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Evaluation of different onion (*Allium cepa* L.) genotypes for growth, yield and quality parameters under Chhattisgarh plain region

Dharmendra Singh, Jitendra Trivedi, PK Sharma and Yugalkishor Lodhi

Abstract
Onion (*Allium cepa* L.) belongs to the family Alliaceae, is an herbaceous bulbous plant with biennials for seed production and annual for bulb production. Onion is a very good source of vitamin C, K, B_1, B_6, folic acid, chromium, dietary fiber, calcium, biotin and vanadium. A research trial was conducted at Horticulture Research cum Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *rabi* season of 2020-2021 to evaluate different onion genotypes for growth, yield and quality parameters in the plain region of Chhattisgarh. The experimental was laid out in Randomized Block Design (RBD) having three replications. Results regarding the growth, yield and quality parameters of onion revealed that the highest values recorded are plant establishment % (in genotype RVA-20-01), plant height, leaf length (in genotype RVB-20-08), thickness of leaves, double bulbs percentage (in genotype RVB-20-02), number of leaves per plant, pseudo stem thickness, polar diameter (in genotype RVB-20-17), equatorial diameter of bulb (in genotype RVB-20-08), TSS (in genotype RVA-20-09), duration of maturity (RVB-20-04), thickness of bulb, bulbs weight, bolting percentage, rotting percentage of bulbs (in genotype RVB-20-10), fresh weight of bulbs, marketable bulb yield, total bulb yield (in genotype RVB-20-11), A grade bulbs (in genotype RVB-20-08), B grade bulbs (in genotype RVB-20-06), C grade bulbs (in genotype RVB-20-09).

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

Introduction
Onion (*Allium cepa* L.) belongs to the family Alliaceae having chromosome number 2n = 16 is an important group of crops produce worldwide. It is native of Central Asia and Mediterranean region. It is an herbaceous bulbous plant with biennials for seed production and annual for bulb production.

Onion is a very good source of vitamin C, K, B_1, B_6, folic acid, chromium, dietary fiber, calcium, biotin and vanadium. Onion bulb contains 86.6 gm moisture and food value per 100 gm of edible portion is carbohydrate (11.1 gm), protein (1.2 gm), mineral matter (0.4 gm), fat (0.1 gm), fiber (0.6 gm), phosphorus (50 mg), calories (50 Kcal), potassium (127 mg), magnesium (16 mg), calcium (46.9 mg), iron (0.6 mg), copper (0.18 mg), sodium (4 mg), vitamin C (119 mg), thiamine (0.08 mg), niacin (0.4 mg), folic acid (15 mg) and riboflavin (0.01 mg) etc.

Onion is used as raw salad, bulbs and leaves are used as vegetable, pickle, culinary, soups, cooked, fried, dried or roasted as vegetable cum spice. “Onion is usually called “Queen of the kitchen” due to Its highly valuables flavor, smell aroma, unique taste, and the medicinal properties of its flavor compounds.

In India it is cultivated in an area of 1315.24 thousand hectares, giving the total production of 23,245.55 thousand MT with the productivity of 16.78 tons per hectare and sharing 32% of the country's total onion production. (Anon, 2019-20) [1]. In Chhattisgarh, onion is grown on 25,332-hectare area with a production of 4, 08,741 MT (Anon, 2019-20) [1] with the productivity of 16.69 tonnes/ha (Anon, 2017-18) [2].

The improvement of every crop is proportional to the significant of its genetic variability present in the genotypes. Availability of adequate genetic variability is most crucial in a crop improvement programme in particular region depends upon the variability present in this region and knowledge of the various components. The amount of genetic variability found in the experimental material is a fundamental need for the successful breeding programme.

Genetic architecture has great influence on growth, yield and quality parameters of onion. Different onion genotypes having wide variation in their yield potential and quality attributes

can be involved in studies of their performances on growth and yield under different agro-climatic. The soil and climate conditions of our state are quite suited for cultivation of onion. Due to suitability and high returns, the area of onion in Chhattisgarh is increasing day by day. Hence, keeping above facts in view an experiment was conducted to study the performance of different genotypes of onion under for growth, yield and quality parameters under plain region of Chhattisgarh.

