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## Genetic Variability Assessment in Onion (*Allium cepa L.*) Genotypes

**Pushpendra Singh, AK Soni, Pratishtha Diwaker, Atma Ram Meena and Deepika Sharma**

### Abstract

The present investigation was carried out to estimate genetic variability among thirty genotypes of onion for fourteen characters comprised of bulb yield and its contributing characters. These genotypes were planted in Complete Randomized Block Design with three replications during *Rabi*-2016-17, SKN College of Agriculture, Jobner. On the basis of mean performance, the genotype RO-1 was the highest yielder followed by RO-643, RO-252, and RO-647. These genotypes may further be utilized in breeding programme aimed at improving bulb yield in onion. Analysis of variance indicated presence of considerable variability for all the fourteen characters. High GCV and PCV were observed for neck thickness, dry matter content and number of fleshy scale leaves. High estimates of heritability along with high genetic advance as per cent of mean was observed for dry matter content, pungency, TSS, bulb volume, equatorial diameter, average bulb weight and bulb yield ha<sup>-1</sup>. Therefore, these characters can aid in selection programme.

**Keywords:** Onion, variability, Heritability and Genetic advance

### Introduction

Onion (*Allium cepa L.*) is one of the important bulb crop of the family Amaryllidaceae and grown widely all over the world and consumed in various forms. It can be grown under wide range of agro-climate condition. Onion is cultivated mainly as annual for bulb production and biennial for seed production.

It is mainly grown for its edible bulb which develops underground. Immature and mature bulb is consumed as vegetable and condiment. Onion has many medicinal values and used for preparation of various *Homeopathic*, *Unani* and *Ayurvedic* medicines. Onion consumption lowers the blood sugar (Augusti, 1990) [2]. Onion leaves and bulbs are nutritionally rich in minerals like calcium, potash and phosphorus (Ullah *et al.*, 2005) [12]. Onion is characterized by its distinctive flavour and pungency which is the due to sulphur containing compounds (Allyl propyl disulphide) found in the scales of bulb. Highly pungent red coloured onions are preferred in India while less pungent yellow or white skinned ones are demanded in European and Japanese market.

India ranks first in area covering 1225 thousand hectare & second in production in the world next to China with production of 209.94 lakh tonnes (Anonymous, 2015-16) [1]. In India, onion is produced during two seasons' *i.e kharif* and *rabi*. The *rabi* crop of onion is grown at a very large scale in comparison to *kharif* crop in the state because of adverse climatic conditions like high temperature at the time of *kharif* seedling raising. Onion accounts for 70 percent of our total foreign exchange earnings from the export of fresh vegetables. Government of India has declared onion as an essential commodity.

Availability of sufficient genetic variability is very important in a crop improvement programme. For successful breeding programme, amount of genetic variability present in the experimental material is a basic requirement. Therefore, it is essential for a plant breeder to measure the variability with the help of parameters like phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance. Hence, these parameters give the information regarding the availability of genetic variability for different characters in available germplasm. Therefore, study of genetic variability of bulb yield and its component characters among different genotypes provides a strong basis for selection of desirable genotypes for augmentation of yield and other yield attributing characters.

## Materials and Methods

The present investigation was carried out at Horticulture Farm, S.K.N College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan during the *rabi* season of the year 2016-17. The experimental material for the present study consisted of thirty promising genotypes of Onion collected from Rajasthan Agriculture Research Institute (RARI), Jaipur, Rajasthan and other genotypes from Directorate of Onion and Garlic, Pune, Maharashtra and CCS Haryana Agriculture University, Hisar, Haryana. The experiment was laid out in a completely Randomized Block Design with three replications of each genotype. Ten rows of each genotype were sown at spacing of 15 x 10 cm in a plot of size of 1.0 x 1.5 m<sup>2</sup>. The standard cultural practices as mentioned in Package of Practices for Vegetable Crops by Thamburaj and Singh [10] were followed to raise the healthy crop stand

## Results and Discussion

### Mean performance

The mean performance and range of the 30 genotypes for all the fourteen characters are presented in the Table 1,2 and 3. The range in mean values, an indicator of variability revealed high variation for bulb yield ha<sup>-1</sup>, plant height at harvest, average bulb weight and bulb volume.

### Plant height at harvest (cm)

The data pertaining to the plant height at harvest have been depicted in Table 1. Plant height varied from 41.7 to 53.4 cm with an overall mean 47.67. The maximum plant height was recorded in genotype RO-631 (53.4 cm) followed by RO-633 (53.1 cm), RO-636 (53.1 cm), RO-647 (52.2 cm) and RO-632 (52.1 cm) while, the genotype Hisar-2 (41.7 cm) exhibited minimum plant height.

