



ISSN (E): 2277-7695
 ISSN (P): 2349-8242
 NAAS Rating: 5.23
 TPI 2022; 11(8): 546-550
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www.thepharmajournal.com
 Received: 23-05-2022
 Accepted: 29-06-2022

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Evaluation of different genotypes of Onion (*Allium cepa* L.) for growth and yield attributing characters under Chhattisgarh plains

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Abstract

Onion (*Allium cepa* L.) has been valued as a food and a medicinal plant since ancient times. It is widely cultivated, second only to tomato, and is a vegetable bulb crop known to most cultures and consumed worldwide (FAO, 2012) [6]. It is a short duration horticultural crop (Brewster, 1990) [4] grown at low latitudes. It is commonly known as “Queen of the kitchen,” It is also used in different forms of processed food, e.g. pickles, powder, paste, and flakes, and it is known for its medicinal values. An investigation was conducted in *rabi* season of 2021-22 at the Research and Instructional Farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), using twenty three different onion genotypes in a Randomized Completely Block Design with three replications. The genotypes RVB-21-20 and RVB-21-16 had the highest bulb yield, marketable bulb yield, average bulb weight, polar diameter, and plant establishment percentage among the genotypes evaluated, whereas genotype RVB-21-24 had the highest plant height, leaf length, and equatorial diameter of the bulb. Maximum leaf count, collar height, and rotten bulb percentage were recorded in RVA-21-19, RVB-21-12, and RVA-21-03, respectively. Maximum collar girth was reported in RVA-21-03. RVC-21-28 recorded the highest dry matter content, respectively.

Keywords: Genotypes, onion, growth, yield, quality parameters etc.

Introduction

The Onion (*Allium cepa* L.) is one of the most important vegetable crops grown all over the world and is said to be native of Central Asia and Mediterranean region (McCullum, 1976) [10]. It is a monocot and belongs to the family Alliaceae, sub-family Allioideae, and order Asparagales having chromosome number $2n=2x=16$. Onion contains an enzyme known as “Allinase”. The pungency in onion is due to volatile oil as *Allyl-propyl disulphide* ($C_6H_{12}S_2$). The colour of the outer skin of onion bulbs is due to quercetin. Anti-fungal factor in onion is phenolics compound known as “catechol”. Tear inducing action in onion by lachrymator factor i.e. 1-Propenyl sulfonic acid. (Kumar *et al.*, 2019) [9] Onion is a very good source of vitamin C, B6, biotin, Chromium, Vanadium, Calcium and dietary fibre. In addition, it contain a good amount of folic acid and vitamin B1 and K. Onion bulb contains 86.6 gm moisture and food value per 100 gm of edible portion is protein (1.2 gm), fat (0.1 gm), mineral matter (0.4 gm), fibre (0.6 gm), carbohydrate (11.1 gm), calories (50 Kcal), Phosphorus (50 mg), Potassium (127 mg), Calcium (46.9 mg), Magnesium (16 mg), Iron (0.6 mg), Sodium (4 mg), Copper (0.18 mg), vitamin C (119 mg), niacin (0.4 mg), thiamine (0.08 mg), riboflavin (0.01 mg). (Pareek *et al.*, 2017) [12]. Onions are grown in an area of 3.65 million hectares throughout the world, yielding 73.23 million tonnes. India, as the world's largest onion producer, produces 20.13 million tonnes from 1.19 million hectares, with a yield of 17.34 tonnes per hectare. (Anon., 2019) [1]. In India, Maharashtra is leading state in area (38.88%) and in production (30.22%) with a productivity of 12.53 tonnes/ha, followed by Karnataka, Gujarat, Madhya Pradesh, Bihar, Andhra Pradesh, Rajasthan, Haryana, Tamil Nadu, Orissa, Telangana. (Rathod *et al.*, 2021) [13]. In Chhattisgarh, onion is grown on 25.542 thousand hectare area with a production of 418.119 thousand MT with productivity of 16.84 tonnes per hectare. (Anon., 2019-20) [2].

Methods and Materials

The research trial was carried out at Horticulture Research cum Instructional Farm, Department of Vegetable Science, IGKV, Raipur (C.G.) during *rabi* season of 2021-2022.