Methods and Materials

The research trial was carried out at Horticulture Research cum Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *rabi* season of 2020-2021. The soil of experimental field was clay-loam having pH 7.09. The experiment was laid out in Randomized Block Design (RBD) having three replications. The experimental material consisted of 16 genotypes of onion maintained by the Department of Horticulture, IGKV, Raipur were used as planting material. Healthy onion seedlings of all the 16 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, gap filling, 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 variables namely plant establishment %, plant height, leaf length, thickness of leaves, double bulbs percentage, number of leaves per plant, pseudostem thickness, polar diameter, equatorial diameter of bulb, TSS, duration of maturity, thickness of bulb, bulbs weight, bolting percentage, rotting percentage of bulbs, fresh weight of bulbs, marketable bulb yield, total bulb yield, A grade bulbs, B grade bulbs, C grade bulbs, 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 method by Gomez and Gomez (1984) [9].

Results and Discussion

The results of trial pertaining to various aspects of growth, yield and quality parameters of onion are summarized as follows:

Plant Establishment (%)

The data of average plant establishment percentage noted within the range from 62.25 to 95.97%. The highest plant establishment percentage (95.97%) was noted in genotype RVA-20-01 followed by RVB-20-10 (95.87%), RVB-20-11 (94.67%) and RVB-20-06 (94.28%). Whereas, the minimum plant establishment percentage (62.25%) was recorded in genotype RVA-20-07. Comparable data also recorded by Sahu and Dewangan (2014) who reported that the highest plant establishment percent in genotype BKHO-1007 (66.33%).

Plant height (cm)

The data of average plant height recorded within the range between 54.50 cm to 76.76 cm. The data showed that the longest plant height (76.77 cm) was reported in RVB-20-08 followed by RVA-20-14 (73.70 cm), RVB-20-17 (71.50 cm) and RVB-20-11 (71.17 cm) and were statistically at par with each other. While, the shortest plant height (54.50 cm) was recorded in genotype RVA-20-09. In conformity of this, similar observation was reported by Singh *et al.* (2011), Dewangan *et al.* (2012) [5], Hirave *et al.* (2015) [10], Das *et al.* (2017) [4] etc.

Number of leaves per plant

The data of average number of leaves per plant recorded within the range from 7.86 to 12.83. The data reveals that genotypes RVB-20-17 (12.83) produced highest number of leaves per plant followed by RVB-20-10 (11.8), RVB-20-011 (10.60), RVB-20-13 (10.5), RVB-20-08 (10.46), which were statistically at par with each other. Whereas, that the least number of leaves per plant (7.86) was recorded in genotype RVA-20-09. Similar data also reported by Dewangan *et al.* (2012) [5], Tripathy *et al.* (2016) [13], Dinkar and Sharma (2017) [6], Dubey *et al.* (2019) [7] in onion.

Leaf length (cm)

The data of average leaf length recorded within the range between from 50.83 to 62.7 cm and overall mean of 56.42 cm. The highest length of leaves (62.7 cm) was recorded in genotype RVB-20-08 followed by RVB-20-02 (62.03 cm), RVB-20-17 (61.58 cm) and RVA-20-14 (59.7 cm), which were statistically *at par* with each other. The minimum length of leaves (50.83 cm) was found in genotype RVA-20-09. Similar findings were also reported by Dewangan *et al.* (2012) [5] and Dubey *et al.* (2019) [7] in onion.

Leaf thickness (cm)

The data of average leaf thickness recorded within the range between from 0.69 cm to 1.05 cm. The highest thickness of leaves (1.05 cm) was noted in genotype RVB-20-02 followed by RVB-20-17 (1.02 cm), RVB-20-11 (1.00 cm), RVB-20-10 (0.96 cm) and RVB-20-15 (0.95 cm) which was statistically *so par* with each other. The minimum leaf thickness (0.69 cm) was recorded in genotype RVA-20-09. Similar data also reported by Sahu and Sharma (2017) who reported that the genotype ON14-23 was finding maximum leaf thickness 1.53 cm.