### Number of leaves

The data pertaining to number of leaves have been depicted in Table 1. The numbers of leaves per plant ranges from 6.88 to 10.98 with an overall mean 9.05. The maximum numbers of leaves per plant were recorded in genotype RO-628 (10.98) followed by RO-1 (10.45), RO-612 (10.25), RO-618 (10.25), RO-621 (10.25) and RO-252 (10.12) while the minimum numbers of leaves were recorded in genotype RO-619 (6.88).

### Neck thickness (cm)

The data pertaining to neck thickness have been depicted in Table 1. Neck thickness varied from 0.74 to 1.8 cm with an overall mean 0.95. The maximum neck thickness was recorded in genotype RO-647 (1.8 cm) followed by RO-618 (1.33 cm), RO-1 (1.10 cm) and RO-631 (1.08 cm) while, the minimum neck thickness was recorded in genotype RO-653 (0.74 cm).

### Polar diameter (cm)

The data pertaining to polar diameter have been depicted in Table 1. Polar diameter varied from 3.89 to 4.8 cm with an overall mean 4.31. The maximum polar diameter was recorded in genotype RO-618 (4.8 cm) followed by RO-646 (4.70 cm), RO-1 (4.68 cm) and RO-647 (4.64 cm) while, the minimum polar diameter was recorded in genotype RO-638 (3.89 cm).

### Equatorial diameter (cm)

The data pertaining to equatorial diameter have been depicted in Table 1. Equatorial diameter varied from 4.26-5.5 cm with an overall mean 5.06. The maximum polar diameter was recorded in genotype RO-1 followed by RO-647 (5.49 cm), RO-252 (5.46 cm) and RO-631 (5.36 cm) while; the minimum polar diameter was recorded in genotype RO-617 (4.26 cm).

**Table 1:** Mean values for different metric characters of Onion genotypes.

S. No.	Genotype	Plant height at harvest (cm)	Number. of leaves	Neck thickness (cm)	Polar diameter (cm)	Equatorial diameter (cm)
1	RO-1	49.25	10.45	1.10	4.68	5.50
2	RO-252	45.70	10.12	0.99	4.13	5.46
3	RO-610	45.60	8.41	0.87	4.19	4.98
4	RO-612	48.60	10.25	0.83	4.39	5.06
5	RO-614	47.40	9.62	0.81	4.21	5.06
6	RO-616	45.60	7.98	0.84	4.15	4.84
7	RO-617	42.30	7.45	0.800	3.95	4.26
8	RO-618	48.90	10.25	1.33	4.80	5.10
9	RO-619	44.28	6.88	0.83	4.08	4.41
10	RO-620	45.20	7.63	0.85	4.10	4.61
11	RO-621	44.28	10.25	0.81	4.08	4.99
12	RO-626	48.80	9.82	0.84	4.21	5.11
13	RO-628	49.00	10.98	1.02	4.54	5.36
14	RO-631	53.40	8.17	1.08	4.60	5.44
15	RO-632	52.10	9.85	0.89	4.25	5.14
16	RO-633	53.10	8.74	0.94	4.36	5.24
17	RO-636	49.80	9.31	0.97	4.45	5.34
18	RO-638	48.60	9.62	0.84	3.89	4.28
19	RO-640	48.70	8.75	1.05	4.54	5.36
20	RO-643	53.10	9.12	0.98	4.38	5.29
21	RO-644	46.50	7.98	0.84	4.21	5.08
22	RO-645	45.60	7.55	0.86	4.19	4.54
23	RO-646	46.10	8.12	0.95	4.70	5.25
24	RO-647	52.20	9.65	1.80	4.64	5.49
25	RO-649	47.50	8.36	0.85	4.21	5.12
26	RO-653	45.30	8.84	0.74	4.21	4.94
27	RO-656	47.40	8.32	0.92	4.35	5.20
28	N-53	46.50	9.84	0.87	4.18	4.99

29	RO-282	47.23	9.14	0.97	4.40	5.30
30	Hisar -2	41.70	9.47	0.89	4.12	5.15

### Bulb volume (cc)

The data pertaining to bulb volume have been depicted in Table 2. Volume of bulb varied from 46.19 to 58.51 cc with an overall mean of 53.28. The maximum volume of bulb was recorded in genotype RO-1 (58.51 cc), followed by RO-647 (58.39 cc), RO-628 (57.5 cc), RO-631 (57.41 cc) and RO-640 (57.27 cc) while, the minimum bulb volume was recorded in genotype RO-638 (46.19 cc).

