Correlation and Path Coefficient Analysis of Onion (*Allium cepa* L.) for Green Foliage Yield

ABSTRACT

The present investigation was carried out during the year 2023-24 in the experimental field of Department of Vegetable Science at Pt. KLS College of Horticulture and Research Station, Rajnandgaon under Mahatma Gandhi University of Horticulture and Forestry, Sankra-Patan, Durg (C.G.). The experiment, consisting of 11 varieties of onion was laid under Randomized Block Design (RBD) with three replications. High magnitude of phenotypic coefficient of variance were observed for green foliage yield per hectare (33.71 %), green foliage yield per plot (33.46 %) and diameter of bulb (22.74 %). High magnitude of genotypic coefficient of variance were observed for green foliage yield per hectare (32.31 %) and green foliage yield per plot (32.02 %). The estimates of heritability were recorded high for dry matter percentage of leaves (97.97 %). High value of genetic advance as percentage of mean was recorded for green foliage yield per hectare (63.79 %). Green foliage yield per hectare had highly significant and positive correlation both at genotypic and phenotypic level with green foliage yield per plant (0.787 and 0.649), dry matter percentage of leaves (0.794 and 0.748), plant height (0.746 and 0.577), length of leaves (0.659 and 0.589), collar girth (0.814 and 0.533), dry matter percentage of bulbs (0.721 and 0.693) and moisture percentage of bulbs (0.740 and 0.646). Path coefficient analysis revealed positive and direct effect of green foliage yield per hectare was recorded *via* length of leaves followed by dry matter percentage of leaves, moisture percentage of bulbs, plant height, collar girth, dry matter percentage of bulbs, leaves width, moisture percentage of leaves, green foliage yield per plant and no. of leaves per plant.

Keywords: Genetic variability, correlation coefficient and path coefficient analysis.

1. Introduction:

The Onion (*Allium cepa* L.) is one of the most important vegetable crops grown throughout the world and is said to be native of Central Asia and Mediterranean region (McCollum *et al*., 1976). It is a monocot and belongs to the family Alliaceae, sub-family Allioideae and order Asparagales, having chromosome number 2n = 16. It is commonly known as "Queen of the kitchen" due to its highly valued flavor, aroma and unique taste (Selvaraj, 1976 and Griffiths *et al*., 2002). The leaves of green onions have a tender texture, making them suitable for raw consumption in salads as well as cooked dishes. Green onion leaves have a mild onion flavor and pungency than bulbs.

Genetic variability is a pre-requisite for the improvement of any crop, as yield often depends on the genetic variation present in germplasm (Srinivasana *et al*., 2015). India being considered as very good amount of genetic variation is present for all the characters in onion, which can be utilized to facilitate the selection programme for better genetic gains. The phenotypic variation arises because of phenotypic, genotypic and interaction between genotypic and environmental variations, but for making effective selections, the heritable unit i.e., the genetic variation is most important. At present, there is urgent need to develop early maturing high yielding region specific varieties to address local problems and varieties with wider adaptability (Singh et al., 2020). Hence, new genotypes must be characterized to assess the variability and identify promising genotypes which can be used in further breeding programmes (Afifa et al., 2024).

The success in breeding depends on the nature and interaction of genetic diversity. It is then important to separate the observed changes into hereditary and non-hereditary with the help of appropriate genetics. Analyzing the correlation between values can provide insight into the relationship between various quantitative characters. This helps growers select ideal plants for their onion breeding program and understand how individual traits affect overall results. However, knowledge of correlation alone is often misleading because when more variables are included in a study, the indirect association becomes more complex. In such situation the path coefficient analysis provides an effective means of finding direct and indirect cause of association.

2. Material and method:

The experiment was conducted under the experimental field of Department of Vegetable Science at Pt. KLS College of Horticulture and Research Station, Rajnandgaon (C.G.) during the *Rabi* season of year 2023-2024. The experiment consisted of eleven varieties of onion, which was laid out in randomized block design with three replications. Public and Private sector varieties available or popular varieties *viz* Desika, Krishi Phal, Pune Fursungi, Yellow Leaf, Super Rambo Gavran, Ankur Commander, Gulmohar TM, Dark King Red, Poona Red, Sankar Gavran, Nasik Red selected to estimate the genetic variability, correlation and path analysis in this experiment. Observations were recorded based on five random competitive separately plants for quantitative and qualitative parameters were evaluated. The observation on various characters were recorded and subjected to statistical analysis to test the level of significance as per the method by Panse and Sukhatme (1967). The mean values of plants were utilized for estimation of genotypic correlation coefficient as per the method suggested by Johnson *et al.*, (1955) whereas path coefficient analysis was worked out by the methods used by Dewey and Lu (1959) to find out the relation between yield and yield attributing traits.