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The experiment was laid out in Randomized Block Design (RBD) having three replications. The experimental material consisted of 23 genotypes of onion maintained by the Department of Horticulture, IGKV, Raipur were used as planting material. Healthy onion seedlings of all 23 genotypes were planted and uniformly maintained all the cultural practices adopted in onion cultivation. All the experimental plants were provided same cultural practices i.e., fertilizer application, irrigation, earthing-up, weed management and plant protection measures during whole period of investigation. Under the growth, yield and quality parameters of onion, the observations recorded for the following parameters namely plant establishment percentage, plant height, leaf length, leaf width, double bulbs percentage, number of leaves per plant, collar girth, collar height, polar diameter, equatorial diameter of bulb, TSS, duration of maturity, average weight of bulb, bulb, rotting percentage of bulbs, marketable bulb yield, total bulb yield, shape and colour of bulb were recorded. The observation on various characters were recorded and subjected to statistical analysis to test the level of significance as per the method by Gomez and Gomez (1984)^[7].

Results and Discussion

Following is a summary of the trial's findings regarding various onion growth, yield, and quality parameters:

Plant establishment (%)

The range for the average plant establishment percentage is 39.77 to 76.77 percent. Genotype RVB-21-20 had the highest plant establishment percentage (76.77%), followed by genotypes RVC-21-36 (71.00 %), RVB-21-26 (67.78 %) and RVC-21-36 (66.11 percent). However, genotype RVC-21-44 had the lowest plant establishment percentage, at 39.77 %. Comparable data also recorded by Dewangan and Sahu (2011)^[5] who reported that the highest plant establishment percent in genotype BKHO-1007 (66.33%).

Plant height (cm)

The data on average plant height was collected between 43.47 cm and 56.00 cm. According to the results, RVB-21-24 reported the maximum plant height (56.00 cm), which was followed by RVB-21-20 (52.87 cm), RVA-21-15 (52.53 cm), and RVA-21-01 (51.67 cm), all of which were substantially similar. While RVC-21-28 had the minimum plant height (54.50 cm). In conformity of this, similar observation was reported by Singh *et al.* (2011)^[16], Dewangan and Sahu (2011)^[5], Hirave *et al.* (2015)^[8].

Number of leaves per plant

The average number of leaves per plant was observed between 7.67 and 10.70. The data shows that genotypes RVB-21-12 (10.70) and RVA-21-15 (10.60), which were statistically equivalent to each other, produced the largest number of leaves per plant, followed by genotypes RVC-21-40 (10.47), RVA-21-09 (10.40) and genotype RVC-21-34 (10.33). On the other hand, the genotype RVC-21-32 had the least leaves per plant (7.67). In onion investigations, Dewangan and Sahu (2011)^[5] and Tripathy *et al.* (2016)^[18] also reported conclusions that have been similar.

Collar height (cm)

The average data of collar height were depicted in table 4.1

which reveals that the maximum collar height was observed in genotype RVA-21-19 (9.03 cm) which was statistically at par with RVB-21-20 (8.73 cm) and RVA-21-03 (8.60) while the minimum collar height (5.93 cm) was observed in RVB-21-14. Similar findings were also recorded by Dewangan and Sahu (2011)^[5] which stated that the maximum collar height (17.03 cm) was recorded in BKHO-1010.

Collar girth (cm)

The average data of collar height were shown in table 4.1 which concluded that the maximum collar girth was observed in genotype RVA-21-03 (6.20 cm) which was statistically at par with RVA-21-05 (5.75 cm) and RVA-21-01 (5.48 cm) while the lowest collar girth (3.62 cm) was observed in RVC-21-28. Similar findings were revealed in Sharma *et al.* (2012)^[15] investigated that CSKO-1119 was produced maximum collar girth (6.20 cm).

Leaf length (cm)

The average leaf length data were recorded in genotype RVB-21-24 had the highest leaf length (42.18 cm), which were statistically at par with RVC-21-36 (40.40 cm) and RVC-21-34 (39.47 cm), however genotype RVC-21-28 (26.60 cm) had the lowest leaf length. Similar results were also reported by Sahu *et al.* (2017)^[14] stated that the maximum leaves length (55.36 cm) was noted in ON16-08.