### Number of scales

The data pertaining to number of scales in bulb have been depicted in Table 2. Number of scales varied from 4.69 to 7.21 with an overall mean of 5.73. The maximum number of scales in bulb was recorded in genotype RO-1 (7.21), followed by RO-647 (7.1), RO-252 (6.87), RO-631 (6.68) and RO-640 (6.60) while, the minimum volume of bulb was recorded in genotype RO-617 (4.69).

### Days to harvest after transplanting

The data pertaining to days to harvest after transplanting have been depicted in Table 2. Days to harvest after transplanting varied from 117.37 to 139.30 days with an overall mean of 126.78. The maximum days to harvest after transplanting

were recorded in genotype RO-632 (139.30) followed by RO-631 (137.97), RO-628 (136.70), RO-626 (135.70) and N-53 (133.70) while minimum days to harvest after transplanting were recorded in genotype RO-617 (117.37 days).

### Total soluble solids (%)

The data pertaining to TSS have been depicted in Table 2. Total soluble solids varied from 9.13 to 14.1 per cent with an overall mean 11.87. The maximum total soluble solids were recorded in genotype RO-1(14.1 %) followed by Hissar-2 (13.77 %), RO-282 (13.33 %) and RO-621 (12.47 %) while, the minimum total soluble solids was recorded in RO-617 (9.13 %).

### Dry matter content (%)

The data pertaining to dry matter content have been depicted in Table 2. Dry matter content varied from 8.4 to 14.1 per cent with an overall mean of 10.92. The maximum dry matter content was recorded in genotype RO-618 (14.1 %) followed by RO-649 (13.73 %), RO-632 (13.5 %) and RO-628 (13.2 %) while, the minimum dry matter content was recorded in genotype RO-617 (8.4 %) and RO-645 (8.4 %).

**Table 2:** Mean values for different metric characters of Onion genotypes.

S. No.	Genotype	Bulb volume(cc)	Number of scales	Days to harvest after transplanting	TSS (%)	Dry matter content (%)
1	RO-1	58.51	7.21	125.70	14.10	11.40
2	RO-252	53.22	6.87	124.00	11.10	9.27
3	RO-610	50.41	5.37	131.00	12.21	10.70
4	RO-612	51.71	5.86	128.88	12.43	13.10
5	RO-614	50.98	5.47	124.30	12.37	12.2
6	RO-616	49.17	4.80	125.69	11.78	9.63
7	RO-617	47.16	4.69	117.37	9.13	8.40
8	RO-618	54.12	5.95	131.70	12.47	14.10
9	RO-619	48.10	4.73	119.30	9.73	9.40
10	RO-620	49.96	4.74	121.66	10.70	9.45
11	RO-621	55.66	4.69	121.00	12.47	10.45
12	RO-626	54.53	5.48	135.70	11.80	12.47
13	RO-628	57.50	6.43	136.70	9.60	13.20
14	RO-631	57.41	6.68	137.97	12.10	9.30
15	RO-632	54.80	5.84	139.30	11.57	13.50
16	RO-633	50.73	6.20	122.30	11.90	10.28
17	RO-636	56.81	6.43	123.00	12.10	8.97
18	RO-638	46.19	4.73	118.70	12.21	12.20
19	RO-640	57.27	6.60	126.40	11.40	12.27
20	RO-643	56.50	6.41	128.90	11.98	9.80
21	RO-644	54.90	5.47	122.67	11.78	9.63
22	RO-645	48.35	4.74	124.21	12.21	8.40
23	RO-646	55.41	6.31	124.21	11.84	11.83
24	RO-647	58.39	7.10	132.79	10.98	12.70
25	RO-649	54.69	5.64	127.45	12.34	13.73
26	RO-653	50.16	4.80	120.36	12.43	9.45
27	RO-656	54.91	6.09	123.45	12.10	8.75
28	N-53	50.95	5.43	133.70	12.21	10.77
29	RO-282	56.65	6.43	129.00	13.33	9.22
30	Hisar -2	53.19	4.84	126.00	13.77	13.01

### Pungency (%)

The data pertaining to pungency have been depicted in Table 3. Pungency varied from 6.43 to 8.6 per cent with an overall mean of 7.68. The maximum pungency was recorded in genotype RO-633 (8.60 %), RO-636 (8.6 %), RO-632 (8.57

%), and RO-626 (8.53 %) while, the minimum pungency was recorded in genotype RO-617 (6.43 %).