3. Result and Discussion

3.1 Genetic variability

3.1.1 Phenotypic and genotypic coefficient of variance

The phenotypic and genotypic coefficient of variance was determined in Table 1. The phenotypic coefficient of variance (PCV) was generally higher than the genotypic coefficient of variance (GCV). High magnitude of phenotypic coefficient of variance (PCV) (i.e. >20 %) were observed for green foliage yield per hectare (33.71 %), green foliage yield per plot (33.46 %) and diameter of bulb (22.74 %), respectively. The moderate magnitude of phenotypic coefficient of variance (PCV) (10-20 %) were observed for green foliage yield per plant (19.67 %), collar girth 17.94 %), dry matter percentage of bulbs (15.87 %), leaves width (15.91 %), length of leaves (14.25 %), plant height (13.87 %), no. of leaves per plant (12.12 %) and dry matter percentage of leaves (11.86 %), respectively. The low magnitude of phenotypic coefficient of variance (PCV) and phenotypic coefficient of variance (PCV) (<10 %) were observed for moisture percentage of bulbs (6.45 %) and moisture percentage of leaves (2.49 %), respectively.

In case of high magnitude of genotypic coefficient of variance (GCV) (i.e. >20 %) were observed for green foliage yield per hectare (32.31 %) and green foliage yield per plot (32.02 %), respectively. The moderate magnitude of genotypic coefficient of variance (GCV) (10-20 %) were observed for diameter of bulb (18.88 %), green foliage yield per plant (16.85 %), dry matter percentage of bulbs

(15.53 %), collar girth (11.75 %), length of leaves (11.62 %) and dry matter percentage of leaves (11.74 %), respectively. The low magnitude of genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) (<10 %) were observed for plant height (7.94 %), no. of leaves per plant (7.63 %), leaves width (7.95 %), moisture percentage of bulbs (5.98 %) and moisture percentage of leaves (0.96 %), respectively.

3.1.2 Heritability

Estimate of heritability in broad sense determined for all the thirteen characters are presented in Table 1. High heritability (>70 %) was recorded for the dry matter percentage of leaves (97.97 %), dry matter percentage of bulbs (95.85 %), green foliage yield per hectare (91.85 %), green foliage yield per plot (91.59 %), moisture percentage of bulbs (85.78 %) and green foliage yield per plant (73.38 %). The character such as diameter of bulb (68.94 %) and length of leaves (66.46 %) exhibited the moderate heritability. However, low heritability estimates were observed for Collar girth (45.13 %), no. of leaves per plant (39.59 %), plant height (32.78 %) and leaves width (24.97 %). The results revealed that for all the traits, high heritability are less influenced by environmental changes and governed by the additive gene effects that are significantly contributing towards the expression of these traits. However, the remain attributes seems to be governed by non-additive gene effects. These results were supported by Singh *et al*., (2011), Dewangan and Sahu (2014), Hosamani *et al.,* (2010), Singh *et al.* (2017), Aditika *et al.,* (2017) and Laxmi *et al.,* (2015).

3.1.3 Genetic Advance

The genetic advance was calculated as percentage of mean for green foliage yield and its component characters which is shown in Table 1. Highest estimates of genetic advance as % of mean (>40 %) observed for green foliage yield per hectare (63.79 %) and green foliage yield per plot (63.14 %). The moderate genetic advance as % of mean (25 to 40 %) was observed in diameter of bulb (32.29 %) and green foliage yield per plant (29.74 %). Low genetic advance as % of mean (< 25 %) was observed for the characters such as dry matter percentage of leaves (23.95 %), length of leaves (19.52 %), Collar girth (16.27 %) and moisture percentage of bulbs (11.41 %). The results revealed that for all the traits, the high value of genetic advance for these attributes showed that these traits are governed by additive genes and the presence of moderate genetic advance indicates that both the additive and non-additive variance and low genetic advance indicates the presence of non-additive gene effects. These results were supported by Hosamani *et al.,* (2010), Singh *et al.,* (2017), Aditika *et al.,* (2017), Santra *et al.,* (2017) and Laxmi *et al.,* (2015).

3.2 Correlation Coefficient Analysis

The correlation coefficient at the phenotypic and genotypic levels, was obtained in all possible combination and is shown in Table 2. The genotypic correlation coefficient was found higher than the phenotypic correlation coefficient indicating a strong inherent association among various characters. The character green foliage yield per hectare exhibited highly significant and positive correlation, both at genotypic and phenotypic level with green foliage yield per plant (0.787 and 0.649), dry matter percentage of leaves (0.794 and 0.748), plant height (0.746 and 0.577), length of leaves (0.659 and 0.589), collar girth (0.814 and 0.533), dry matter percentage of bulbs (0.721 and 0.693) and moisture percentage of bulbs (0.740 and 0.646), respectively. The green foliage yield per hectare exhibited the positive and significant association, both at genotypic and phenotypic level with no. of leaves per plant (0.516 and 0.304), leaves width (0.782 and 0.414) and moisture percentage of leaves

(0.806 and 0.210). The results revealed that for all the traits, the level of genotypic correlation was higher to the corresponding phenotypic values for all the traits indicating that the association between the traits analysed is genetically regulated and will be followed in the subsequent generations. The low phenotypic values represent a significant amount of influence of environment on expression of characters. These findings corroborate by Singh *et al*., (2011) and Visalakshi *et al*., (2018), Hosamani *et al*., (2010) and Dewangan *et al*., (2014).

