

## Variability studies in Rabi onion (*Allium cepa* var *cepa* L) for yield and yield contributing traits

ADITIKA, PRIYANKA\*, VN DOD\*\* and MONIKA SHARMA

Department of Vegetable Science  
Dr YS Parmar University of Horticulture and Forestry  
Nauni, Solan 173230 Himachal Pradesh, India

\*School of Agricultural Biotechnology, Punjab Agricultural University  
Ludhiana 141004 Punjab, India

\*\*Department of Horticulture, Dr Panjabrao Deshmukh Krishi Vidyapeeth  
Akola 444104 Maharashtra, India

Email for correspondence: aditikasharma123@gmail.com

---

© Society for Advancement of Human and Nature 2017

Received: 7.8.2015/Accepted: 12.11.2015

---

### ABSTRACT

The present study was aimed at investigating the yield and yield contributing traits in onion in order to generate information regarding the extent of genetic variability, heritability and genetic advance. The experiment was laid under randomized block design with three replications at college of Horticulture, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra during Rabi season 2012-13 to investigate the genetic variability among 21 genotypes. High degree of variation was observed for all the characters studied. The difference between phenotypic (PCV) and genotypic (GCV) coefficient of variation was found to be narrow for most of the traits except bulb weight and neck thickness. The GCV ranged from 4.82 (bulb diameter) to 14.60 per cent (bulb weight) while PCV ranged from 5.72 (number of marketable bulbs per plot) to 17.29 per cent (bulb weight) for the various characters studied. The high estimates of heritability were found for all the characters studied. Expected genetic advance over mean was observed high for the characters viz yield per plot, bulb weight and number of marketable bulbs per plot. These characters are therefore governed by additive gene effects. Selection on the basis of these characters will be more useful for the improvement of this crop towards attaining higher yield.

**Keywords:** Variability; heritability; genetic advance; GCV; PCV

### INTRODUCTION

Onion (*Allium cepa* var *cepa* L) is a highly cross-pollinated crop, biennial for seed production and annual for bulb production and belongs to family Alliaceae (2n= 16). It is one of the most important vegetables and is grown worldwide under outdoor conditions. It is an indispensable item in every kitchen as vegetable and condiment used to flavour many of the foodstuffs. In addition onion is used as salad and pickle. Nowadays it is used by processing industries for dehydration in the form of onion flakes and powder which are in great demand in the world market. In the world India ranks first in total area (10.51 lakh hectares) and second in production (168.13 lakh tons) for onion after China. The crop accounts for 10.4 per cent share out of total vegetable production in India

after tomato (Anon 2012). It has become an important commercial crop because of its area, production and consumption. Yield is a complex character; it depends on a number of agronomic traits and is influenced by many factors which could be genetic or environmental (Uddin et al 1985). To improve the bulb yield, quality and storability through selection the information on the nature and magnitude of variability for yield and yield contributing characters present in the population owing to its genetic and non-genetic causes plays an important role and as such it is a basic prerequisite for any systematic breeding programme. Thus for improving the efficiency of selection in any base population the knowledge of genetic variability present in it is of prime importance to the breeder. The improvement in any crop is proportional to the magnitude of its genetic variability present in the genotypes (Mallor et al 2011).

Most of the economic plant characters in onion are polygenic in nature and highly influenced by the environment. To improve the yield through selection of better varieties, knowledge of variability and nature of association of bulb yield with yield contributing characters is very essential. Therefore present field investigation was carried out with a view to study the genetic variability, heritability and genetic advance in onion by assessing onion genotypes collected from various sources.

## MATERIAL and METHODS

The present investigation was conducted at College of Horticulture, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra during Rabi season 2012-13 along with twenty one genotypes. The experiment was laid out in randomized block design with three replications. The observations were recorded on ten plants from each plot at random on plant height, number of leaves per plant, days to harvest, neck thickness (cm), bulb diameter (cm), bulb weight (g), number of marketable bulbs per plot, TSS and yield per plot (kg). The data were analyzed to work out variance components and coefficient of variations as per method suggested by Burton (1952). Heritability in broad sense and expected genetic advance as per cent of mean were estimated as suggested by Johnson et al (1955).

