

## Estimates of genetic variability and correlation in red onion (*Allium cepa*) advance lines\*

R K SINGH<sup>1</sup>, B K DUBEY<sup>2</sup>, S R BHONDE<sup>3</sup> and R P GUPTA

National Horticultural Research and Development Foundation, Nashik, Maharashtra 422 011

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Onion (*Allium cepa* L.) is one of the important crops and spices grown in India. Both mature and immature bulbs are used for vegetable and spices purpose. Non availability of required germplasm and no stability in desirable traits bring research gap in onion improvement programme. In any crop improvement programme, knowledge of various variability parameters and association among different traits in base population are pre-requisite to initiate and execute properly selection for yield. Most of the economic plant characters in onion are polygenic in nature and highly influenced by the environment. To improve yield through selection of better variety, knowledge of the nature of association of bulb yield with yield contributing characters is very essential. However, knowledge of correlations among various characters and their relative contributions to yield is useful for multiple trait selection. Keeping these above facts, the present investigation was undertaken to assess the magnitude of variability and correlation in diverse red onion advance lines collected from different areas.

The present investigation was carried out at the National Horticultural Research and Development Foundation Nashik (20°N latitude and 73°E longitudes and altitude of 492 m mean sea levels), Maharashtra, during winter season (*rabi*) 2005–07. The experiment was laid out in a randomized block design with three replications. The soil was clay loam, medium in organic carbon (0.58%), available N (385.2 kg/ha), P (45.13 kg/ha) and high in available K (291.2 kg/ha). The climate of Nashik is sub-tropical with minimum and maximum temperatures and humidity ranging between 16° and 32°C and 48 and 80%, respectively with an annual rainfall around 881 mm. The study comprises sixteen diverse red advance lines selected among 200 germplasm evaluated

at this centre along with one check 'Agrifound Light Red'. Eight week old seedlings of each advance line were transplanted in flat beds during the last week of December at the spacing of 15 cm × 10 cm in a plot of 3.6 m × 1.8 m size. The recommended package of practices were followed for raising the successful crop. Randomly 10 plants from each plot were selected to record observation on plant height, leaves per plant, neck thickness, bulb diameter, bulb size index, weight of 20 bulbs, days for bulb initiation, days for harvesting, gross yield, marketable yield, total soluble solids (TSS) and dry matter content. The pooled data were analyzed to work out variance components and coefficient of variations as per suggested method by Burton and Devane (1953). Heritability in broad sense and expected genetic advance as per cent of mean were estimated as suggested by Johnson, 1955 and correlation as by Al-jibouri *et al.* (1958).

Analysis of variance for twelve characters (Table 1) indicated considerable variations. The highest bulb diameter (5.54 cm), bulb size index (25.25 cm<sup>2</sup>) and weight of 20 bulbs (1.32 kg) were observed in advance line '652', which was at a par with '574' (5.47 cm), (24.28 cm<sup>2</sup>) and (1.22 kg), respectively. Highest gross yield (41.4 tonnes/ha) and marketable yield (38.3 tonnes/ha) was also recorded in advance line '652' and that was at a par with '672' (38.8 tonnes/ha) and (34.8 tonnes/ha).

The extent of variability with respect to various characters in different advance lines of red onion measured in terms of range, general mean, genotypic coefficient of variation phenotypic coefficient of variation, environmental coefficient of variation along with the amount of heritability (h<sup>2</sup>) and expected genetic advance as per cent of mean (Table 2). The range of variation was high for gross yield (26.9 to 41.5 tonnes/ha), marketable yield (22.7 to 38.3 tonnes/ha), plant height (60 to 68 cm), bulb size index (20.01 to 25.25 cm<sup>2</sup>), day for bulb initiation (46–55 days) and dry matter content (11.73 to 14.26%). The remaining characters, viz leaves/plant (8.43–9.33), neck thickness (1.47–1.60 cm), bulb diameter (5.07–5.54 cm), weight of 20 bulbs (1.08–1.32 kg), days for

\*Short note

<sup>1</sup>Assistant Director (Horticulture); (e mail: singhrknbpr@yahoo.com); <sup>2</sup>Assistant Director (Horticulture), (e mail: nhrdf\_nsk@sancharnet.in); <sup>3</sup>Additional Director (e mail: nhrdf\_nsk@sancharnet.in) and <sup>4</sup>Director (e mail: nhrdf\_nsk@sancharnet.in).

