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Assessment of Genetic Variability, Heritability and Genetic Advance in Onion (*Alllium cepa* L.)

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ABSTRACT: This study aimed to evaluate the growth, yield and yield attributing traits of twenty-three genotypes of onion at the Instructional Farm, Department of Vegetable Science, Dr. P.D.K.V., Akola, during the year 2018-19 in the *rabi* season the experiment was conducted in a randomized block design (RBD) with three replications for each genotype. The observations were recorded for number of leaves/plants, plant height, leaf length, leaf area, neck thickness, bulb diameter, bulb weight, yield/plot, TSS and yield/ha. The results revealed that highly significant difference among the genotypes for all the traits studied. The phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for all the traits. The result revealed that the PCV and GCV mean ranged for leaf area (4.590 cm^2, 2.571 cm^2) to yield per plot (30.906 kg, 29.858 kg), respectively. The highest genotypic coefficient of variation as well as phenotypic coefficient of variation was observed for the trait yield per plot and yield per hectare. Almost all characters exhibited high heritability (31.364% to 94.071%), genetic advance over mean was ranged from 2.966 to 59.442 for all the characters.

Keywords: Onion, Genetic advance, Genotypes, Heritability, Variability.

INTRODUCTION

Onion (*Allium cepa* L.) is a highly cross-pollinated crop, biennial for seed production and annual for bulb production and belongs to the family Alliaceae (2n=16). "*Allium*" is the largest and the most important genus of the Alliaceae family that comprises 700 species, widely distributed in the Northern Hemisphere, North America, North Africa, Europe and Asia. It is one of the most important vegetables and is grown worldwide. It is an essential element in every kitchen as vegetable and condiment used to flavor many of the foodstuffs and also onion is used as salad and pickle. The quality of onion depends on shape, size, color and pungency of bulbs. Highly pungent red-colored onions are preferred in India while less pungent, yellow or white skinned ones are demanded in European and Japanese country. India is next to china in area and production of onion. Among all the different states in India, Maharashtra is leading state in terms of area and production. Other major onion producing states are Karnataka, Madhya Pradesh, Gujarat, Rajasthan and Odisha. The variation in yield and its components is influenced by various characters that affect crop productivity. To improve the crop performance, it is important to measure the extent of variation in these characters. This study focuses on evaluating the variability of several yield-related characteristics in a crop of interest. Phenotypic expression is not a reliable indicator of quantitative characters for selection purposes, as it may be influenced by environmental and other non-genetic factors. Therefore, it is important to measure the genetic and non-genetic variation of each character separately. This is achieved by estimation of genetic variability using suitable parameters like genotypic coefficient of variation, heritability in broad sense and expected genetic advance for individual characters. Although genetic coefficient of variation is indicative of presence of degree of variation, the amount of heritable portion of variation can only the determined with the help of estimates and genetic gain. Therefore, for development of high yielding varieties, it is necessary to study the genetic variability for yield and yield contributing characters for further exploitation in further breeding programme. Similarly, it is necessary to work out genetic association between yield and yield components which will be very effective for the improvement of the crop.

MATERIAL AND METHODS

The present investigation was conducted at Instructional Farm, Department of Vegetable Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS.) during *rabi* season in the year 2018-19 along with twenty-three different genotypes of onion. The field was well level and uniform in topography. The

field soil was medium black cotton soil having uniform texture and structure with good drainage was selected. The experiment was laid out in randomized block design (RBD) with three replications. Each genotype was accommodated on flat bed in a plot of 1.8×1.5 m size by keeping 15×10 cm distance between two rows and two plants, respectively. All the recommended cultural practices were adopted to raise a healthy crop. A random sample of five plants per plot was used to collect the data. The observations were taken from each plant and recorded in a spreadsheet. The data analysis was performed using statistical software to compare the effects of different treatments on the plant growth, yield and yield attributing traits *i.e.*, number of leaves per plant, plant height (cm), leaf length (cm), leaf area (cm^2), neck thickness (cm), bulb diameter (cm), bulb weight (g), TSS (^oBrix), yield per plot (kg) and yield per hectare (t). The material under study was constituted of twenty-three genotypes of onion which were collected from different institutes as listed below.

Table 1: Genotypes under study.