Leaf width (cm)

The average data of leaf width were ranging between 1.05 and 0.75 with an overall mean of 0.90, where among all genotypes the highest leaf width (1.05 cm) is measured in genotype RVA-21-07 which were statistically at par with RVC-21-38 (1.00 cm) and RVC-21-36 (0.95 cm). Whereas the lowest leaf width (0.75 cm) is measured in genotype RVA-21-03. Similar findings were also reported by Singh *et al.* (2020)^[17] recorded the highest thickness of leaves (1.05 cm) in genotype RVB-20-02.

Average weight of bulbs (g)

The data of average weight of bulb ranging from 105.40 to 78.61. The maximum average weight of bulb (105.40 g) exhibited in RVB-21-20 which was statistically at par with RVB-21-16 (95.24 g) and RVB-21-26 (90.64 g). While the minimum average weight of bulb (78.61 g) is seen in RVC-21-44. Similar discoveries were also recorded by Sahu *et al.* (2017)^[14] that the highest average fresh bulb weight (195.63 g) were observed in BKHO-1002.

Polar diameter of bulb (cm)

The average data of polar diameter of bulb were ranging between 10.04 and 8.93 where among all the genotype the maximum polar diameter of bulb (10.04 cm) was recorded by RVB-21-20 which were statistically at par with RVB-21-16 (9.71 cm), RVB-21-26 (9.57 cm) and RVA-21-03 (9.49 cm). While minimum polar diameter of bulb (8.35 cm) was recorded by RVC-21-44. Similar data were also observed by Dewangan and Sahu (2011)^[5] revealed that BKHO-1002 recorded maximum polar diameter of bulb.

Equatorial diameter of bulb (cm)

The average data for equatorial diameter of bulb were ranging from 10.03 to 8.35 cm. Among all the genotypes, the highest equatorial diameter of bulb (10.03 cm) was produced by

RVB-21-24 which were statistically at par with rvb-21-20 (9.82 cm), RVA-21-19 (9.81 cm) and RVB-21-26 (9.80 cm). Whereas the least equatorial diameter of bulb (8.35 cm) was produced by RVC-21-36. Similar information were also revealed by Mohanty *et al.* (2001) [11] also discovered that Arka Niketan gave the highest equatorial diameter of bulb (6.18 cm).

Double bulbs (%)

In the present investigation, none of the genotype recorded double bulb in any treatment.

Rotting of bulbs (%)

The average data of rotten bulb percentage ranging from 2.54 to 0.36 where, the maximum rotting percentage of bulb (2.54 %) was recorded in the genotype RVA-21-19 which were statistically at par with RVA-21-15 (2.46 %), RVA-21-09 (1.84 %) and RVA-21-01 (1.82 %). However, the least percentage of rotten bulb (0.36 %) were recorded in RVB-21-26.

Bulb colour

The observation for colour of bulbs of different genotype by simple visualization is presented through table 2. It is clear from the table that the colour of bulbs varies from genotype to genotype, it is different as red, light red, light orange, light pink and dark red.

Bulb shape

The observation for shape of bulbs of different genotype by simple visualization is presented through table 2. It is clear from the table that the shape of bulbs varies from genotype to genotype, it is different as globular round, flat and oval.

Total soluble solids (%)

The average data for total soluble solid were ranging between 11.95 and 8.52 with an overall mean of 10.28. The highest total soluble solid (11.95 %) is recorded by the RVC-21-34 which was statistically at par with RVC-21-32 (11.84 %) and RVC-21-40 (11.64 %). While the least total soluble solid (8.52 %) was observed by the genotype RVA-21-15. Similar data were reported by Dewangan and Sahu (2014) [5] in genotype BKHO-1007 (13.62 %). Sharma *et al.* (2012) [14] discovered that ASKO-1106 (15.56 %) recorded maximum total soluble solids.

