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Assessment of genetic variability in 16 white onion (*Allium cepa* L.) genotypes

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Abstract
The aim of the investigation was to assess extent of genetic variability among sixteen genotypes along with check Bheema Safed of onion for fifteen characters comprised of bulb yield and its contributing characters. These genotypes were planted in Complete Randomized Block Design with two replications during *rabi*-2021, at the new orchard of Main Agriculture Research Station, UAS, Dharwad. On the basis of mean performance, the genotype Puna White was the highest yielder followed by Bheema Shubra and W-364. The analysis of variance revealed the existence of significant amount of variation for the traits studied. High PCV and GCV were noticed for centres per bulb, total yield and fresh weight of bulb. Whereas, moderate GCV and high PCV was observed for weight of single bulb and average weight of marketable bulbs. Therefore, these characters can aid in selection programme. High heritability coupled with high genetic advance over mean was recorded for number of centres per bulb, total bulb yield, fresh weight of the bulbs, average weight of marketable bulb and weight of single bulb, indicates the predominance of an additive gene effects and these provides ample scope for further improvement of these characters through selection.

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) [1]. Onion leaves and bulbs are nutritionally rich in minerals like calcium, potash and phosphorus (Ullah *et al*, 2005) [9]. 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 colored onions are preferred in India while less pungent yellow or white skinned ones are demanded in European and Japanese market. 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.

Material and Methods
Plant materials
The present investigation was undertaken at the new orchard of Main Agriculture Research Station, UAS, Dharwad. The research material was collected from different parts of India. The experimental material for present study comprised of 16 of onion.

Evaluation
The material generated was evaluated in *rabi* 2021 by laying out in the Completely Randomized Block Design (RBD) with 16 genotypes were replicated twice.

Totally 16 plots represented 16 entries. All the 16 genotypes along with one check planted with spacing 10 ×15 cm. Recommended practices were followed for successful cultivation.

The observations were recorded on five competitive plants taken at random in each entry over the replications on plant height (cm), number of functional leaves per plant, leaf length (cm), length of bulb (cm), diameter of bulb (cm), days to maturity, bulb fresh weight per plot (kg), average weight of 10 marketable bulbs (g), weight of single bulb (g), total yield (t/ha), number of rings per bulb, number of centers per bulb, total soluble solid (^{0}Brix) and bulb shape index.

Analysis

The collected data were subjected to analysis of variance and parameters of variability. The analysis of variance for the design of experiment (RBD) was carried out according to the set statistical procedures. The genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and heritability in broad sense (h2bs) were computed following the methodology given by Burton and deVane (1953) [2]. Genetic advance (GA) as percent of mean was estimated by the method suggested by Johnson *et al*. (1955) [6].

Results and Discussions

Mean performance of genotypes

The mean performance and range of the 16 genotypes for all the 15 characters are presented in the Table 1. The range in mean values, an indicator of variability revealed high variation for bulb yield per hectare, plant height, and average bulb weight.

Variability parameters

The analysis of variability showed that each plant differed significantly among themselves for all the fifteen traits in the material studied. The mean, range, genotypic (GCV) and phenotypic (PCV) coefficients of variation, heritability and genetic advance as per cent of mean for all the traits are presented in Table 1. The magnitude of PCV was higher than that of GCV for all the traits indicating that all the fifteen traits were influenced by the environment. The high phenotypic coefficients of variation (PCV) and genotypic coefficients of variation (GCV) were observed for number of centres per bulb (31.54% and 29.89%, respectively), followed by total yield (27.99% and 24.89%, respectively) and fresh weight of bulb (27.78% and 24.49%, respectively). Whereas high PCV and moderate GCV were observed for weight of single bulb (20.67% and 19.64%, respectively) and average weight of bulbs (20.65% and 19.75%, respectively). While low phenotypic coefficients of variation (PCV) and genotypic coefficients of variation (GCV) were noticed for days to maturity (3.31% and 2.97%, respectively) and bulb shape index (3.58% and 3.15%, respectively). The results obtained in the present study are confirmed with the findings of Hosamani *et al*. (2010) [5], Ram *et al.* (2011) [7], Singh *et al.* (2012) [8] and Chattopadhyay *et al.* (2013) [3].