Table 1 Mean values for different advance lines of red onion for some quantitative traits

Advance lines	Plant height (cm)	Leaves/plant	Neck thickness (cm)	Bulb diameter (cm)	Bulb size index (cm <sup>2</sup> )	Weight of 20 bulbs (Kg)	Days for bulb initiation	Days for harvesting	TSS (%)	Dry matter (%)	Marketable Yield (tonnes/ha)	Gross Yield (tonnes/ha)
343	65	9.01	1.53	5.17	21.29	1.09	54	112	11.83	12.96	22.7	26.9
350	60	8.66	1.51	5.17	22.22	1.16	54	112	11.58	12.61	30.6	35.5
351	66	8.86	1.60	5.32	24.42	1.17	53	111	11.33	12.51	30.9	32.9
359	61	8.43	1.54	5.34	23.36	1.16	53	112	12.00	13.21	24.1	29.3
380	65	9.00	1.52	5.31	22.59	1.17	53	111	11.91	12.64	30.2	34.6
382	62	9.33	1.56	5.14	21.23	1.11	48	111	11.41	13.03	31.1	34.5
400	65	9.09	1.55	5.19	21.68	1.08	53	112	11.00	11.73	29.1	33.7
453	68	9.09	1.56	5.33	23.25	1.18	48	105	10.91	12.06	32.5	37.2
472	64	8.86	1.52	5.25	21.76	1.08	55	112	12.41	14.26	25.5	32.5
474	64	8.96	1.60	5.31	23.15	1.19	46	104	11.50	12.79	33.3	37.8
546	63	9.29	1.54	5.31	20.01	1.12	48	104	11.41	12.66	32.8	35.7
574	64	8.84	1.51	5.47	24.28	1.22	49	112	11.00	12.64	32.4	35.4
652	60	9.15	1.50	5.54	25.25	1.32	47	112	10.66	12.48	38.3	41.5
653	66	9.09	1.50	5.07	20.31	1.08	48	112	11.83	13.39	27.7	32.0
672	68	8.96	1.47	5.39	23.51	1.28	53	112	11.33	11.89	34.8	38.8
ALR	67	8.66	1.48	5.41	24.05	1.21	50	112	11.66	13.20	34.2	37.4
Range	60–68	8.43–9.33	1.47–1.60	5.07–5.54	20.01–25.25	1.08–1.32	46–55	104–112	10.66–12.41	11.73–14.26	22.7–38.3	26.9–41.5
SEm ±	1.35	0.17	0.03	0.08	0.77	0.02	0.76	0.78	0.29	0.49	12.67	11.86

Table 2 Range, mean, coefficient of variation, heritability and genetic advance for different characters in red onion

Characters	Range	General Mean	SEm ±	Coefficient of variation			Heritability (%)	Genetic advance (GA)	GA as percent of mean
				Phenotypic coefficient of variation (PCV) %	Genotypic coefficient of variation (GCV) %	Environmental coefficient of variation (ECV) %			
Plant height (cm)	60.23–68.00	64.74	1.35	4.92	3.33	3.62	45.81	3.01	4.64
Leaves per plant	8.43–9.33	8.96	0.17	3.78	1.79	3.32	22.66	0.15	1.67
Neck thickness (cm)	1.47–1.6	1.53	0.03	3.81	1.52	3.49	15.90	0.02	1.24
Bulb diameter (cm)	5.07–5.54	5.29	0.08	3.14	1.82	2.56	33.56	0.12	2.27
Bulb size index (cm <sup>2</sup> )	20.01–25.25	22.77	0.77	7.66	4.91	5.88	41.06	1.47	6.45
Weight of 20 bulbs (kg)	1.08–1.32	1.16	0.02	6.79	5.55	3.92	66.71	0.10	8.62
Days for bulb initiation	46.0–55.0	51.02	0.76	6.21	5.64	2.60	82.42	5.38	10.54
Days for harvesting	104.33–112.66	110.70	0.78	2.90	2.63	1.23	82.06	5.44	4.91
TSS (%)	10.66–12.41	11.49	0.29	5.35	2.95	4.46	30.48	0.38	3.30
Dry matter (%)	11.73–14.26	12.75	0.49	7.30	2.86	6.72	15.33	0.29	2.27
Marketable yield (tonnes/ha)	22.7–38.3	30.70	12.67	14.57	12.69	7.15	75.90	7.00	22.80
Gross yield (tonnes/ha)	26.9–41.5	34.70	11.86	11.42	9.78	5.90	73.26	5.99	17.26