Day to taken to maturity

The data for days taken to maturity is represented in table 4.1 and were ranging from 128.00 to 100.33 days. The RVC-21-38 takes the determiner days to reach maturity (128 days) which were statistically at par with RVC-21-44 (127 days), RVC-21-40 (126 days). While RVB-21-20 took the least days

for maturity (100.33 days). Similar data also reported by Singh *et al.* (2020) [17] recorded the maximum duration from transplanting to harvesting (139 days) in genotype RVB-20-04.

Dry matter content (%)

Percentage of dry matter content varies significantly among all the genotypes. The average data for percent dry matter content is illustrated in table 4.1 which were ranging from 12.59 to 9.09 with an overall mean of 10.57. The maximum percent dry matter content (12.59 %) was recorded by RVC-21-28 which was statistically at par with RVC-21-40 (11.79 %) and RVB-21-26 (11.52 %). Whereas among all the genotype the least percent dry matter content (9.09 %) was recorded by RVA-21-03. Similar findings were recorded by Kumar *et al.* (2019) [9] who stated that AW-O-18 MS (13.71 %) recorded the maximum percent dry matter content.

Marketable bulb yield (q/ha)

The average data of total marketable bulb yield quintal per hectare ranged from 226.58 to 103.75 q/ha and is showed in table 4.1. The highest marketable bulb yield (226.58 q/ha) was recorded by the RVB-21-20 which were statistically at par with RVC-21-36 (194.83 q/ha) and RVC-21-38 (186.58 q/ha) Whereas the minimum total bulb yield (103.75 q/ha) was recorded by RVC-21-44. Similar finding was also reported by Singh *et al.* (2011) who reported that the marketable bulb yield was in range from 100.50 to 391.3 q/ha. Similarly, Hirave *et al.* (2015) [8] also reported that the Bhima Red (328.57 q/ha) finding the maximum marketable yield per hectare.

Total yield (q/ha)

The average data of total bulb yield quintal per hectare were ranging from 263.49 to 196.53 q/ha and is depicted in table 4.1. The highest total bulb yield (263.49 q/ha) was produced by the genotype RVB-21-20 which were statistically at par with RVB-21-16 (237.10 q/ha) and RVB-21-26 (226.60 q/ha). Whereas the minimum total bulb yield (196.53 q/ha) was produced by genotype RVC-21-44. In this present study, genotype Similar data were also discovered by Attri *et al.* (2015) [3] who reported that the total bulb yield within range from 171.6 q/ha to 313.5 q/ha in genotype AVT-I-BLRO-1229 and AVT-II-CLRO-1275 respectively. Similarly, Singh *et al.* (2011) [16] reported total yield in range between 196.5 to 411.7 q/ha.

Conclusion

In this present investigation, it can be concluded that among all the genotype RVB-21-20 and RVB-21-16 performs outstanding and found suitable for growing in Chhattisgarh plains.

Table 1: Growth, yield and quality parameters of different onion (*Allium cepa* L.) genotypes under Chhattisgarh plain region