Pseudostem thickness (cm)

The data of average pseudostem thickness recorded within the range between from 1.35 to 2.29 cm. The result indicated that the highest pseudostem thickness (2.29 cm) was recorded in genotype RVB-20-17 followed by RVB-20-11 (2.15 cm), RVB-20-15 (2.11 cm), RVB-20-02 (2.07 cm) and RVB-20-10 (2.06 cm), which were statistically *at par* with each other, whereas, the minimum pseudostem thickness (1.35 cm) was recorded in genotype RVA-20-09. Similar data also reported by Tripathy *et al.* (2014) who recorded that the maximum pseudostem thickness (1.44 cm) for genotype NRCWO-3.

Polar diameter of bulb (cm)

The data of average polar diameter of bulb recorded within the range from 4.52 to 6.07 cm. The result revealed that the highest polar diameter of bulbs (6.07 cm) was noted in genotype RVB-20-17 followed by RVB-20-15 (5.86 cm), RVB-20-08 (5.83 cm) and RVA-20-09 (5.81 cm), which were statistically *at par* with each other. The minimum polar diameter (4.52 cm) was noted in genotype RVA-20-04. Similar data also finding by Dewangan *et al.* (2012) [5], Dinkar and Sharma (2017) [6] and Peerzade *et al.* (2017) in onion.

Equatorial diameter of bulb (cm)
The data of average equatorial diameter of bulb recorded within the range from 5.76 cm to 7.10 cm. The result revealed that the highest equatorial diameter of bulb (7.10 cm) was noted in genotype RVB-20-08 followed by RVB-20-11 (7.02 cm), RVA-20-14 (6.72 cm) and RVA-20-12 (6.67 cm), which were statistically *at par* with each other. The minimum equatorial diameter of bulb (5.76 cm) was noted in genotype RVA-20-05. Similar data also finding by Dewangan *et al.* (2012) [5] and Dinkar and Sharma (2017) [6] in onion.

Neck thickness (cm)
The data of average neck thickness of bulb recorded within the range from 0.43 cm to 0.89 cm. The result revealed that the highest neck thickness of bulb (0.89 cm) was recorded in genotype RVB-20-10 followed by RVB-20-11 (0.73 cm), RVB-20-13 (0.70 cm), RVB-20-05 (0.64 cm) and RVB-20-017 (0.64 cm). Whereas, the minimum neck thickness of bulb was noted (0.43 cm) in genotype RVB-20-04. Similar data also reported by Hirave *et al.* (2015) [10] who also reported that variety Pune Red recorded minimum (0.87cm) neck thickness.

Total soluble solids (%)
The data of average TSS percentage of onion bulb recorded within the range from 10.25% to 13.7%. The highest TSS (13.7%) was recorded in RVA-20-09 followed by RVA-20-05 (13.25%), RVB-20-13 (13.25%), and RVB-20-15 (13.12%), however, all were statistically *at par* with each other, while the minimum TSS % was recorded (10.25%) in genotype RVB-20-04. Similar data also reported by Yadav *et at* (2010), Dewangan *et al.* (2012) [5], Hirave *et al.* (2015) [10] in onion.

Day to harvesting from transplanting
The average data of day to harvesting from transplanting of onion recorded within the range from 133.33 to 139 days and overall mean of 136.14 days. The longest duration of maturity (139 day) was recorded in genotype RVB-20-04 followed by RVA-20-05 (138.66 days), RVA-20-07 (138.33 days), and RVB-20-17 (137.66 days), however, all were statistically *at par* with each other. The genotype RVA-20-01 has taken shortest duration (133.33 days) to harvesting from transplanting. Similar data also reported by Dewangan *et al.* (2012) [5] and Dinkar and Sharma (2017) [6] in onion.

