International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(9): 921-926
www.biochemjournal.com
Received: 08-08-2025
Accepted: 18-09-2025

Rajshree Gayen
Principal Scientist, Department of Vegetable Science, College of Agriculture, (IGKV), Raipur, Chhattisgarh, India

Kimneihchong Gangte
M.Sc. Research Scholar, Department of Vegetable Science, College of Agriculture, (IGKV), Raipur, Chhattisgarh, India

Jitendra Trivedi
Principal Scientist, Department of Vegetable Science, College of Agriculture, (IGKV), Raipur, Chhattisgarh, India

Kiran N
M.Sc. Research Scholar, Department of Vegetable Science, College of Agriculture, (IGKV), Raipur, Chhattisgarh, India

Corresponding Author:
Kimneihchong Gangte
M.Sc. Research Scholar, Department of Vegetable Science, College of Agriculture, (IGKV), Raipur, Chhattisgarh, India

Genetic variability and character association analysis in white onion (*Allium cepa* L.) genotypes

Rajshree Gayen, Kimneihchong Gangte, Jitendra Trivedi and Kiran N

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i9Sl.5618

Abstract
The study on "Genetic variability and character association analysis in white onion (*Allium cepa* L.) genotypes" was conducted during *rabi* 2024-25 at IGKV, Raipur using 14 genotypes in RBD with three replications. Significant variability was observed for yield and its components. WTA-24-14 (365.04 q/ha) was the highest yielder, followed by WTA-24-04 and WTA-24-07. High GCV, PCV, heritability and genetic advance were recorded for % A grade bulbs, number of bulbs per plot, average bulb weight and total yield. Total yield showed strong positive correlations with number of bulbs per plot, bulb weight, marketable yield and vegetative growth characters. Path analysis revealed that number of bulbs per plot, average bulb weight, neck length, marketable yield and bulb diameter exerted direct positive effects on yield, suggesting these traits as key selection criteria for genetic improvement.

Keywords: Genetic variability, heritability, correlation, path analysis and onion

Introduction
Onion (*Allium cepa* L.) is one of the most important commercial vegetable and spice crops, belonging to the family *Alliaceae* with a chromosome number of 2n = 16. India is the second largest producer after China and onion is a major export-oriented crop contributing significantly to the national economy (Singh, 2021) [19]. Based on bulb colour, onions are classified into red, yellow, and white types. Among these, white onion is preferred for processing due to its high total soluble solids (TSS) and mild flavour.

White onions are also valued for their nutritional and therapeutic properties, being rich in vitamins, minerals, flavonoids and sulphur compounds that provide antioxidant, antimicrobial, anti-inflammatory and cardioprotective benefits (Amarananjundeswara *et al*., 2020) [2]. Despite its importance, the productivity of high TSS white onions in India remains relatively low owing to limited improved varieties, post-harvest losses and inadequate breeding efforts.

In India, Onion is grown in an area of 1540.7 thousand hectares, yielding a total of 24244.4 thousand MT with a 15.7 MT productivity. India is the world's second largest onion producer with Maharashtra accounting for 35.5% of India's total onion production (Anon., 2023-24 a) [3].

In Chhattisgarh, it is cultivated in an area of 22.81 thousand hectares with a total production of 380.82 thousand MT and a productivity of 16.69 MT. Raipur, Durg, Raigarh, Kanker, Surajpur, Dantewada, Kondagaon, Mahasamund, Kabirdham and Sarguja are some of the major onion farming districts in Chhattisgarh. (Anon., 2023-24 b) [4]

As a cross-pollinated crop, onion possesses wide genetic variability which can be effectively exploited for improvement. Estimation of genetic parameters such as genotypic and phenotypic coefficients of variation (GCV and PCV), heritability and genetic advance as percentage of mean provides useful information for the selection of superior genotypes. In addition, correlation and path coefficient analysis help in understanding the inter-relationship among traits and identifying effective selection criteria for yield improvement.

Thus, the present study was carried out to estimate genetic variability, heritability and genetic advance as percentage of mean and to analyse correlation and path coefficients in white onion genotypes in order to identify key traits influencing bulb yield.