harvesting (104–112 days) and TSS (10.66 to 12.41%) exhibited medium to low range of variability.

The genotypic coefficient of variation was less than that of phenotypic variation for all characters (Table 2), indicating a considerable influence of environment on their expression.

The phenotypic and genotypic coefficients of variations were high for marketable yield (14.57–12.69%) and gross yield (11.42–9.78%), and moderate to low for remaining traits.

This variation shows greater genetic variability among the advance lines and responsiveness of the attributes for making further improvement by selection. Wide differences between phenotypic and genotypic coefficients of variations indicated their susceptibility to environmental fluctuation and narrow differences between phenotypic and genotypic coefficients of variation in traits, viz bulbs weight and plant height implied their relative resistance to environmental alteration.

Table 3 Genotypic (G), and Phenotypic (P) correlation coefficients for different characters in red onion advance lines

Characters		Plant height (cm)	Leaves/plant	Neck thickness (cm)	Bulb diameter (cm)	Bulb size index (cm <sup>2</sup> )	Weight of 20 bulbs (Kg)	Days for bulb initiation	Days for harvesting	TSS (%)	Dry matter (%)	Marketable Yield (tonnes/ha)	Gross Yield (tonnes/ha)
Plant height (cm)	G	1.000	-0.099	-0.309	-0.102	0.078	-0.065	-0.052	-0.035	-0.016	-0.341	-0.014	-0.057
	P	1.000	0.150	-0.014	0.101	-0.083	-0.026	0.116	-0.078	0.023	-0.166	0.159	0.059
Leaves per plant	G		1.000	0.041	-0.720**	-0.714**	-0.288	-0.748**	-0.564**	-0.656**	-0.446*	0.348	0.331
	P		1.000	0.278	0.077	0.113	0.052	-0.309	-0.253	-0.257	-0.191	0.242	0.189
Neck thickness (cm)	G			1.000	-0.732**	-0.035	-0.614	-0.449*	-0.851**	-0.272	-0.646**	-0.243	-0.361
	P			1.000	-0.041	-0.072	-0.170	-0.097	-0.369	-0.008	0.091	-0.081	-0.096
Bulb diameter (cm)	G				1.000	0.811**	0.703**	-0.342	-0.084	-0.798**	-0.292	0.766**	0.735**
	P				1.000	0.778**	0.693**	-0.184	-0.049	-0.247	-0.211	0.499*	0.473*
Bulb size index (cm <sup>2</sup> )	G					1.000	0.802**	-0.201	-0.033	-0.765**	-0.348	0.731**	0.693**
	P					1.000	0.691**	-0.150	0.038	-0.333	-0.301	0.501**	0.423*
Weight of 20 bulbs (kg)	G						1.000	-0.358	-0.023	-0.820**	-0.490*	0.819**	0.804**
	P						1.000	-0.199	0.029	-0.336	-0.375	0.721**	0.698**
Days for bulb initiation	G							1.000	0.657**	0.763**	0.261	-0.630**	-0.597**
	P							1.000	0.523**	0.321	0.454*	-0.515**	-0.454*
Days for harvesting	G								1.000	0.243	0.237	-0.325	-0.342
	P								1.000	0.219	0.179	-0.229	-0.242
TSS (%)	G									1.000	0.626**	-0.930**	-0.834**
	P									1.000	0.568**	-0.547**	-0.456*
Dry matter (%)	G										1.000	-0.694**	-0.587**
	P										1.000	-0.396	-0.345
Marketable yield (tonnes/ha)	G											1.000	0.976**
	P											1.000	0.939**
Gross yield (tonnes/ha)	G												1.000
	P												1.000