Average weight of bulbs (g)
The average data of average bulbs weight of bulbs noted within the range from 93.45 to 138.33 gm and overall mean of 117.74 gm. The maximum (138.33 g) was recorded in genotype RVB-20-10 followed by RVA-20-14 (136 g), RVB-20-06 (135.53 g), RVA-20-12 (130.66 g) and RVB-20-11 (125.61 g) however; all were statistically *at par* with each other. The minimum average weight of bulbs was recorded (93.45 g) in genotypes RVA-20-07. Similar data also reported by Dewangan *et al.* (2012) [5] and Dinkar and Sharma (2017) [6] in onion.

Fresh weight of bulbs (kg/plot)
The average data of fresh weight of bulbs recorded within the range from 6.09 to 29.48 kg and overall mean of 20.33 kg. The maximum fresh weight of bulbs (29.48 kg) was recorded in RVB-20-11 followed by RVB-20-08 (27.78 kg), RVB-20-06 (26.46 kg), and RVB-20-10 (25.31 kg), however, all were statistically *at par* with each other. The minimum fresh weight of bulbs was recorded (6.09 kg) in genotype RVA-20-07. Similar data also reported by Dinkar and Sharma (2017) [6] who reported that the range between 8.75 to 20.72 kg/plot cm in genotype ON15-01 and OSK13-17, respectively.

Marketable bulb yield (q/ha)
The average data of marketable bulb yield recorded within the range from 50.62 q/ha to 463.80 q/ha. The highest marketable bulb yield (463.80 q/ha) was recorded in genotype RVB-20-11 followed by RVB-20-08 (435.35 q/ha), RVB-20-06 (430.68 q/ha) and RVA-20-01 (359.56 q/ha), however, all were statistically *at par* with each other. While, the minimum marketable bulb yield (50.62 q/ha) was obtained in genotype RVA-20-07. Similar data also reported by Singh *et al.* (2011), Dewangan *et al.* (2012) [5], Hirave *et al.* (2015) [10], Gebremeskel *et al.* (2016), Tripathy *et al.* (2016) [13] in onion.

Total yield (q/ha)
The average data of total bulb yield noted within the range from 120.29 q/ha to 582.09 q/ha. The result revealed that the highest total bulb yield (582.09 q/ha) was recorded in genotype RVB-20-11 followed by RVB-20-08 (548.73 q/ha), RVB-20-06 (522.81 q/ha) and RVB-20-10 (500.01 q/ha), which were statistically *at par* with each other. Whereas, the lowest total bulb yield (120.29 q/ha) was noted in genotype RVA-20-07. (Note: observation on five plant basis)
The average data of total bulb yield was noted within the range from 111.96 q/ha to 465.42 q/ha. The result revealed that the highest total bulb yield (465.42 q/ha) was recorded in genotype RVB-20-11 followed by RVB-20-08 (442.40 q/ha), RVB-20-06 (441.81 q/ha) and RVB-20-10 (388.68 q/ha), which were statistically *at par* with each other. Whereas, the lowest total bulb yield (111.96 q/ha) was noted in genotype RVA-20-07. (Note: observation on net plot basis). Similar data also finding by Singh *et al.* (2011), Dewangan *et al.* (2012) [5], Attri *et al.* (2015), Dinkar and Sharma (2017) [6] and Peerzade *et al*. (2017) [11] in onion.

Bolting Percent
The average data of bolting percentage of onion noted within the range from 1.18 to 3.41%. The highest bolting percentage (3.41%) was recorded in genotype RVB-20-10 followed by RVB-20-04 (2.48%), RVB-20-17 (2.20%), RVB-20-11 (2.17%) and RVA-20-14 (2.16%). The minimum bolting percentage was recorded in genotypes RVA-20-07 (1.18%).

Double bulbs (kg/plot)
The average data of double bulbs percentage of onion noted within the range from 1.00 to 2.25 kg/plot. The maximum double bulbs (2.25 kg/plot) were recorded in genotype RVB-20-02 and the minimum double bulbs was recorded (1.00 kg/plot) in genotypes RVA-20-05, RVB-20-06, RVB-20-08 and RVB-20-11. (Note: it is square root transformation data). Similar data also reported by Dinkar and Sharma (2017) [6].