Materials and Methods
Location and traits: The present study was carried out at Horticulture Research cum Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi

Vishwavidyalaya, Raipur (C.G.) during winter (*rabi*) season of 2024-25. The soil of the experimental field was clay-loam having pH 7.09. The experiment was laid out in Randomized Block Design (RBD) in a plot size 2.25 m x 2 m with three replications at spacing of 15 cm x 10 cm. The experimental material consisted of 14 genotypes of white onion maintained by the Department of Horticulture, IGKV, Raipur were used as a planting material. Healthy onion seedlings of all the 14 genotypes were planted and uniformly maintained by adopting the cultural practices in onion cultivation. The data were recorded for 23 characters, *viz.* plant height (cm), number of leaves per plant, leaf length (cm), neck length (cm), neck thickness (cm), polar diameter (cm), equatorial diameter (cm), % A grade bulbs (by number), % B grade bulbs (by number), % C grade bulbs (by number), % bolter bulbs (by number), % double bulbs (by number), % undersize bulbs (by number), % rot bulbs (by number), days to harvesting from transplanting, number of bulbs per plot (kg/plot), average bulb weight (g), marketable yield (A+B+C) (q/ha), total yield (q/ha), total soluble solids (TSS%), reducing sugars (%), non-reducing sugars (%) and total sugars (%).

Statistical analysis: As suggested by Panse and Sukhatme (1967) [15], statistical analysis was performed on the mean values obtained from the 5 competitive plants for different horticultural traits that were randomly selected from each genotype in each replication. The variables of genotypic and phenotypic coefficients of variation were computed according to formula given by Lush (1940) [14] while broad sense heritability as per Hanson *et al.* (1956) [9]. Expected genetic advance (GA) was calculated as per the method suggested by Johnson *et al.* (1955) [12]. The genotypic and phenotypic correlation coefficient between the variables were computed as proposed by Miller *et al*. (1958) [13]. The genotypic correlation coefficients were further divided into direct and indirect effects with the help of path coefficient analysis as suggested by Wright (1921) [20] and elaborated by Dewey and Lu (1959) [6].

Results and Discussion

The analysis of variance as shown in Table 1 revealed highly significant differences among the genotypes for all the traits studied, indicating the existence of considerable variability within the genotypes. Variability in onion genotypes provides a broad base for selection, enabling breeders to identify superior plants for yield and quality traits. Assessing variability is essential to understand the extent of genetic diversity and to plan effective breeding and improvement programs. Dinkar (2017) [7], Hugar (2018) [10] and Jat and Vikram (2018) [11] also recorded adequate variability in their genetic materials.

Estimates of phenotypic and genotypic coefficients of variability, heritability and genetic advance as percentage of mean for different traits are presented in Table 2. The magnitude of phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters. High estimates of genotypic and phenotypic coefficients of variation (GCV and PCV) were recorded for % A grade bulbs (52.66% and 53.45%, respectively) followed by % undersize bulbs (43.91% and 45.12%), % rot bulbs (37.44% and 38.89%), number of bulbs per plot (28.66% and 30.78%), % double bulbs (28.25% and 29.91%), average bulb weight (25.72% and 27.91%), % bolter bulbs (18.83% and 21.44%) and total soluble solids (18.59% and 20.58%) reflecting wide genetic variability and offering considerable scope for improvement through direct selection. Moderate estimates of GCV and PCV were observed for % C grade bulbs (17.52% and 19.25%), total yield (16.86% and 19.20%), plant height (14.58% and 16.67%), reducing sugars (14.29% and 16.95%), number of leaves per plant (14.02% and 15.56%), polar diameter (13.59% and 16.17%), neck length (13.55% and 16.32%), non-reducing sugars (13.47% and 16.68%), equatorial diameter (12.42% and 14.69%), marketable yield (11.24% and 14.81%), leaf length (9.95% and 13.18%), % B grade bulbs (8.49% and 12.00%) and neck thickness (7.41% and 11.16%) suggesting the presence of moderate variability, where selection may be effective under appropriate breeding strategies. Low estimates of both GCV and PCV were recorded for total sugars (5.59% and 8.39%) and days to harvesting from transplanting (0.80% and 1.28%) which indicate limited variability, implying that improvement in these traits may be difficult through simple selection and might require alternative approaches such as hybridization or biotechnological interventions. These findings are in agreement with Sahu *et al*. (2017) [17], Dinkar (2017) [7], Dangi *et al*. (2018) [5] and Jat and Vikram (2018) [11].