| Character | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|------------|-------|-------|------|-------|-------|------|-------|-------|-------|-------|-------|-------|--------|-------|--------|--------|
| RVA-21-01 | 51.67 | 10.2 | 8.37 | 5.48 | 35.42 | 0.88 | 10.49 | 1.82 | 85.73 | 9.38 | 9.76 | 50.89 | 121.33 | 9.24 | 153.58 | 214.33 |
| RVA-21-03 | 49 | 9.4 | 8.6 | 6.2 | 34.47 | 0.75 | 9.89 | 1.58 | 86.86 | 9.49 | 9.68 | 48.11 | 124.67 | 9.09 | 145.33 | 217.15 |
| RVA-21-05 | 48.53 | 9.1 | 7.43 | 5.75 | 35.14 | 0.94 | 8.77 | 1.43 | 81.57 | 9.15 | 8.78 | 53.66 | 119.33 | 9.91 | 172.92 | 203.93 |
| RVA-21-07 | 48.8 | 10.13 | 8.32 | 5.09 | 36.45 | 1.05 | 9.06 | 1.32 | 83.44 | 9.26 | 9.79 | 56.22 | 122.33 | 10.67 | 166 | 208.6 |
| RVA-21-09 | 49.13 | 10.4 | 7.5 | 5.45 | 34.47 | 0.85 | 8.8 | 1.84 | 82.27 | 9.18 | 9.71 | 51.88 | 117.67 | 10.73 | 154.17 | 205.68 |
| RVA-21-15 | 52.53 | 10.6 | 6.82 | 5.37 | 36.83 | 0.89 | 8.52 | 2.46 | 83.83 | 9.27 | 9.5 | 57.22 | 124.33 | 11.09 | 184.58 | 209.58 |
| RVA-21-19 | 51.27 | 8.72 | 9.03 | 5.41 | 31.67 | 0.93 | 8.99 | 2.54 | 87.54 | 9.54 | 9.81 | 50.44 | 115.67 | 9.74 | 168.67 | 218.85 |
| RVC-21-42 | 46 | 10.7 | 7.2 | 5.27 | 32.93 | 0.94 | 10.73 | 0.81 | 84.26 | 9.32 | 8.45 | 50.33 | 116.33 | 11.08 | 129.5 | 210.64 |
| RVB-21-14 | 48.2 | 9.2 | 5.93 | 4.83 | 29.47 | 0.91 | 10.96 | 1.04 | 80.66 | 9.13 | 9.66 | 40.11 | 116 | 10.88 | 116.58 | 201.65 |
| RVB-21-16 | 46.9 | 9.33 | 6.73 | 3.91 | 35.23 | 0.87 | 10.36 | 1.4 | 95.24 | 9.71 | 9.79 | 40 | 120 | 10.79 | 133.25 | 237.1 |
| RVB-21-20 | 52.87 | 8.56 | 8.73 | 5.23 | 39.04 | 0.88 | 10.39 | 0.38 | 105.4 | 10.04 | 9.82 | 76.77 | 100.33 | 10.03 | 226.58 | 263.49 |
| RVB-21-22 | 52.87 | 9.8 | 8.07 | 5.03 | 28.66 | 0.93 | 10.57 | 0.6 | 81.2 | 9.14 | 9.56 | 53.55 | 115.67 | 9.73 | 132 | 202.99 |
| RVB-21-24 | 56 | 9.53 | 7 | 4.59 | 42.18 | 0.85 | 10.03 | 1.06 | 85.58 | 9.37 | 10.03 | 49.66 | 115 | 10.17 | 163.33 | 213.94 |
| RVB-21-26 | 51.67 | 9.6 | 5.95 | 4.61 | 35.67 | 0.9 | 10.04 | 0.36 | 90.64 | 9.57 | 9.8 | 67.78 | 119.67 | 11.52 | 158.42 | 226.6 |
| RVC-21-28 | 43.47 | 10 | 7.2 | 3.62 | 26.6 | 0.92 | 10.8 | 0.53 | 79.37 | 8.96 | 9.6 | 44.22 | 123.27 | 12.59 | 101.08 | 198.42 |
| RVC-21-30 | 45.13 | 9.8 | 8.47 | 4.61 | 35.07 | 0.96 | 10.59 | 0.74 | 79.87 | 9.1 | 9.75 | 58.44 | 124.33 | 10.8 | 160.33 | 199.67 |
| RVC-21-32 | 49 | 7.67 | 7.63 | 4.56 | 32.8 | 0.89 | 11.84 | 0.44 | 80.19 | 9.11 | 9.36 | 62.66 | 125 | 10.57 | 183.67 | 200.48 |
| RVC-21-34 | 52.53 | 10.33 | 6.87 | 4.31 | 39.47 | 0.9 | 11.95 | 0.61 | 84.47 | 9.34 | 9.41 | 66.11 | 119 | 9.77 | 183.5 | 211.17 |
| RVC-21-36 | 52.47 | 9.8 | 7.97 | 5.06 | 40.4 | 0.95 | 9.97 | 0.87 | 81.82 | 9.16 | 8.35 | 71 | 123 | 10.39 | 194.83 | 204.54 |
| RVC-21-38 | 51.6 | 9.57 | 6.53 | 4.47 | 38.27 | 1 | 11.17 | 1.26 | 86.01 | 9.42 | 9.72 | 63.55 | 128 | 10.63 | 186.58 | 215.03 |
| RVC-21-40 | 49.33 | 10.47 | 7.67 | 4.69 | 31.33 | 0.83 | 11.64 | 1.61 | 86.6 | 9.45 | 9.55 | 55.55 | 126.33 | 11.79 | 155.5 | 216.51 |
| RVC-21-42 | 48.67 | 10.27 | 8.47 | 4.57 | 34.8 | 0.89 | 10.65 | 1.39 | 85 | 9.35 | 9.1 | 49.33 | 125 | 11.02 | 137.67 | 212.51 |
| RVC-21-44 | 45.93 | 9.73 | 8.2 | 4.63 | 32.93 | 0.91 | 10.17 | 0.92 | 78.61 | 8.93 | 9.45 | 39.77 | 127.33 | 10.96 | 103.75 | 196.53 |
| Grand mean | 49.72 | 9.69 | 7.6 | 4.9 | 34.75 | 0.9 | 10.28 | 1.17 | 85.05 | 9.32 | 9.5 | 54.66 | 120.42 | 10.57 | 157.04 | 212.58 |
| Sem | 1.89 | 0.41 | 0.37 | 0.32 | 2.14 | 0.03 | 0.39 | 0.12 | 4.37 | 0.19 | 0.15 | 5.66 | 4.43 | 0.55 | 12.9 | 10.86 |
| Sed | 2.67 | 0.58 | 0.53 | 0.46 | 3.03 | 0.05 | 0.55 | 0.17 | 6.18 | 0.26 | 0.21 | 8.01 | 6.26 | 0.77 | 18.25 | 15.36 |
| CV (%) | 6.58 | 7.31 | 8.49 | 11.44 | 10.66 | 6.57 | 6.54 | 18.01 | 8.9 | 3.46 | 2.74 | 17.95 | 6.37 | 8.39 | 14.23 | 8.85 |
| CD | 5.39 | 1.17 | 1.06 | 0.92 | 6.1 | 0.1 | 1.11 | 0.35 | 12.45 | 0.53 | 0.43 | 16.14 | 12.62 | 1.46 | 36.78 | 30.97 |