Treatments	Name of the genotypes	Source
T_1	AKON-1	Dr. P.D.K.V., Akola
T_2	AKON-2	Dr. P.D.K.V., Akola
T_3	AKON-3	Dr. P.D.K.V., Akola
T_4	AKON-4	Dr. P.D.K.V., Akola
T_5	AKON-5	Dr. P.D.K.V., Akola
T_6	AKON-6	Dr. P.D.K.V., Akola
T_7	AKON-7	Dr. P.D.K.V., Akola
T_8	AKON-8	Dr. P.D.K.V., Akola
T_9	AKON-9	Dr. P.D.K.V., Akola
T_{10}	AKON-10	Dr. P.D.K.V., Akola
T_{11}	AKON-11	Dr. P.D.K.V., Akola
T_{12}	AKON-12	Dr. P.D.K.V., Akola
T_{13}	AKON-13	Dr. P.D.K.V., Akola
T_{14}	AKON-14	Dr. P.D.K.V., Akola
T_{15}	MLO-1	Dr. P.D.K.V., Akola
T_{16}	MLO-1-1	Dr. P.D.K.V., Akola
T_{17}	MLO-2	Dr. P.D.K.V., Akola
T_{18}	MLO-4	Dr. P.D.K.V., Akola
T_{19}	MLO-4-1	Dr. P.D.K.V., Akola
T_{20}	Selection-1	Dr. P.D.K.V., Akola
T_{21}	Arka Kalyan	IIHR, Banglore
T_{22}	Arka Kirtiman	IIHR, Banglore
T_{23}	Akola Safed	Dr. P.D.K.V., Akola

RESULTS AND DISCUSSION

The characters studies exhibited a wide range of variation for yield and its attributes. The formulae suggested by (Burton, 1952) were used to estimate the genotypic and phenotypic coefficient of variation. PCV and GCV were categorized as low (<10%), moderate (10-20%) and high (>20%).

The data presented in Table 2, the high genotypic coefficient of variation was recorded for (GCV) yield per plot (29.858%) followed by yield per hectare (29.854%). Whereas, moderate genotypic coefficient of variation observed for bulb diameter (12.051%), and low genotypic coefficient of variation was reported for number of leaves (8.787%), total soluble solid (7.957%), bulb weight (7.207%), neck thickness (5.938%), leaf length (5.322%), plant height (4.456%) and leaf area (2.571%).

The phenotypic coefficient of variation was ranged from 4.590% to 30.906%. The high phenotypic coefficient of variation was recorded for the trait yield per plot (30.906%), yield per hectare (30.887%) and moderate phenotypic coefficient of variation was recorded for bulb diameter (14.683%), number of leaves per plant (10.391%), bulb weight (10.061%), while, low PCV were reported for TSS (8.204%), leaf length (8.159%), neck thickness (7.893%), plant height (7.126%), leaf area (4.590%). The results indicated that the value of phenotypic coefficient of variations were higher in magnitude than that of genotypic coefficient of variation for all the characters. Similar results were reported by Ranjitha *et al.* (2018); Sharma *et al.* (2017); Komali *et al.* (2020); Solanki *et al.* (2022); Pushpa *et al.* (2023); Satya *et al.* (2023).

The heritability was classified as suggested by Robinson (1949), less than 30%-Low, 30-60%-Moderate, above 60%-High. The range was recorded from 31.364% to 94.071%. The high heritability character TSS (94.071%), yield per hectare (93.424%), yield per plot (93.335%), number of leaves per plant (71.514%) and bulb diameter (67.368%). Similar results were reported by Mohapatra *et al*. (2017); Komali *et al.* (2020); Solanki *et al.* (2022); Pushpa *et al.* (2023); Satya *et al.* (2023). The moderate heritability were reported for the traits like, neck thickness (56.601%), bulb weight (51.315%), leaf length (42.545%), plant height (39.091%) and leaf area (31.364%). The moderate heritability in Plant height is similar results were reported by Solanki *et al.* (2022); Pushpa *et al.* (2023).

Based on the recommendations of Johnson *et al*. (1955a) ; Johnson *et al*. (1955b), the genetic advance as

percent of mean was divided into three groups: Low (less than 10%), Moderate (10% to 20%) and High (> 20%).

The results indicated that the expected genetic advance over mean observed was in the range of 2.966% to 59.442% for different characters. It was recorded low in case of leaf area (2.966%), plant height (5.739%), leaf length (7.151%) and neck thickness (9.203%) whereas, the moderate genetic advance were reported for the characters, bulb weight (10.636%), TSS (15.897%) and number of leaves per plant (15.308%). The values of expected genetic advance in percentage over mean was recorded high for the characters *viz.*, bulb diameter (20.377%), yield per hectare (59.442%) and yield per plot (59.422%). Similar results were reported by Parmar *et al.* (2018); Satya *et al.* (2023).