3.3 Path Coefficient Analysis

The direct and indirect effects of various characters on green foliage yield shown in Table 3. The highest positive direct effect which contributed towards green foliage yield per hectare was recorded via length of leaves (0.756), dry matter percentage of leaves (0.498), moisture percentage of bulbs (0.452), plant height (0.345), collar girth (0.198), dry matter percentage of bulbs (0.108), leaves width (0.099), moisture percentage of leaves (0.098), green foliage yield per plant (0.085) and no. of leaves per plant (0.017). Green foliage yield per plant exhibited positive indirect effect on green foliage yield per hectare through length of leaves (0.430), dry matter percentage of leaves (0.343), moisture percentage of bulbs (0.311) and plant height (0.159). The analysis of the path coefficients is calibrated for partial regression coefficients. It is immensely beneficial for vegetable breeders in two ways: first, it allows them to assess the direct consequences of specific characters on the dependent trait's green foliage production, and second, it clarifies the overall correlation between dependent and independent traits. The results are in propinquity with Aliyu *et al*., (2007), Hosamani *et al*., (2010), Dewangan *et al*., (2014), Visalakshi *et al.,* (2018), and Jatra *et al*., (2022).

4. Conclusion:

The phenotypic coefficient of variance (PCV) was generally higher than the genotypic coefficient of variance (GCV) for all the characters. Among different yield attributing traits studied, green foliage yield per hectare had the highest magnitude of GCV and PCV. The estimates of heritability were recorded high for dry matter percentage of leaves followed by dry matter percentage of bulbs, green foliage yield per hectare, green foliage yield per plot, moisture percentage of bulb and green foliage yield per plant. The high value of genetic advance as percentage of mean was recorded for green foliage yield per hectare followed by green foliage yield per plot, diameter of bulb and green foliage yield per plant. Genotypic correlation coefficient for majority of the traits exhibited higher value to their corresponding phenotypic correlation coefficient values, showing the inherent correlation among the traits. Green foliage yield per hectare had highly significant and positive correlation both at genotypic and phenotypic level with green foliage yield per plant, dry matter percentage of leaves, plant height, length of leaves, collar girth, dry matter percentage of bulbs and moisture percentage of bulbs. Path coefficient analysis revealed positive and direct effect of green foliage yield per hectare was recorded via length of leaves followed by dry matter percentage of leaves, moisture percentage of bulbs, plant height, collar girth, dry matter percentage of bulbs, leaves width, moisture percentage of leaves, green foliage yield per plant and no. of leaves per plant.

Table 1. Estimates of genetic parameters of variation for green foliage yield and its attributing traits in onion

Characters	Mean	Range		Coefficient of Variation (%)		Heritability (H^2b) %	Genetic Advance	GA value % means
		Minimum	Maximum	Phenotypic	Genotypic			
Plant height (cm)	41.36	38.86	56.06	13.87	7.94	32.78	4.29	9.36
No. of leaves per plant	5.20	4.60	5.93	12.12	7.63	39.59	0.51	9.89
Length of leaves (cm)	40.58	35.73	42.18	14.25	11.62	66.46	7.92	19.52
Leaves width (cm)	0.66	0.54	0.79	15.91	7.95	24.97	0.05	8.18
Collar girth (cm)	3.03	2.47	3.96	17.94	11.75	45.13	0.49	16.27
Diameter of bulb (cm)	1.73	1.14	2.85	22.74	18.88	68.94	0.55	32.29
Dry matter percentage of leaves	13.28	11.15	15.67	11.86	11.74	97.97	3.18	23.95
Dry matter percentage of bulbs	29.23	19.65	36.28	15.87	15.53	95.85	9.16	31.34
Moisture percentage of leaves	86.67	84.38	88.85	2.49	0.96	14.89	0.66	0.76
Moisture percentage of bulbs	70.70	63.73	79.37	6.45	5.98	85.78	8.06	11.41
Green foliage yield per plant (g)	24.88	18.39	33.77	19.67	16.85	73.38	4.7	29.74
Green foliage yield per plot (kg)	4.22	1.16	5.78	33.46	32.02	91.59	2.66	63.14
Green foliage yield per hectare (t)	8.43	2.24	11.56	33.71	32.31	91.85	5.37	63.79