## RESULTS and DISCUSSION

The analysis of variance was highly significant for all the characters (Table 1). Highest yield per plot was recorded for L-652 (8.43 kg/plot) followed by Akola Local-2 (8.36 kg/plot). Highest bulb weight was recorded for Akola Local-2 (106.3 g) followed by L-652 (97.67 g) (Table 2). The extent of variability with respect to various characters in different genotypes was measured in terms of range, general mean, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability ( $h^2$ ) and expected genetic advance as per cent of mean (Table 3).

The PCV was found to be greater of its GCV for all the characters studied. The results are similar to the findings of Chattopadhyay et al (2013). The GCV ranged from 4.82 per cent (bulb diameter) to 14.60 per GCV was observed for bulb weight (14.60%) followed by yield per plot (14.22%) and low values of GCV were observed for neck thickness (9.05%)

followed by TSS (8.69%), plant height (8.23%), number of leaves per plant (7.07%), days to harvest (6.03%), number of marketable bulbs per plot (5.19%) and bulb diameter (4.82%). Gurjar et al (2006) reported low GCV and PCV for plant height and days to maturity. The PCV ranged from 5.72 per cent (number of marketable bulbs per plot) to 17.29 per cent (bulb weight) for the various characters studied. The moderate PCV was recorded for the character bulb weight (17.29%), yield per plot (14.23%) and neck thickness (11.44%). However low values of PCV were observed for plant height (9.39%), number of leaves per plant (8.89%), TSS (8.94%), days to harvest (6.23%) and bulb diameter (5.87%). Hosamani et al (2010) reported high value of GCV and PCV for yield per hectare and for average bulb weight. Exactly not equal but somewhat similar magnitude of GCV and PCV was recorded for the characters viz plant height, days to harvest, number of marketable bulbs per plot, TSS and yield per plot which indicates the less influence of environment and that the character expressions are totally due to genetic makeup.

As the coefficient of variation indicated only the extent of variability it does not reflect on heritable proportion of variation. Hence estimation of heritability coupled with genetic advance as per cent over mean permits greater effectiveness for selection by separating out the environmental influence from the total variability and thereby allowing accurate selection of a potential phenotype. The heritability estimates in broad sense were high for all the characters. Similar results were reported by Ananthan and Balkrishnamoorthy (2007). The range was observed from 62.58 to 94.41 per cent for all the traits under study (Table 3). These heritability values in that order were for neck thickness (62.58), number of leaves per plant (63.17%), bulb diameter (67.35%), yield per plot (67.85%), bulb weight (73.36%), plant height (76.83%), number of marketable bulbs per plot (82.32%), days to harvest (93.72%) and TSS (94.41%).

The parameter genetic advance in per cent of mean is a more reliable index for understanding the characters because its estimate is derived by involvement of deviation and intensity of selection. Expected genetic advance in percentage over mean was estimated for different characters and indicated that the expected genetic advance over mean observed was in the range of 8.15 to 27.05 per cent for different characters. It was observed low in case of bulb diameter (8.15%) and moderate for the characters viz

Table 1. Analysis of variance for nine characters in onion

| Source      | df | Mean sum of square |                         |                 |                     |                    |                 |                                 |       |                  |
|-------------|----|--------------------|-------------------------|-----------------|---------------------|--------------------|-----------------|---------------------------------|-------|------------------|
|             |    | Plant height (cm)  | Number of leaves /plant | Days to harvest | Neck thickness (cm) | Bulb diameter (cm) | Bulb weight (g) | Number of marketable bulbs/plot | TSS   | Yield /plot (kg) |
| Replication | 2  | 26.35              | 0.487                   | 5.81            | 4.86                | 0.034              | 13.45           | 13.01                           | 0.032 | 0.018            |
| Treatment   | 20 | 110.18*            | 0.995*                  | 163.02*         | 0.115*              | 0.259*             | 483.05*         | 59.14*                          | 4.60* | 3.18*            |
| Error       | 40 | 10.06              | 0.161                   | 3.55            | 1.92                | 0.036              | 56.98           | 3.94                            | 0.08  | 0.434            |

\*Significant at 5% level (1.86)