Genetic coefficient of variation does not indicate amount of heritable variation; hence, estimation of heritability needs to be work out. Heritability indicates the proportion of observed variation due to genetic factors and helps predict the effectiveness of selection for trait improvement. High estimates of heritability in the broad sense were observed for several traits, indicating a strong genetic influence with relatively low environmental effects. The highest heritability was recorded for % A grade bulbs (97.06 %) followed by % undersize bulbs (94.67 %), % rot bulbs (92.66 %), % double bulbs (89.17 %), number of bulbs per plot (86.74 %), average bulb weight (84.91 %), % C grade bulbs (82.81 %), total soluble solids (81.57 %), number of leaves per plant (81.21 %), % bolter bulbs (77.14 %), total yield (77.13 %), plant height (76.55 %), equatorial diameter (71.51 %), reducing sugars (71.07 %), polar diameter (70.72 %), neck length (68.93 %) and non-reducing sugars (65.17 %). Moderate estimates of heritability in the broad sense were recorded for marketable yield (57.60 %), leaf length (57.00 %), % B grade bulbs (50.09 %), total sugars (44.45 %), neck thickness (44.08 %) and days to harvesting from transplanting (38.81 %) suggesting that both genetic and environmental factors influence these characters. Similar observations were also reported by Aditika *et al.* (2017) [1], Dinkar (2017) [7], Hugar (2018) [10], Jat and Vikram (2018) [11] in their experiment.

Genetic advance as percentage of mean indicates the expected improvement over the population mean after selection, helping to judge the effectiveness of selection for a trait. Genetic advance as percentage of mean values ranges from 1.03 - 106.88 %. High values of genetic advance as percentage of mean were recorded for % A grade bulbs (106.88 %) followed by % undersize bulbs (88.01 %), % rot bulbs (74.24 %), number of bulbs per plot (55.00 %), % double bulbs (54.96 %), average bulb weight (48.83 %), total soluble solids (34.59 %), % bolter bulbs (34.08 %), %

C grade bulbs (32.84 %), total yield (30.51 %), plant height (26.29 %), number of leaves per plant (26.03 %), reducing sugars (24.82 %), polar diameter (23.55 %), neck length (23.18 %), non-reducing sugars (22.40 %) and equatorial diameter (21.64 %) which indicates the predominance of additive gene action and the effectiveness of selection for these traits. High GAM values coupled with high heritability (as observed in the present study) suggest that direct selection would lead to substantial improvement in these characters. Moderate genetic advance as percentage of mean was observed for marketable yield (17.58 %), leaf length (15.48 %), % B grade bulbs (12.38 %) and neck thickness (10.13 %).Low values of genetic advance as percentage of mean were recorded for total sugars (7.68 %) and days to harvesting from transplanting (1.03 %).Similar results were also reported by Aditika *et al.* (2017) [1], Dinkar (2017) [7], Hugar (2018) [10], Jat and Vikram (2018) [11] in their experiment.

Correlation coefficient analysis is a statistical tool used to determine the strength and direction of a relationship between two or more variables. Association among different yield attributing characters with total yield was calculated in all possible phenotypic (P) and genotypic (G) levels which is presented in Table 3 and 4. Character wise results of the correlation study were explained at genotypic and phenotypic levels. Estimates for phenotypic and genotypic correlation coefficients revealed that phenotypic correlations were generally of a higher magnitude than the corresponding genotypic correlations for most of the character combinations, indicating that the apparent associations among traits were largely influenced by environmental factors rather than strong inherent genetic relationships. Number of bulbs per plot (0.772; 0.772) expressed highest positive and highly significant association with total yield at genotypic and phenotypic level followed by average bulb weight (0.725; 0.726), marketable yield (0.706; 0.707), plant height (0.704; 0.711), % A grade bulbs (0.688; 0.688), number of leaves per plant (0.681; 0.683), neck length (0.664; 0.667), equatorial diameter (0.575; 0.576), polar diameter (0.570; 0.581), leaf length (0.555; 0.556), % double bulbs (0.538; 0.539). Total yield expressed positive and significant association on neck thickness (0.381; 0.381) and days to harvesting from transplanting (0.370; 0.387) whereas, % C grade bulbs, % undersize bulbs and % bolter bulbs expressed negative and significant association at genotypic and phenotypic correlation with total yield. These results are in agreement with Sahu *et al.* (2017) [17], Santra *et al.* (2017) [16], Dinkar (2017) [7] and Singh *et al.* (2018) [18]