\*. \*\* Significant at 5 and 1%, respectively

Robinson (1966), has categorized estimates of heritability as low (5–10%) medium (10–30%) and high (30 and above). Following this classification, the heritability estimates obtained were higher for all the characters except leaves per plant, neck thickness and dry matter. The heritability in broad sense ranged from 15.33 to 82.42%. Higher values of heritability were obtained for days for bulb initiation (82.42%) days for harvesting (82.06%), marketable yield (75.90%), gross yield (73.26%), weight of 20 bulb (66.71%), plant height (45.81%), bulb diameter (33.56%) and total soluble solid (30.48%), and moderate for other attributes which indicate that they were least affected by environmental modification, and selection based on phenotypic performance would be reliable. Mehta *et al.* (2005) also reported high heritability for weight of bulbs, diameter of bulbs, plant height, days for maturity and total soluble solids.

The genetic advance as per cent of mean ranged between 1.24 and 22.80%. High genetic advance was recorded for marketable yield (22.80%), gross yield (17.26%) and days for bulbs initiation (10.54%). However, the heritability estimates along with genetic advance is more useful than heritability values alone for selecting best individuals. In the present study, the traits, marketable yield and gross yield showed high heritability coupled with high genetic advance as per cent of mean. Plant height, bulb size index, bulb

diameter, bulb weight, and TSS showed high heritability with low genetic advance.

The characters which exhibited high heritability with high genetic advance as per cent of mean are genetically controlled by additive gene actions (Panse 1957) and can be improved through mass selection or any other modified selection procedure. Where the traits exhibited high heritability with moderate to low genetic advance as per cent of mean these can be improved through multiple crosses. Sidhu *et al.* (1986) reported low heritability estimates for all characters except bulb diameter and yield.

The phenotypic as well as genotypic correlations between different pairs of traits are presented in Table 3. In general the values of correlation at genotypic level were higher than phenotypic correlations. This indicated little role of environment in the expression of genetic relationship on the phenotypes.

The gross yield had strong positive correlation between bulb diameters, bulb size index and bulbs weight at both genotypic and phenotypic levels, and significantly negative with days for bulb initiation, total soluble solids and dry matter content at both genotypic and phenotypic levels. Haydar *et al.* (2007) also reported a positive correlation between bulb diameter and yield. The bulb diameter had negative correlation with number of leaves per plant and neck

thickness at genotypic level. Bulb size index was positively correlated with bulb diameter at both genotypic and phenotypic levels. Weight of 20 bulbs was significantly positive with bulb diameter and bulb size index. Days for bulb initiation are seen negatively correlated with number of leaves per plant and neck thickness at genotypic levels. TSS is significantly and is negatively correlated with number of leaves per plant, bulb diameter, bulb size index, bulbs weight at the genotypic level and positively correlated with days for bulb initiation at genotypic level.

The present study showed that the number of leaves per plant, bulb diameter, bulb size index, bulbs weight, days for bulbs initiation, were the most important characters correlated to yield.

#### SUMMARY

The extent of genetic variability, heritability, genetic advance and correlation were studied in onion with sixteen red onion advance lines. Results revealed that the advance lines '652', '574' and '672' performed better in terms of yield and yield contributing traits and these lines may be used for further breeding programmes. The highest phenotypic and genotypic coefficients of variation were noted for marketable yield (14.57–12.69%), followed by gross yield (11.42–9.78%) and days for bulb initiation (6.21–5.64%). The high heritability and high genetic advance were recorded in gross yield (73.26 and 17.26%) and marketable yield (75.90 and

22.80%), suggesting the major role of genetic constituents in the expression of the character. The gross yield had strong positive correlation with bulb diameter, bulb size index and bulb weight.

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