Table 2. Phenotypic (PCV) and genotypic (GCV) coefficient of correlation for green foliage yield and its attributing traits in onion

Characters		Plant height	No. of leaves per plant	Length of leaves	Leaves width	Collar girth	Diameter of bulb	Dry matter percentage of leaves	Dry matter percentage of bulbs	Moisture percentage of leaves	Moisture percentage of bulbs	Green foliage yield per plant	Green foliage yield per hectare
Plant height	P	1.000	0.291	0.624**	0.479**	0.409*	0.120	0.491**	0.558**	0.113	0.394*	0.463**	0.577**
	G	1.000	0.622**	0.686**	0.840**	0.857**	0.374*	0.758**	0.741**	0.315	0.595**	0.735**	0.746**
No. of leaves per plant	P			0.532**	0.620**	0.365*	0.009	0.246	0.220	-0.369*	0.369*	0.524**	0.304
	G			0.715**	0.843**	0.864**	-0.294	0.351*	0.434*	-0.559**	0.595**	0.972**	0.516**
Length of leaves	P				0.391*	0.644**	0.214	0.672**	0.644**	0.059	0.584**	0.710**	0.589**
	G				0.960**	0.931**	0.343	0.848**	0.818**	0.564**	0.828**	0.953**	0.659**
Leaves width	P					0.542**	0.141	0.324	0.473**	0.317	0.605**	0.462**	0.414*
	G					0.916**	0.280	0.603**	0.941**	0.634**	0.978**	0.975**	0.782**
Collar girth	P						0.256	0.589**	0.529**	0.297	0.539**	0.693**	0.533**
	G						0.178	0.844**	0.756**	0.648**	0.927**	0.884**	0.814**
Diameter of bulb	P							0.206	0.448**	0.196	0.096	-0.123	-0.398*
	G							0.236	0.553**	0.658**	0.163	-0.130	-0.474**
Dry matter percentage of leaves	P								0.658**	-0.281	0.542**	0.690**	0.748**
	G								0.681**	-0.800**	0.592**	0.788**	0.794**
Dry matter percentage of bulbs	P									0.314	-0.692**	0.593**	0.693**
	G									0.846**	-0.754**	0.676**	0.721**
Moisture percentage of leaves	P										0.285	0.133	0.210
	G										0.898**	0.356*	0.806**
Moisture percentage of bulbs	P											0.691**	0.646**
	G											0.889**	0.740**
Green foliage yield per plant	P												0.649**
	G												0.787**
Green foliage yield per hectare	P												1.000
	G												1.000

Residuals are – 0.22616

Table 3. Direct and indirect effect of component character on green foliage yield in onion

Characters	Plant height	No. of leaves per plant	Length of leaves	Leaves width	Collar girth	Diameter of bulb	Dry matter percentage of leaves	Dry matter percentage of bulbs	Moisture percentage of leaves	Moisture percentage of bulbs	Green foliage yield per plant	Corre coeff. For green foliage yield per hectare
Plant height	**0.345**	0.005	0.086	-0.047	0.090	0.039	0.244	-0.060	0.011	0.177	0.039	0.746**
No. of leaves per plant	0.100	**0.017**	0.324	-0.014	0.064	-0.002	0.122	-0.023	0.036	0.166	0.044	0.516**
Length of leaves	0.215	0.009	**0.756**	-0.038	0.116	0.070	0.334	-0.069	0.005	0.263	0.060	0.659**
Leaves width	0.165	0.002	0.561	**0.099**	0.118	0.046	0.161	-0.050	-0.031	0.273	0.039	0.782**
Collar girth	0.141	0.006	0.443	-0.053	**0.197**	0.084	0.293	-0.056	-0.029	0.243	0.059	0.814**
Diameter of bulb	0.041	0.001	0.040	-0.014	0.080	**-0.331**	0.102	-0.048	-0.019	0.043	0.010	-0.474**
Dry matter percentage of leaves	0.169	0.004	0.128	0.032	0.043	0.068	**0.498**	-0.070	-0.027	-0.244	0.058	0.794**
Dry matter percentage of bulbs	0.192	0.003	-0.016	0.046	0.001	0.148	0.327	**0.108**	0.030	-0.312	0.050	0.721**
Moisture percentage of leaves	0.038	-0.006	-0.158	0.031	-0.011	0.064	0.139	-0.033	**0.098**	0.128	0.011	0.806**
Moisture percentage of bulbs	0.135	0.006	-0.003	-0.059	-0.003	0.031	0.269	-0.074	0.027	**0.452**	0.059	0.740**
Green foliage yield per plant	0.159	0.007	0.430	0.045	0.137	0.040	0.343	-0.063	0.012	0.311	**0.085**	0.787**

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