Direct and indirect effect was work out through path analysis by taking total yield as depended variables and remaining characters as independent variables. Direct and indirect effects of bulb yield and its contributing characters in onion are shown in Table 5. Among all the characters studied, number of bulbs per plot (0.4005), neck length (0.2832), % undersize bulbs (0.2572), % A grade bulbs (0.2372), marketable yield (0.1724), number of leaves per plant (0.1535), equatorial diameter (0.1158), % B grade bulbs (0.1056), plant height (0.0723), leaf length (0.0628), % C grade bulbs (0.0191), average bulb weight (0.0101) and polar diameter (0.0088) had significant positive direct effect on total yield. Whereas, % bolter bulbs (-0.1300), % double bulbs (-0.1308) and neck thickness (-0.2288) had negative direct effect on total yield. The residual effect at the genotypic level was minimal (0.292) indicating that the maximum number of independent variables were used in this study on the dependent variable. These results are in close conformity with the findings of Dinkar (2017) [7], Dwivedi and Jain (2017) [8], Sahu *et al*. (2017) [17] and Singh *et al*. (2018) [18].

Table 1: Analysis of variance for bulb yield and its components characters in white onion (*Allium cepa* L.) genotypes

S. No.	Characters	Mean sums of squares		
		Replication	Treatment	Error
		Degree of freedom		
		2	13	26
1	Plant height (cm)	19.530	201.669**	18.681
2	Number of leaves per plant	0.234	5.407**	0.387
3	3Leaf length (cm)	11.493	82.963**	16.668
4	Neck length (cm)	0.013	0.599**	0.078
5	Neck Thickness (cm)	0.003	0.029**	0.009
6	Polar diameter (cm)	0.407	1.493**	0.181
7	Equatorial diameter (cm)	0.051	1.972**	0.231
8	% A grade bulbs (by number)	0.188	134.543**	1.344
9	% B grade bulbs (by number)	3.423	57.823**	14.413
10	% C grade bulbs (by number)	17.418	103.978**	6.726
11	% bolter bulbs (by number)	0.034	0.371**	0.033
12	% double bulbs (by number)	0.016	0.598**	0.023
13	% undersize bulbs (by number)	0.158	5.141**	0.095
14	% rot bulbs (by number)	0.003	7.607**	0.196
15	Days to harvesting from transplanting	3.304	4.005*	1.380
16	Number of bulbs per plot (kg/plot)	0.509	98.452**	4.774
17	Average bulb weight (g)	6.229	1067.538**	59.664
18	Marketable yield (A+B+C) (q/ha)	88.374	3005.166**	592.026
19	Total yield (q/ha)	60.992	7193.248**	647.009
20	Total soluble solids (TSS %)	0.592	16.390**	1.148
21	Reducing sugars (%)	0.007	0.594**	0.071
22	Non-reducing sugars (%)	0.102	0.601**	0.091
23	Total sugars (%)	0.342	0.483**	0.142

Table 2: Estimates of phenotypic and genotypic coefficients of variability, heritability and genetic advance as percentage of mean

Characters	Range		Coefficient of variability (%)		Heritability $(H^2)_{bs}$ (%)	Genetic advance as % of mean
	Min	Max	PCV	GCV		
Plant height (cm)	42.55	67.27	16.67	14.58	76.55	26.29
Number of leaves per plant	7.00	11.51	15.56	14.02	81.21	26.03
Leaf length (cm)	38.30	56.96	13.18	9.95	57.00	15.48
Neck length (cm)	2.33	3.84	16.32	13.55	68.93	23.18
Neck thickness (cm)	0.87	1.25	11.16	7.41	44.08	10.13
Polar diameter (cm)	3.92	6.02	16.17	13.59	70.72	23.55
Equatorial diameter (cm)	4.55	7.26	14.69	12.42	71.51	21.64
% A grade bulbs (by number)	6.26	30.02	53.45	52.66	97.06	106.88
% B grade bulbs (by number)	36.52	51.66	12.00	8.49	50.09	12.38
% C grade bulbs (by number)	17.79	38.19	19.25	17.52	82.81	32.84
% bolter bulbs (by number)	1.22	2.34	21.44	18.83	77.14	34.08
% double bulbs (by number)	1.06	2.47	29.91	28.25	89.17	54.96
% undersize bulbs (by number)	1.15	5.35	45.12	43.91	94.67	88.01
% rot bulbs (by number)	1.59	7.68	38.89	37.44	92.66	74.24
Days to harvesting from transplanting	115.33	119.33	1.28	0.80	38.81	1.03
Number of bulbs per plot (kg/plot)	9.07	26.79	30.78	28.66	86.74	55.00
Average bulb weight (g)	36.50	94.10	27.91	25.72	84.91	48.83
Marketable yield (A+B+C) (q/ha)	199.04	300.00	14.81	11.24	57.60	17.58
Total yield (q/ha)	225.56	365.03	19.20	16.86	77.13	30.51
Total soluble solids (TSS%)	9.40	16.79	20.58	18.59	81.57	34.59
Reducing sugars (%)	2.27	3.63	16.95	14.29	71.07	24.82
Non-reducing sugars (%)	2.14	3.73	16.68	13.47	65.17	22.40
Total sugars (%)	5.36	6.94	8.39	5.59	44.45	7.68

