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Assessment of genetic variability and character association for yield improvement in F_2 population of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.)

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Abstract

The present investigation was undertaken to assess genetic variability, heritability, genetic advance, correlation, and path coefficient analysis for yield and its component traits in the F_2 population of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). The experiment was conducted at the Horticultural Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, during Summer 2025-26 using a Randomized Block Design with three replications. The phenotypic coefficient of variation was slightly higher than the corresponding genotypic coefficient of variation for all traits, indicating limited environmental influence on trait expression. High heritability coupled with high genetic advance was observed for yield per plot, fruit length, average fruit weight, and node number of first male flower, suggesting the predominance of additive gene action. Correlation analysis revealed significant positive associations of yield with fruit length, average fruit weight, number of fruits per plant, vine length, and number of branches per plant. Path coefficient analysis identified average fruit weight, number of branches per plant, fruit girth, and days to 50% flowering as the major traits contributing directly to yield. These findings indicate that selection based on these traits would be effective for developing high-yielding bottle gourd genotypes.

Keywords: Bottle gourd, F_2 population, genetic variability, correlation analysis, path coefficient analysis

Introduction

Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) is one of the oldest cultivated vegetable crops belonging to the family Cucurbitaceae and is widely grown in tropical and subtropical regions of the world for its tender fruits and diverse uses (Robinson & Decker-Walters, 1997) ^[15]. It is an important vegetable crop in India because of its high productivity, adaptability to diverse agro-climatic conditions, and year-round cultivation potential (Choudhary *et al.*, 2017) ^[5]. The fruits are rich in dietary fibre, vitamins, minerals, and bioactive compounds, making them valuable for nutritional security and human health (Minocha *et al.*, 2015) ^[13]. In addition to fresh consumption, bottle gourd is utilized in food processing, traditional medicine, and the manufacture of various household articles from mature fruits (Paris, 2016) ^[14]. Despite its economic importance, the productivity of bottle gourd is still below its genetic potential due to the limited availability of superior high-yielding cultivars (Singh *et al.*, 2020) ^[16]. The development of improved varieties requires the exploitation of genetic variability available within breeding populations (Falconer & Mackay, 1996) ^[10]. The F_2 generation is particularly valuable for crop improvement because it provides greater segregation and recombination, facilitating the identification of desirable transgressive segregants (Allard, 1999) ^[2]. Estimation of genotypic and phenotypic coefficients of variation provides useful information on the extent of genetic variability present in a population (Burton & DeVane, 1953) ^[4]. Heritability coupled with genetic advance is considered an effective criterion for predicting the efficiency of selection and the nature of gene action governing different traits (Johnson *et al.*, 1955) ^[11]. Correlation analysis helps in understanding the association among yield and its component traits, thereby assisting breeders in simultaneous improvement of multiple characters (Al-Jibouri *et al.*, 1958) ^[1].

Path coefficient analysis further partitions correlation coefficients into direct and indirect effects, enabling identification of traits with the greatest contribution to yield (Dewey & Lu, 1959) [8]. Therefore, the present investigation was undertaken to estimate genetic variability, heritability, genetic advance, correlation, and path coefficient analysis for yield and its component traits in the F₂ generation of bottle gourd to identify reliable selection criteria for developing high-yielding genotypes (Kumar *et al.*, 2022) [12].

Materials and Methods

The present investigation entitled "Assessment of Genetic Variability and Character Association for Yield Improvement in F₂ Population of Bottle Gourd (*Lagenaria siceraria* (Mol.) Standl.)" was conducted at the Horticultural Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh, India, during Kharif 2023 to Summer 2025-26. Initially, thirty bottle gourd genotypes were evaluated during Kharif 2023 in a Randomized Block Design (RBD) with three replications. Selected parental lines and testers were subsequently crossed during Summer 2023-24 using controlled emasculation and hand pollination to generate F₁ hybrids. The F₁ hybrids were raised during Kharif 2024, and the F₂ population along with their respective parents was evaluated during Summer 2025-26 under RBD with three replications. Each experimental plot measured 27 m² with a spacing of 3.0 m × 0.75 m, and recommended agronomic practices were followed throughout the crop season. Observations were recorded from five randomly selected competitive plants in each plot for fifteen quantitative traits, namely days to first male flower, days to first female flower, node number at first male flower, node number at first female flower, days to 50% flowering, days to first fruit set, days to first fruit harvest, fruit length, fruit girth, average fruit weight, number of fruits per plant, number of branches per plant, crop duration, vine length, and yield per plot. Genetic parameters including genotypic and phenotypic coefficients of variation (GCV and PCV), broad-sense heritability, and genetic advance were estimated following standard biometrical procedures. Genotypic and phenotypic correlation coefficients were computed to determine the association among traits, while path coefficient analysis was performed to partition the correlation coefficients into direct and indirect effects, thereby identifying the most important yield-contributing characters for selection in the F₂ population.