Rotting of bulbs (kg/plot)
The average data of rotting percentage of bulbs noted within the range from 0.24 to 5.59 kg/plot. The highest rotting percentage of bulbs (5.59 kg/plot) was recorded in genotype RVB-20-10 while, the minimum rotting percentage of bulbs was recorded (0.24 kg/plot) in genotypes RVA-20-05.

Different grade's bulb
The data of bulbs of onion are graded in different categories

to their bulbs size like A, B and C. The data of A graded bulbs was noted within the range from 1.14 to 12.12 kg/plot. The highest A grade bulbs (12.12 kg/plot) was recorded in genotype RVB-20-08 and the minimum A grade bulbs was recorded (1.14 kg/plot) in genotypes RVA-20-07.

The data of B graded bulbs percentage noted within the range from 1.1 to 13.16 kg/plot. The highest B grade bulbs (13.16 kg/plot) was recorded in genotype RVA-20-06 while the minimum B grade bulb was recorded (1.1 kg/plot) in genotypes RVA-20-07.

The data of C graded bulbs percentage noted within the range from 0.32 to 1.33 kg/plot. The highest C grade bulbs (1.33 kg/plot) was recorded in genotype RVA-20-09 however, the minimum C grade bulb was recorded (0.32 kg/plot) in genotypes RVB-20-07.

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 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 round, flat and oval.

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

Treatment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
RVA-20-01	71.10	10.2	59.56	0.84	1.74	5.30	6.19	0.61	13.08	95.97	1.31	22.73	113.2	359.56	449.04	8.21	9.10	0.88	1.13	3.67	133.33	378.71
RVA-20-03	62.96	9.2	52.83	0.83	1.64	5.06	5.83	0.58	13	84.43	1.48	14.92	96.4	269.56	294.83	3.58	9.26	0.80	1.04	0.70	136.33	280.17
RVA-20-05	60.66	8.66	52.23	0.76	1.46	5.15	5.76	0.60	13.25	80.12	1.94	12.28	94.13	228.60	242.62	1.70	8.57	1.29	1.00	0.24	138.66	232.96
RVA-20-07	68.6	8.76	55.96	0.82	1.41	5.29	5.90	0.55	13.2	62.25	1.18	6.09	93.45	50.62	120.29	1.14	1.1	0.32	1.18	2.66	138.33	111.96
RVA-20-09	54.50	7.86	52.63	0.69	1.35	5.81	6.03	0.59	13.7	87.50	1.75	15.23	119.8	281.15	300.97	3.29	9.60	1.33	1.01	0.73	133.66	290.30
RVA-20-12	69.46	9.86	57.9	0.81	1.71	5.51	6.65	0.62	12.70	91.00	1.96	20.26	130.66	330.73	400.32	5.41	10.29	1.04	1.71	0.93	135.66	348.66
RVA-20-14	73.70	9.53	59.7	0.90	1.88	5.62	6.72	0.61	12.98	92.90	2.16	22.46	136	334.88	443.64	8.47	7.75	0.73	1.10	4.6	137.33	361.98
RVB-20-02	70.36	10.4	62.03	1.05	2.07	4.88	6.35	0.64	12.46	87.77	1.77	19.67	116.13	193.05	388.60	4.40	4.46	0.91	2.25	5.23	134.33	327.27
RVB-20-04	58.76	10.03	50.83	0.88	1.70	4.52	5.89	0.43	10.25	86.09	2.48	15.81	99.2	243.00	312.36	5.45	7.12	0.63	1.10	1.88	139	271.69
RVB-20-06	70.33	10.13	58.93	0.91	1.87	5.51	6.58	0.60	12.94	94.28	2.01	26.46	135.53	430.68	522.81	7.91	13.16	0.72	1.00	3.98	135.33	441.48
RVB-20-08	76.76	10.46	62.7	0.94	1.99	5.83	7.10	0.63	12.96	92.16	1.36	27.78	119.36	435.35	548.73	12.12	9.43	0.48	1.00	5.16	133.66	442.40
RVB-20-10	64.7	11.8	51.9	0.96	2.06	5.60	6.71	0.89	12.56	95.87	3.41	25.31	138.33	356.87	500.01	8.83	8.66	0.56	1.39	5.59	135.66	388.68
RVB-20-11	71.16	10.6	57.43	1.00	2.15	5.57	7.02	0.73	12.88	94.67	2.17	29.48	125.61	463.80	582.09	11.52	11.57	0.38	1.00	5.38	137.33	465.42
RVB-20-13	63.13	10.5	52.3	0.93	2.02	5.21	6.28	0.70	13.25	92.59	1.93	23.42	125.1	338.19	462.74	7.58	9.10	0.59	1.02	5.51	135.33	372.74
RVB-20-15	67.40	9.93	54.26	0.95	2.11	5.86	6.47	0.57	13.12	82.21	2.06	21.86	120.26	316.90	431.96	7.20	8.38	0.45	1.19	4.8	136.66	350.96
RVB-20-17	71.50	12.83	61.58	1.02	2.29	6.07	6.59	0.64	12.73	81.05	2.20	21.63	120.66	287.27	427.32	7.51	6.50	0.52	2.12	2.94	137.66	341.98
Grand mean	67.19	10.05	56.42	0.89	1.84	5.42	6.38	0.62	12.81	87.55	1.95	20.33	307.51	117.74	401.77	6.52	8.38	0.73	1.26	3.37	136.14	337.96
Sem	2.47	0.35	2.06	0.04	0.12	0.22	0.28	0.05	0.37	4.06	0.19	1.87	7.94	19.34	21.93	0.74	0.71	0.17	0.05	0.53	0.41	18.56
CD	7.14	1.02	5.95	0.13	0.36	0.64	0.83	0.16	1.07	11.73	0.55	5.40	22.93	55.87	63.34	2.14	2.05	0.51	0.15	1.54	1.18	53.62
CV (%)	6.37	6.11	6.33	11.81	9.26	7.13	7.80	15.67	5.04	8.03	17.16	15.94	11.68	10.89	9.45	19.73	14.72	42.29	7.30	27.41	0.52	9.51