Table 3: Genotypic coefficient of correlation among different traits in white onion genotypes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.000	0.812**	0.735**	0.749**	0.561**	0.726**	0.717**	0.783**	0.700**	-0.520**	-0.424**	0.498**	-0.691**	0.208	0.498**	0.627**	0.538**	0.563**	0.704**
2		1.000	0.717**	0.814**	0.742**	0.819**	0.781**	0.820**	0.811**	-0.645**	-0.390*	0.512**	-0.642**	0.227	0.324*	0.482**	0.461**	0.472**	0.681**
3			1.000	0.588**	0.660**	0.725**	0.770**	0.745**	0.573**	-0.566**	-0.368*	0.459**	-0.555**	0.292	0.350*	0.468**	0.373*	0.412**	0.555**
4				1.000	0.613**	0.756**	0.759**	0.774**	0.679**	-0.625**	-0.392*	0.488**	-0.635**	0.185	0.382*	0.429**	0.499**	0.400**	0.664**
5					1.000	0.643**	0.592**	0.589**	0.614**	-0.474**	-0.282	0.282	-0.539**	0.245	0.189	0.314*	0.367*	0.333*	0.381*
6						1.000	0.778**	0.743**	0.624**	-0.567**	-0.354*	0.446**	-0.653**	0.275	0.195	0.389*	0.415**	0.310*	0.570**
7							1.000	0.729**	0.733**	-0.552**	-0.277	0.455**	-0.678**	0.347*	0.258	0.378*	0.367*	0.368*	0.575**
8								1.000	0.712**	-0.762**	-0.336*	0.658**	-0.446**	0.182	0.621**	0.490**	0.460**	0.506**	0.688**
9									1.000	-0.563**	-0.301	0.376*	-0.559**	0.215	0.318*	0.393**	0.367*	0.346*	0.588**
10										1.000	0.061	-0.348*	0.200	-0.240	-0.432**	-0.412**	-0.415**	-0.338*	-0.548**
11											1.000	-0.432**	0.440**	-0.087	-0.214	-0.214	-0.191	-0.266	-0.345*
12												1.000	-0.316*	-0.071	0.400**	0.492**	0.471**	0.524**	0.538**
13													1.000	-0.200	-0.082	-0.334*	-0.311*	-0.331*	-0.387*
14														1.000	-0.032	-0.183	-0.149	-0.180	-0.138
15															1.000	0.396**	0.321*	0.317*	0.370*
16																1.000	0.902**	0.750**	0.772**
17																	1.000	0.735**	0.725**
18																		1.000	0.706**

1. Plant height (cm)	2. Number of leaves per plant	3. Leaf length (cm)
4. Neck length (cm)	5. Neck thickness (cm)	6. Polar diameter (cm)
7. Equatorial diameter (cm)	8. % A grade bulbs (by number)	9. % B grade bulbs (by number)
10. % C grade bulbs (by number)	11. % bolter bulbs (by number)	12. % double bulbs (by number)
13. % undersize bulbs (by number)	14. % rot bulbs (by number)	15. Days to harvesting from transplanting
16. Number of bulbs per plot (kg/plot)	17. Average bulb weight (g)	18. Marketable yield (A+B+C) (q/ha)
19. Total yield (q/ha)		