Table 2. Mean performance of genotypes

| Genotype            | Plant height (cm) | Number of leaves/ plant | Days to harvest | Neck thickness (cm) | Bulb diameter (cm) | Bulb weight (g) | Number of marketable bulbs/plot | TSS   | Yield /plot (kg) |
|---------------------|-------------------|-------------------------|-----------------|---------------------|--------------------|-----------------|---------------------------------|-------|------------------|
| L-65-2 TL           | 72.40             | 7.57                    | 106.7           | 2.05                | 5.66               | 79.13           | 82.33                           | 11    | 6.51             |
| ALRTL               | 64.57             | 6.80                    | 120             | 2.00                | 5.74               | 76.63           | 83.33                           | 15.63 | 6.38             |
| ADR-TL              | 57.06             | 6.22                    | 130             | 1.62                | 5.40               | 69.1            | 86.67                           | 13.33 | 5.99             |
| Nhrdf- Red -1       | 66.77             | 6.66                    | 120             | 2.16                | 5.86               | 81.13           | 85.33                           | 13.37 | 6.92             |
| L-355-TL            | 68.60             | 7.64                    | 125             | 2.10                | 5.41               | 65.37           | 86.33                           | 12.73 | 5.64             |
| Agrifound White     | 59.71             | 7.50                    | 112.7           | 1.70                | 5.06               | 52.40           | 81                              | 12.2  | 4.24             |
| Agrifound Light Red | 63.33             | 8.08                    | 116             | 2.10                | 5.56               | 75.80           | 82.33                           | 15.5  | 6.24             |
| Nhrdf- Red-2        | 66.27             | 7.62                    | 119.3           | 2.13                | 5.40               | 76.57           | 86                              | 14.27 | 6.59             |
| L-652               | 71.51             | 8.41                    | 120             | 2.05                | 5.42               | 97.67           | 86.33                           | 15.33 | 8.43             |
| Bhima Kiran         | 69.65             | 7.86                    | 127.7           | 2.01                | 6.42               | 94.93           | 86.33                           | 14.43 | 8.20             |
| Bhima Shweta        | 65.57             | 7.08                    | 107.7           | 1.97                | 5.50               | 76.43           | 86                              | 13.33 | 6.58             |
| Bhima Shakti        | 70.95             | 7.11                    | 130             | 1.94                | 5.58               | 88.79           | 88                              | 14.77 | 7.79             |
| Arka Niketan        | 71.24             | 6.95                    | 125             | 1.83                | 5.79               | 90.33           | 81.33                           | 15.13 | 7.34             |
| Bhima Super         | 73.31             | 6.86                    | 110             | 1.61                | 5.60               | 70.20           | 83.67                           | 14.37 | 5.86             |
| Bhima Red           | 73.77             | 7.80                    | 118             | 1.68                | 5.48               | 71.50           | 81.67                           | 14.40 | 5.84             |
| N-2-4-1             | 75.77             | 7.40                    | 133             | 2.09                | 6.12               | 87              | 84.67                           | 13.47 | 7.35             |
| Bhima Shubra        | 76.93             | 7.15                    | 124.7           | 1.89                | 5.99               | 88.73           | 84                              | 13.47 | 7.45             |
| Bhima Raj           | 74.28             | 7.66                    | 120             | 2.01                | 5.48               | 76.93           | 75                              | 15.23 | 5.77             |
| Akola Local-5       | 75.97             | 8.18                    | 119             | 2.15                | 5.66               | 96.33           | 74.67                           | 15.5  | 7.18             |
| Akola local-2       | 82.47             | 7.6                     | 124             | 2.34                | 5.8                | 106.3           | 78.67                           | 13.4  | 8.36             |
| Akola Safed         | 73.95             | 8.36                    | 129             | 2.17                | 5.8                | 92              | 71.33                           | 15.4  | 6.57             |
| Grand mean          | 70.19             | 7.45                    | 120.8           | 1.98                | 5.65               | 81.58           | 82.62                           | 14.11 | 6.72             |
| SEm                 | 1.83              | 0.23                    | 1.08            | 0.08                | 0.10               | 4.35            | 1.14                            | 0.17  | 0.38             |
| CD <sub>0.05</sub>  | 5.233             | 0.66                    | 3.91            | 0.22                | 0.31               | 12.46           | 3.27                            | 0.49  | 1.08             |