### Sulphur content in bulb (%)

The data pertaining to sulphur content in bulb have been depicted in Table 3. Sulphur content in bulb varied from 0.60

to 0.69 per cent with an overall mean 0.66. The maximum sulphur content in bulb was recorded in genotype RO-632 (0.69 %), RO-633 (0.69 %), RO-636 (0.69 %) followed by RO-618 (0.68 %) and RO-626 (0.68 %), RO-631 (0.68 %) while, the minimum sulphur content in bulb was recorded in genotype RO-617 (0.60 %) and RO-619 (0.60 %).

#### Average bulb weight (g)

The data pertaining to average bulb weight have been depicted in Table 3. Average bulb weight varied from 50.21 to 63.6 g with an overall mean of 58.06. The maximum average bulb weight was recorded in genotype RO-1 (63.6 g),

followed by RO-647 (63.47 g), RO-252 (62.5 g), RO-631 (62.4 g) and RO-640 (62.25 g) while, the minimum average weight of bulb was recorded in genotype RO-617 (50.21 g).

#### Bulb yield ha<sup>-1</sup> (q)

The data pertaining to bulb yield ha<sup>-1</sup> have been depicted in Table 3. Bulb yield varied from 334.73 to 424.00 quintal per hectare with an overall mean 387.01. The maximum bulb yield was recorded in genotype RO-1 (424.0 q ha<sup>-1</sup>) followed by RO-647 (423.13 q ha<sup>-1</sup>), RO-252 (416.67 q ha<sup>-1</sup>), RO-631 (416.0 q ha<sup>-1</sup>) and RO-640 (415.0 q ha<sup>-1</sup>) while, the minimum yield was recorded in genotype RO-617 (334.73 q ha<sup>-1</sup>).

**Table 3:** Mean values for different metric characters of Onion genotypes

S. No.	Genotype	Pungency (%)	Sulphur content in bulb (%)	Average Bulb Weight (g)	Bulb yield ha <sup>-1</sup> (q)
1	RO-1	6.81	0.62	63.60	424.00
2	RO-252	6.75	0.62	62.50	416.67
3	RO-610	7.40	0.66	54.80	365.33
4	RO-612	8.23	0.67	56.21	374.73
5	RO-614	8.07	0.67	55.41	369.40
6	RO-616	7.33	0.66	54.30	362.00
7	RO-617	6.43	0.60	50.21	334.73
8	RO-618	8.37	0.68	58.10	387.33
9	RO-619	6.53	0.60	52.28	348.53
10	RO-620	6.71	0.61	53.45	356.33
11	RO-621	6.71	0.61	55.14	367.60
12	RO-626	8.53	0.68	59.27	395.13
13	RO-628	8.30	0.67	62.00	413.33
14	RO-631	8.40	0.68	62.40	416.00
15	RO-632	8.57	0.69	59.57	397.13
16	RO-633	8.60	0.69	60.50	403.33
17	RO-636	8.60	0.69	61.75	411.67
18	RO-638	8.37	0.67	51.26	341.73
19	RO-640	8.30	0.67	62.25	415.00
20	RO-643	7.33	0.67	61.41	409.40
21	RO-644	7.43	0.66	57.82	385.47
22	RO-645	8.07	0.67	52.56	350.40
23	RO-646	7.53	0.66	60.78	405.20
24	RO-647	8.10	0.67	63.47	423.13
25	RO-649	8.33	0.67	59.45	396.33
26	RO-653	7.40	0.66	54.52	363.47
27	RO-656	7.80	0.66	60.23	401.53
28	N-53	7.43	0.67	55.38	369.20
29	RO-282	6.91	0.62	61.57	410.47
30	Hisar -2	7.10	0.64	59.67	397.80

#### Parameters of genetic variability

The range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, genetic advance and genetic advance as per cent of mean are given in Table 4.