Characters like, number of centres per bulb, total yield and fresh weight of bulb recorded high phenotypic coefficients of variation (PCV), indicating little influence of environment on the expression of these characters. In other words, improvement can be achieved by simple selection based on phenotypic performance. Whereas, moderate GCV and high PCV was observed for weight of single bulb and average weight of marketable bulbs. However, highest difference between GCV and PCV was observed for number of leaves per plant, bulb yield per hectare and number of rings per bulb indicating.

The least difference between GCV and PCV was noticed for average weight of marketable bulbs, weight of single bulb and number of centres per bulb, indicating little influence of environment on the expression of these characters. In other words, improvement can be achieved by simple selection based on phenotypic performance. Whereas, moderate difference between GCV and PCV was observed for total yield and fresh weight of bulbs, indicating environmental factor has moderate influence on these characters.

Heritability estimates in the broad sense include both additive and non additive gene effects and in the narrow sense include only additive gene effects. Since, heritability estimates fluctuate in interaction with environment as well as genetic background; it should be studied only along with genetic advance for characters in concern for effective selection (Johnson *et al.*, 1955 and Hanson *et al.*, 1956) [6, 4].

High heritability coupled with high genetic advance over mean was recorded for number of centres per bulb, total bulb yield, fresh weight of the bulbs, average weight of marketable bulb and weight of single bulb. High heritability coupled with high genetic advance over mean for the above traits indicates the predominance of an additive gene effects and these provides ample scope for further improvement of these characters through selection. Whereas high heritability coupled with moderate genetic advance over mean was recorded for leaf length, bulb length, plant height and bulb diameter. Moderate heritable values captured with moderate genetic advance suggests the role of additive gene action in the expressing of traits. These findings are concerned with those of Ram *et al.* (2011) [7] for yield per hectare, plant height, bulb size and bulb weight, marketable yield and weight of 10 bulbs.

Table 1: Estimates of phenotypic and genotypic coefficients of variation, heritability and genetic advance for various traits in Onion genotypes

Sl. No.	Characters	Range		Mean	PCV (%)	GCV (%)	h^2_{BS} (%)	GA	GAM (%)
1.	PH	35.5	46.13	41.23	8.1	7.48	85.30	5.87	14.23
2.	NL	10.33	12.2	11.38	4.8	3.22	44.99	0.51	4.45
3.	LL	33.33	44.03	38.89	8.44	7.8	85.42	5.78	14.85
4.	DMP	97.49	107.47	102.96	3.31	2.97	80.5	5.64	5.48
5.	DB	4.32	5.79	5.04	8.36	7.07	71.51	0.62	12.31
6.	LB	3.37	4.52	3.81	9.31	8.19	77.38	0.57	14.84
7.	BWP	3.47	8.17	5.58	27.78	24.49	77.73	2.48	44.49
8.	AWMB	414.67	778.33	559.6	20.65	19.75	91.50	217.78	38.92
9.	WSB	40.16	74.59	54.37	20.67	19.64	90.30	20.91	38.45
10.	TY	11.88	27.56	18.85	27.99	24.89	79.08	8.59	45.60
11.	NR	6.52	8.9	7.65	7.68	6.19	65.04	0.79	10.29
12.	NC	1	2.07	1.33	31.54	29.89	89.85	0.78	58.37

13.	TSS	12.8	16.3	13.94	7.42	6.43	75.13	1.6	11.48
14	BSI	0.73	0.81	0.76	3.58	3.15	77.27	0.04	5.70

GCV- Genotypic co-efficient of variance h2 BS - Broad sense heritability GA- genetic advance
PCV- Phenotypic co-efficient of variance GAM- Genetic advance as per cent of mean
Where,
PH=Plant height (cm), NL=Number of leaves/plant, LL=Leaf length (cm), DMP=Days to maturity period (Days), DB=Diameter of bulb (cm), LB=Length of the bulb (cm) and BWP=Bulb fresh weight (kg/plot), AWMB=Average weight of 10 marketable bulbs (gm), WSB=weight of single bulb (gm), TY=Total yield (t/ha), NR=Number of rings per bulb, NC=Number of centre per bulb, TSS=Total soluble solids (°Brix) and BSI=Bulb shape index.

Conclusion

Analysis of variance revealed highly significant differences among the 16 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 number of centres per bulb, total bulb yield, fresh weight of the bulbs, average weight of marketable bulb and weight of single bulb. Therefore, these characters can aid in selection programme.

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