Table 2: Estimates of mean performance, range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance (GA) and expected genetic advance (EGA) for different traits in Onion.

Sr. No.	Characters	Range		Mean	GCV (%)	PCV (%)	Heritability % (h^2)	Genetic Advance	EGA in % of mean
		Min.	Max.						
1.	**No. of leaves/ plant**	6.40	9.10	7.767	8.787	10.391	71.514	1.189	15.308
2.	**Plant height (cm)**	66.27	80.203	74.232	4.456	7.126	39.091	4.260	5.739
3.	**Leaf length (cm)**	57.49	69.97	64.076	5.322	8.159	42.545	4.582	7.151
4.	**Leaf area (cm^2)**	280.88	309.867	292.946	2.571	4.590	31.364	8.688	2.966
5.	**Neck thickness (cm)**	1.04	1.29	1.173	5.938	7.893	56.601	0.108	9.203
6.	**Bulb diameter (cm)**	3.16	5.34	4.311	12.051	14.683	67.368	0.878	20.377
7.	**Bulb weight (g)**	63.21	85.74	73.464	7.207	10.061	51.315	7.813	10.636
8.	**Yield per plot (kg)**	2.597	7.776	4.647	29.858	30.906	93.335	2.762	59.422
9.	**TSS (°Brix)**	10.92	14.22	12.270	7.957	8.204	94.071	1.951	15.897
10.	**Yield per ha. (ton)**	9.623	28.8	17.217	29.854	30.887	93.424	10.234	59.442

Min: Minimum; **Max:** Maximum; **GCV:** Genotypic Coefficient Variation; **PCV:** Phenotypic Coefficient Variation; **EGA:** expected genetic advance

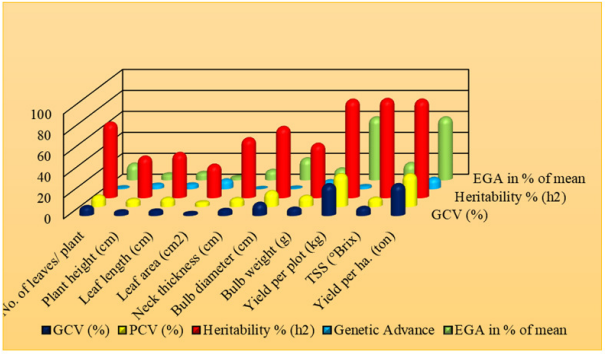

Fig. 1. Estimates of genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance (GA) and expected genetic advance (EGA) for different traits in Onion

Plate 1: General view of research field.

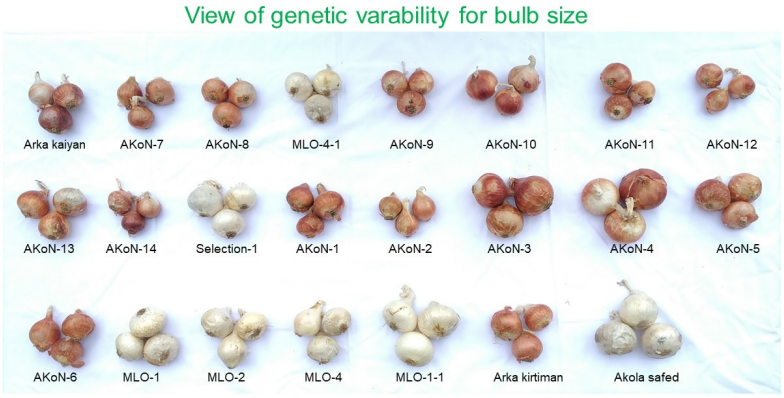

Plate 2: Genetic variability of different onion genotypes.

CONCLUSIONS

The phenotypic coefficient of variation in general was greater in magnitude than the corresponding genotypic ones. The differences between PCV and GCV for many characters such as no. of leaves, height of plant, leaf length, leaf area, neck thickness, bulb diameter, bulb weight, yield per plot, TSS were found minimum indicating less environmental effect. High values of GCV and heritability estimates supplemented with greater genetic gains are also indicative of additive gene effects regulating the inheritance of such traits therefore, these characters reflect the greater selective value and offer ample scope for selection and phenotypic coefficient of variation was lessened under the influence of environment.

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