Table 3. Genetic parameters in respect of nine quantitative traits in onion genotypes

| Character                       | Range         | Mean  | GCV   | PCV   | Heritability % (h <sup>2</sup> ) | Genetic advance | EGA in % of mean |
|---------------------------------|---------------|-------|-------|-------|----------------------------------|-----------------|------------------|
| Plant height (cm)               | 57.06 - 82.47 | 70.19 | 8.23  | 9.39  | 76.83                            | 10.43           | 14.86            |
| Number of leaves/plant          | 6.22 - 8.4    | 7.45  | 7.07  | 8.89  | 63.17                            | 0.86            | 11.57            |
| Days to harvest                 | 106.7 - 133   | 120.8 | 6.03  | 6.23  | 93.72                            | 14.54           | 12.04            |
| Neck thickness (cm)             | 1.61 - 2.34   | 1.98  | 9.05  | 11.44 | 62.58                            | 0.29            | 14.75            |
| Bulb diameter (cm)              | 5.06 - 6.42   | 5.66  | 4.82  | 5.87  | 67.35                            | 0.46            | 8.15             |
| Bulb weight (g)                 | 52.4 - 106.3  | 81.58 | 14.60 | 17.29 | 73.36                            | 20.74           | 25.42            |
| Number of marketable bulbs/plot | 71.33 - 86.67 | 82.62 | 5.19  | 5.72  | 82.32                            | 22.35           | 27.05            |
| TSS (°Brix)                     | 11 - 15.63    | 14.11 | 8.69  | 8.94  | 94.41                            | 2.46            | 17.43            |
| Yield/plot (kg)                 | 4.24-8.43     | 6.73  | 14.22 | 14.23 | 67.85                            | 1.62            | 24.15            |

number of leaves per plant (11.57%), days to harvest (12.04%), neck thickness (14.75%), plant height (14.86%) and TSS (17.43%). The values of expected genetic advance in per cent over mean was recorded high for the characters viz yield per plot (24.15%), bulb weight (25.42%) and number of marketable bulbs (27.05%) per plot. Bharti et al (2011) also reported high expected genetic advance in percentage over mean for yield per plot, yield per hectare, bulb size and bulb weight. Thus heritability and genetic advance in per cent of mean in combination provide clearer picture regarding the effectiveness of selection for improving the characters.

### ACKNOWLEDGEMENTS

Gratitude is expressed to ASPEE Agricultural Research and Development Foundation, Mumbai for grant of Junior Research Fellowship to the first author.

### REFERENCES

- Ananthan M and Balkrishnamoorthy G 2007. Genetic variability and correlation studies in onion (*Allium cepa* var *cepa* L) for economic dry matter yield. *Agricultural Science Digest* **27(3)**: 190-193.
- Anonymous 2012. National horticulture database. National Horticulture Board, Gurgaon, Haryana, India.
- Bharti N, Ram RB, Meena ML and Yogita 2011. Genetic variability studies in onion (*Allium cepa* L). *Annals of Horticulture* **4(2)**: 171-175.
- Burton GW 1952. Quantitative inheritance in grasses. *Proceeding, 6<sup>th</sup> International Grassland Congress*, Pennsylvania State College, 17-23 August 1952, Vol 1, pp 277-283.
- Chattopadhyay A, Sharangi AB, Dutta S, Das S and Denre M 2013. Genetic relatedness between quantitative and qualitative parameters in onion (*Allium cepa* L). *Vegetos* **26(1)**: 151-157.
- Gurjar RSS and Singhania DL 2006. Genetic variability, correlation and path analysis of yield and yield components in onion. *Indian Journal of Horticulture* **63(1)**: 53-58.
- Hosamani RM, Patil BC and Ajjappalavara PS 2010. Genetic Variability and character associated studies in onion (*Allium cepa* L). *Karnataka Journal Agricultural Sciences* **3(2)**: 302-305.
- Johnson HW, Robinson HF and Comstock RE 1955. Estimates of genetic and environmental variability in soybeans. *Agronomy Journal* **47(7)**: 314-318.
- Mallor C, Carravedo M, Estopanan G and Mallor F 2011. Characterization of genetic resources of onion (*Allium cepa* L) from the Spanish secondary centre of diversity. *Spanish Journal of Agricultural Research* **9(1)**: 144-155.
- Uddin MM, Samad A, Khan MR, Begum S and Salam MA 1985. Correlation and path analysis of yield and yield contributing characters in *Brassica* species. *Bangladesh Journal of Agricultural Research* **10**: 71-75.