****** Significant at 1

Table 4: Phenotypic coefficient of correlation among different traits in white onion genotypes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.000	0.814**	0.759**	0.749**	0.563**	0.724**	0.726**	0.786**	0.701**	-0.525**	-0.441**	0.508**	-0.692**	0.210	0.532**	0.634**	0.542**	0.566**	0.711**
2		1.000	0.729**	0.817**	0.741**	0.822**	0.789**	0.821**	0.810**	-0.644**	-0.396**	0.519**	-0.640**	0.228	0.357*	0.484**	0.464**	0.470**	0.683**
3			1.000	0.599**	0.671**	0.761**	0.773**	0.753**	0.584**	-0.578**	-0.360*	0.457**	-0.565**	0.294	0.356*	0.468**	0.376*	0.416**	0.556**
4				1.000	0.617**	0.765**	0.762**	0.775**	0.682**	-0.635**	-0.401**	0.492**	-0.636**	0.186	0.395**	0.431**	0.499**	0.402**	0.667**
5					1.000	0.643**	0.600**	0.590**	0.612**	-0.468**	-0.285	0.288	-0.536**	0.246	0.222	0.316*	0.371*	0.329*	0.381*
6						1.000	0.802**	0.753**	0.624**	-0.565**	-0.374*	0.466**	-0.655**	0.280	0.245	0.400**	0.425**	0.309*	0.581**
7							1.000	0.731**	0.741**	-0.567**	-0.278	0.453**	-0.685**	0.348*	0.253	0.378*	0.366*	0.372*	0.576**
8								1.000	0.713**	-0.770**	-0.339*	0.660**	-0.446**	0.182	0.646**	0.491**	0.461**	0.507**	0.688**
9									1.000	-0.560**	-0.305*	0.382*	-0.557**	0.216	0.351*	0.396**	0.371*	0.343*	0.589**
10										1.000	0.058	-0.358*	0.193	-0.242	-0.494**	-0.417**	-0.424**	-0.334*	-0.551**
11											1.000	-0.432**	0.445**	-0.087	-0.225	-0.213	-0.193	-0.267	-0.344*
12												1.000	-0.322*	-0.071	0.402**	0.492**	0.471**	0.528**	0.539**
13													1.000	-0.201	-0.103	-0.335*	-0.314*	-0.329*	-0.388*
14														1.000	-0.032	-0.183	-0.149	-0.180	-0.138
15															1.000	0.409**	0.325*	0.345*	0.387*
16																1.000	0.902**	0.752**	0.772**
17																	1.000	0.738**	0.726**
18																		1.000	0.707**

1. Plant height (cm)	2. Number of leaves per plant	3. Leaf length (cm)
4. Neck length (cm)	5. Neck thickness (cm)	6. Polar diameter (cm)
7. Equatorial diameter (cm)	8. % A grade bulbs (by number)	9. % B grade bulbs (by number)
10. % C grade bulbs (by number)	11. % bolter bulbs (by number)	12. % double bulbs (by number)
13. % undersize bulbs (by number)	14. % rot bulbs (by number)	15. Days to harvesting from transplanting
16. Number of bulbs per plot (kg/plot)	17. Average bulb weight (g)	18. Marketable yield (A+B+C) (q/ha)
19. Total yield (q/ha)		

****** Significant at

Table 5: Direct and indirect effect of yield and yield component trait on white onion (*Allium cepa* L.) at genotypic level