1. Plant Height (cm) 5. Leaf Length(cm) 9. Average weight of bulb (g) 13. Days taken to Maturity
2. Number of leaves/plant 6. Leaf Width (cm) 10. Polar diameter of bulb (g) 14. Dry Matter Content (%)
3. Collar Height (cm) 7. Total Soluble Solid (brix) 11. Equatorial diameter of bulb (g) 15. Marketable Bulb Yield (q/ha)
4. Collar Girth (cm) 8. Rotten Bulb (%) 12. Plant Establishment (%) 16. Total Bulb Yield (q/ha)

Table 2: Morphological characteristics (colour and shape) of different genotype of *rabi* onion under Chhattisgarh plain region

| Entry code | Colour | shape |
|------------|-----------------------------|-------------------------|
| RVA-21-01 | Light pink | Globular round |
| RVA-21-03 | Light pink and white | Globular round |
| RVA-21-05 | Light orange | Flat round |
| RVA-21-07 | Light orange | Flat and globular round |
| RVA-21-09 | Pink | Globular round |
| RVA-21-15 | Pink and Light orange | Globular round |
| RVA-21-19 | Pink and Light orange | Globular round |
| RVC-21-42 | Pink and Brownish | Globular round |
| RVB-21-14 | Light pink and Light orange | Globular round |
| RVB-21-16 | Light pink | Globular round |
| RVB-21-20 | Dark and Light red | Globular round |
| RVB-21-22 | Dark and Light red | Flat and globular round |
| RVB-21-24 | Dark pink | Globular round |
| RVB-21-26 | Dark pink and Light orange | Globular round |
| RVC-21-28 | Dark red and pink | Globular round |
| RVC-21-30 | Dark red and pink | Flat round |
| RVC-21-32 | Light pink | Globular round |
| RVC-21-34 | Dark and light pink | Globular round |
| RVC-21-36 | Dark pink and orange | Globular round |
| RVC-21-38 | Dark and light pink | Globular round |
| RVC-21-40 | Light pink and Light orange | Globular round |
| RVC-21-42 | Light pink and Light orange | Globular round |
| RVC-21-44 | Dark red and pink | Flat and globular round |

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