1. Plant height (cm)
2. Number of leaves per plant
3. Leaf length (cm)
4. Leaf thickness (cm)
5. Pseudo stem thickness (cm)
6. Polar diameter of bulbs (cm)
7. Equatorial diameter of bulbs (cm)
8. Neck thickness of bulbs (cm)
9. Total soluble solid (TSS) %
10. Plant establishment percent
11. bolting percent
12. Fresh weight of bulbs (kg/plot)
13. Average bulbs weight (g)
14. Marketable bulbs yield (q/ha)
15. Total yield (q/ha) (5 plant basis)
16. A grade bulb (kg/plot)
17. B grade bulbs (kg/plot)
18. C grade bulbs (kg/plot)
19. Double bulbs (kg/plot)
20. Rotting bulbs (kg/plot)
21. Days to maturity
22. Total yield (q/ha) (Net plot basis)

Note: The data of double bulb (kg/plot) is a square root transformation data.

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

Genotypes	Bulb colour	Bulb shape
RVA-20-01	Light Red	Round
RVA-20-03	Light Red	Round
RVA-20-05	Light Red	Round
RVA-20-07	Red	Flat
RVA-20-09	Red	Oval
RVA-20-12	Red	Flat
RVA-20-14	Red	Round
RVB-20-02	Red	Flat
RVB-20-04	Light Red	Flat
RVB-20-06	Red	Round
RVB-20-08	Red	Round
RVB-20-10	Red	Round
RVB-20-11	Light Red	Round
RVB-20-13	Light Red	Flat
RVB-20-15	Light Red	Round
RVB-20-17	Dark Red	Flat

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