#### Coefficients of variability (%)

The estimate of phenotypic and genotypic coefficients of variability gives a clear picture of amount of variations present in the available germplasm. For all the traits studied, phenotypic coefficients of variability were higher in magnitude than genotypic coefficients of variability, though the difference was very less in majority of cases, thus showing that these traits are less influenced by environmental factors. Coefficients of variability varied in magnitude from trait to trait, either low or moderate or high. Therefore, it indicated the presence of high diversity. Among all the characters high GCV and PCV were observed for neck thickness (20.41 & 22.71) followed by dry matter content (16.29 & 16.40) in comparison to other characters, indicating the presence of high amount of genetic variability for these traits and selection for these characters might be effective

because the response to selection is directly proportional to the variability present in the experimental material. Moderated to low GCV and PCV were observed for number of scales (13.15 & 15.67), number of leaves (10.61 & 12.76), pungency (9.20 & 9.26), TSS (9.03 & 9.10), equatorial diameter (6.64 & 6.95), average bulb weight (6.59 & 7.19), bulb yield ha<sup>-1</sup> (6.59 & 7.19), bulb volume (6.53 & 6.91), plant height at harvest (6.09, 6.93), polar diameter (5.20 & 5.52), days to harvest after transplanting (4.28 & 5.28) and minimum for sulphur content in bulb (4.13 & 4.27). These results are in broad conformity to earlier researchers Gurjar and Singhania (2006) [4], Trivedi *et al.* (2006) [11] and Solanki *et al.* (2015) [9]

#### Heritability (%)

A wide range of heritability (69.22-98.70 %) was observed for the characters under study. High values of heritability were observed for dry matter content (98.70 %) followed by pungency (98.70 %) TSS (98.36 %), sulphur content in bulb (93.60 %), equatorial diameter (91.14 %), bulb volume (89.14 %), average bulb weight (83.88 %), bulb yield ha<sup>-1</sup> (83.88 %), polar diameter (88.83 %), neck thickness (80.81 %), plant height at harvest (77.42 %), number of scales (70.43 %),

number of leaves (69.22 %), and days to harvest after transplanting (65.68 %). These results are in broad conformity to earlier researchers Hosamani *et al.* (2010) [5], Pyasi and Tiwari (2016) [7].

### Genetic Advance (%)

The high genetic gain was recorded for neck thickness (37.80 %) followed by dry matter content (33.35 %), number of scales (22.73 %), pungency (18.82 %), TSS (18.44 %),

number of leaves (18.19 %), equatorial diameter (13.06 %), bulb volume (12.69%), average bulb weight (12.43 %), bulb yield ha<sup>-1</sup> (12.43 %), plant height at harvest (11.05 %), polar diameter (10.11 %) and sulphur content in bulb (8.23%). The character that recorded the lowest genetic gain was days to harvest after transplanting (7.15 %). These results are in broad conformity to earlier researchers Mohanty and Prusti (2001) [6], Dhotre *et al.* (2010) [3] and Saini (2010) [8].

**Table 4:** Estimates of genetic parameters of variation for the different characters of onion genotypes

S. No.	Character	Mean	Range	GCV	PCV	Heritability (%)	GA	GA as % of Mean
1	Plant height at harvest (cm)	47.67	41.7-53.40	6.09	6.93	77.42	5.27	11.05
2	No of leaves	9.05	6.88-10.98	10.61	12.76	69.22	1.65	18.19
3	Neck thickness (cm)	0.95	0.74-1.80	20.41	22.71	80.81	0.36	37.80
4	Polar diameter (cm)	4.31	3.89-4.80	5.20	5.52	88.83	0.44	10.11
5	Equatorial diameter (cm)	5.06	4.26-5.50	6.64	6.95	91.14	0.66	13.06
6	Bulb volume (cc)	53.28	46.19-58.51	6.53	6.91	89.14	6.76	12.69
7	Number of scales	5.73	4.69-7.21	13.15	15.67	70.43	1.30	22.73
8	Days to harvest after transplanting	126.78	117.37-139.3	4.28	5.28	65.68	9.06	7.15
9	TSS (%)	11.87	9.13-14.1	9.03	9.10	98.36	2.19	18.44
10	Dry matter content (%)	10.92	8.4-14.1	16.29	16.40	98.70	3.64	33.35
11	Pungency (%)	7.68	6.43-8.60	9.2	9.26	98.70	1.45	18.82
12	Sulphur content in bulb (%)	0.66	0.60-0.69	4.13	4.27	93.60	0.05	8.23
13	Average bulb weight (g)	58.06	50.21-63.60	6.59	7.19	83.88	7.22	12.43
14	Bulb yield ha <sup>-1</sup> (q)	387.08	334.73-424	6.59	7.19	83.88	48.11	12.43

### Conclusion

Analysis of variance revealed highly significant differences among the genotypes for all the characters showing thereby considerable amount of genetic variability for all the characters and were amenable to improvement. High estimates of heritability along with high genetic advance as per cent of mean was observed for dry matter content, pungency, TSS, bulb volume, equatorial diameter, average bulb weight and bulb yield. Therefore, these characters can aid in selection programme.

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