJWO-3 were performed better and produced maximum average bulb weight, ten bulb weight, bulb yield per plot and yield per hectare. Therefore from the study, it was concluded that the genotypes GJWO-3 and ON-14-09 were found better with respect to bulb yield production in *Rabi* season.

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