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	0.0723	0.0588	0.0532	0.0541	0.0406	0.0525	0.0518	0.0566	0.0507	-0.0376	-0.0307	0.0360	-0.0500	0.0150	0.0361	0.0454	0.0389	0.0407	0.7038**
2	0.1247	0.1535	0.1100	0.1250	0.1140	0.1257	0.1199	0.1258	0.1245	-0.0990	-0.0599	0.0786	-0.0986	0.0349	0.0497	0.0740	0.0707	0.0725	0.6814**
3	0.0461	0.0450	0.0628	0.0369	0.0414	0.0455	0.0483	0.0468	0.0360	-0.0355	-0.0231	0.0288	-0.0348	0.0184	0.0220	0.0294	0.0234	0.0258	0.5550**
4	0.2119	0.2306	0.1665	0.2832	0.1735	0.2140	0.2150	0.2191	0.1924	-0.1770	-0.1111	0.1383	-0.1797	0.0525	0.1083	0.1216	0.1412	0.1132	0.6639**
5	-0.1285	-0.1699	-0.1510	-0.1402	-0.2288	-0.1471	-0.1354	-0.1347	-0.1406	0.1085	0.0646	-0.0646	0.1233	-0.0561	-0.0432	-0.0719	-0.0840	-0.0761	0.3808*
6	0.0064	0.0072	0.0064	0.0067	0.0057	0.0088	0.0069	0.0066	0.0055	-0.0050	-0.0031	0.0039	-0.0058	0.0024	0.0017	0.0034	0.0037	0.0027	0.5700**
7	0.0829	0.0904	0.0891	0.0879	0.0685	0.0901	0.1158	0.0844	0.0848	-0.0639	-0.0321	0.0527	-0.0785	0.0402	0.0298	0.0438	0.0425	0.0426	0.5747**
8	0.1856	0.1944	0.1768	0.1836	0.1396	0.1762	0.1730	0.2372	0.1688	-0.1808	-0.0796	0.1561	-0.1056	0.0432	0.1472	0.1162	0.1092	0.1201	0.6876**
9	0.0740	0.0857	0.0605	0.0718	0.0649	0.0660	0.0774	0.0752	0.1056	-0.0595	-0.0318	0.0397	-0.0591	0.0227	0.0336	0.0415	0.0388	0.0365	0.5875**
10	-0.0099	-0.0123	-0.0108	-0.0120	-0.0091	-0.0108	-0.0106	-0.0146	-0.0108	0.0191	0.0012	-0.0067	0.0038	-0.0046	-0.0083	-0.0079	-0.0079	-0.0065	-0.5477**
11	0.0552	0.0507	0.0479	0.0510	0.0367	0.0461	0.0361	0.0437	0.0391	-0.0079	-0.1300	0.0562	-0.0572	0.0113	0.0279	0.0279	0.0249	0.0347	-0.3449*
12	-0.0652	-0.0670	-0.0600	-0.0639	-0.0369	-0.0584	-0.0595	-0.0861	-0.0492	0.0455	0.0566	-0.1308	0.0414	0.0093	-0.0523	-0.0644	-0.0617	-0.0685	0.5380**
13	-0.1776	-0.1652	-0.1427	-0.1632	-0.1386	-0.1681	-0.1744	-0.1146	-0.1439	0.0514	0.1131	-0.0814	0.2572	-0.0515	-0.0210	-0.0858	-0.0800	-0.0851	-0.3872*
14	-0.0364	-0.0399	-0.0513	-0.0325	-0.0430	-0.0483	-0.0609	-0.0320	-0.0378	0.0421	0.0152	0.0125	0.0352	-0.1755	0.0055	0.0321	0.0262	0.0316	-0.1378
15	-0.0917	-0.0596	-0.0644	-0.0703	-0.0347	-0.0358	-0.0474	-0.1142	-0.0585	0.0794	0.0395	-0.0735	0.0150	0.0058	-0.1839	-0.0728	-0.0590	-0.0583	0.3696*
16	0.2513	0.1930	0.1874	0.1720	0.1259	0.1560	0.1516	0.1963	0.1575	-0.1651	-0.0858	0.1970	-0.1336	-0.0732	0.1585	0.4005	0.3612	0.3005	0.7716**
17	0.0055	0.0047	0.0038	0.0051	0.0037	0.0042	0.0037	0.0047	0.0037	-0.0042	-0.0019	0.0048	-0.0032	-0.0015	0.0033	0.0091	0.0101	0.0074	0.7249**
18	0.0971	0.0814	0.0710	0.0689	0.0573	0.0535	0.0635	0.0873	0.0596	-0.0583	-0.0460	0.0903	-0.0571	-0.0310	0.0547	0.1293	0.1266	0.1724	0.7063**

1. Plant height (cm)	2. Number of leaves per plant	3. Leaf length (cm)
4. Neck length (cm)	5. Neck thickness (cm)	6. Polar diameter (cm)
7. Equatorial diameter (cm)	8. % A grade bulbs (by number)	9. % B grade bulbs (by number)
10. % C grade bulbs (by number)	11. % bolter bulbs (by number)	12. % double bulbs (by number)
13. % undersize bulbs (by number)	14. % rot bulbs (by number)	15. Days to harvesting from transplanting
16. Number of bulbs per plot (kg/plot)	17. Average bulb weight (g)	18. Marketable yield (A+B+C) (q/ha)
19. Total yield (q/ha)		

Residual effect 0.292

Conclusion

The present study revealed the presence of wide variability among the genotypes for several yield and yield-attributing traits. High GCV, PCV, heritability and genetic advance were observed for traits such as percentage of A-grade bulbs, number of bulbs per plot, average bulb weight, total soluble solids and total yield indicating predominance of additive gene action and effectiveness of direct selection for these traits.

Correlation and path coefficient analysis revealed number of bulbs per plot, neck length, percentage of A-grade bulbs, marketable yield, number of leaves per plant, equatorial diameter and plant height as the most important traits exerting positive and direct effects on total yield. In contrast, percentage of bolter bulbs, double bulbs, and neck thickness showed negative direct effects on total yield.

Overall, the study highlights number of bulbs per plot, average bulb weight and percentage of A-grade bulbs as the most reliable selection criteria for improving total yield in white onion (*Allium cepa* L.) genotypes. Therefore, genotypes WTA-24-14, WTA-24-04 and WTA-24-07 were identified as promising lines and can be effectively utilized in future breeding programs for yield improvement.

References

1. Aditika A, Priyanka, Dod V, Sharma M. Variability studies in rabi onion (*Allium cepa* var. *cepa* L.) for yield and yield contributing traits. Int J Farm Sci. 2017;7(1):123-126.
2. Amarananjundeswara H, Priyadarshini G, Doddabasappa B, Vasudeva KR, Anjanappa M, Prasad PS, *et al*. Evaluation of white onion (*Allium cepa* L.) genotypes for growth, yield and yield attributing characters. J Pharmacogn Phytochem. 2020;9(5):477-480.
3. Anonymous. Agricultural statistics at a glance 2023-24. Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India; 2023. p.166.
4. Anonymous. Area, production and productivity of horticulture crops district wise in Chhattisgarh 2023-24. Directorate of Horticulture and Farm Forestry, Naya Raipur (C.G.); 2024.
5. Dangi R, Kumar A, Khar A. Genetic variability, heritability, and diversity analysis studies in short day tropical onion (*Allium cepa* L.). Indian J Agric Sci. 2018;88(6):140-149.
6. Dewey DR, Lu K. A correlation and path-coefficient analysis of components of crested wheatgrass seed production. Agron J. 1959;51(9):515-518.
7. Dinkar RK. Studies on genetic variability and performance of kharif onion genotypes [MSc thesis]. Raipur: Indira Gandhi Krishi Vishwavidyalaya; 2017.
8. Dwivedi M, Jain N. Correlation and path analysis study in onion (*Allium cepa* L.) genotypes. Int J. 2017;10(27):5667-5672.
9. Hanson CH, Robinson HF, Comstock RE. Biometrical studies of yield in segregating populations of Korean lespedeza. Agron J. 1956;48(6):268-272.
10. Hugar HM. Genetic variability and molecular characterization in onion (*Allium cepa* L.) [MSc thesis]. Bagalkot: University of Horticultural Sciences; 2018.
11. Jat MK, Vikram B. Studies of variability pattern in agro-morphological characters in the onion genotypes (*Allium cepa* L.) in rabi season under Allahabad agro-climactic condition. J Pharmacogn Phytochem. 2018;7(2):2051-2054.
12. Johnson HW, Robinson HF, Comstock RE. Genotypic and phenotypic correlations in soybeans and their implications in selection. Agron J. 1955;47(10):477-480.
13. Miller PA, Williams JC Jr, Robinson HF, Comstock RE. Estimates of genotypic and environmental variances and covariances in upland cotton and their implications in selection. Agron J. 1958;50(3):126-131.
14. Lush JL. Intra-sire correlations or regressions of offspring on dam as a method of estimating heritability of characteristics. J Anim Sci. 1940;1(3):293-301.
15. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 2nd ed. New Delhi: Indian Council of Agricultural Research; 1967. p.381-385.
16. Santra P, Manna D, Sarkar HK, Maity TK. Genetic variability, heritability and genetic advance in kharif onion (*Allium cepa* L.). J Crop Weed. 2017;13(1):103-106.
17. Sahu K, Sharma PK, Dixit A, Nair SK. Correlation and path coefficient analysis in kharif onion (*Allium cepa* L.) genotypes for Chhattisgarh plains condition. Int J Curr Microbiol Appl Sci. 2017;6:256-263.
18. Singh P, Soni AK, Khandelwal SK, Diwaker P, Agarwal H, Regar OP. Character association and path coefficient analysis in onion (*Allium cepa* L.). J Pharmacogn Phytochem. 2018;7(1):1882-1886.
19. Singh PR. Diversity studies in white onion (*Allium cepa* L.) genotypes [PhD thesis]. Raipur: College of Agriculture, IGKV; 2021.
20. Wright S. Correlation and causation. J Agric Res. 1921;20(7):557-585.