Results and Discussions

Coefficient of variation, heritability and genetic advance

The estimates of genotypic coefficient of variation (GCV),

phenotypic coefficient of variation (PCV), heritability, and genetic advance as percent of mean for yield and its component traits are presented in Table 1. In general, the PCV values were slightly higher than the corresponding GCV values for all the traits, indicating that environmental factors had a limited influence on the expression of these characters. High GCV and PCV were recorded for yield per plot (25.75 and 27.90%), fruit length (22.97 and 25.86%), and average fruit weight (19.99 and 21.93%), suggesting the presence of substantial genetic variability and good scope for improvement through selection. Moderate GCV and PCV were observed for node number of first male flower, number of branches per plant, days to first male flowering, days to first female flowering, node number of first female flower, number of fruits per plant, and fruit girth. In contrast, low GCV and PCV were recorded for days to 50% flowering, days to first fruit set, days to first fruit harvest, crop duration, and vine length, indicating comparatively narrow variability for these traits.

Heritability estimates ranged from 3.02% for vine length to 92.57% for node number of first male flower. High heritability was observed for node number of first male flower (92.57%), yield per plot (85.23%), average fruit weight (83.13%), crop duration (81.03%), fruit length (78.91%), node number of first female flower (77.74%), days to first male flowering (72.23%), number of branches per plant (69.42%), and days to first female flowering (65.30%). The highest genetic advance as percent of mean was recorded for yield per plot (48.98%), followed by fruit length (42.03%), average fruit weight (37.55%), node number of first male flower (33.47%), number of branches per plant (22.89%), and days to first male flowering (21.78%). The combination of high heritability with high genetic advance for these traits indicates the predominance of additive gene action and suggests that direct selection would be effective for improving yield in bottle gourd.

The predominance of high heritability across several traits suggests that they are largely governed by genetic factors and can be effectively improved through selection. When high heritability coincides with high genetic advance as in yield per quintal, fruit length, average fruit weight, and node number at first male flower it points to additive gene action and greater potential for genetic improvement. Similar findings have been reported by Duhan *et al.* (2022) [9], Bhardwaj *et al.* (2013) [3], Vaidya *et al.* (2016) [19], Damor *et al.* (2016) [6] and Deepthi *et al.* (2016) [7]. Traits with moderate heritability, such as days to first male flower and number of branches per plant, may involve both additive and non-additive effects, requiring selection in later generations. Low heritability traits, including vine length and fruit girth, appear more influenced by environmental factors, as also noted by Duhan *et al.* (2022) [9].

Table 1: Genetic variability for yield and its components characters in F₂ generation

S. No.	Range		Mean	Coefficient of Variation		H ₂ (%)	GA as of % Mean
	Min.	Max		GCV (%)	PCV (%)		
1	24.85	38.37	30.64	12.44	14.64	72.23	21.78
2	31.96	44.73	37.61	9.55	11.81	65.30	15.89
3	7.30	14.44	10.54	16.89	17.55	92.57	33.47
4	11.63	17.09	14.64	9.65	10.95	77.74	17.53
5	35.18	44.36	40.60	4.11	8.33	24.34	4.17
6	41.99	53.64	48.06	4.69	8.21	32.55	5.51
7	52.37	60.05	56.80	2.75	6.34	18.81	2.45
8	11.82	32.23	22.01	22.97	25.86	78.91	42.03
9	27.98	41.02	34.17	7.85	14.50	29.32	8.76
10	543.29	1131.49	856.90	19.99	21.93	83.13	37.55
11	6.91	9.66	7.94	7.92	11.28	49.28	11.45
12	4.57	7.90	6.20	13.34	16.01	69.42	22.89
13	126.49	161.53	141.83	7.81	8.68	81.03	14.49
14	163.56	195.71	184.33	1.17	6.76	3.02	0.42
15	139.73	402.03	269.62	25.75	27.90	85.23	48.98

1-Days to First Male Flower, 2-Days to First Female Flower, 3-Node Number of First Male Flower, 4-Node Number of First Female Flower, 5-Days to 50% Flowering, 6-Days to First Fruit Set, 7-Days to First Fruit Harvest, 8-Fruit Length, 9-Fruit Girth, 10-Average Fruit Weight, 11-Number of Fruits per Plant, 12-Number of Branches per Plant (90 days), 13-Duration of Crop (Sowing to Harvest), 14-Vine Length (cm), 15-Yield per Plot (q/ha)

Correlation studies in F₂ generation

The phenotypic (P) and genotypic (G) correlation coefficients among yield and its component characters are presented in Table 1. In general, the magnitude of genotypic correlation coefficients was higher than the corresponding phenotypic correlations, indicating a stronger inherent genetic association among the characters with comparatively lesser environmental influence on their relationships. Correlation analysis revealed that genotypic correlation coefficients were generally higher than the corresponding phenotypic coefficients, indicating that environmental factors reduced the expression of genetic associations among the traits. Yield per plot exhibited highly significant positive genotypic correlations with fruit length (0.994), average fruit weight (0.962), number of fruits per plant (0.917), vine length (0.710), and number of branches per plant (0.605). Significant negative genotypic correlations were observed with days to first male flowering, days to first female flowering, days to 50% flowering, days to first fruit harvest, and crop duration, indicating that early flowering and harvesting genotypes were associated with higher yield. At the phenotypic level, yield per plot maintained significant positive associations with fruit length, average fruit weight, number of fruits per plant, and number of branches per plant, while negative correlations were observed with days to 50% flowering and days to first fruit harvest. The flowering and maturity traits exhibited strong positive interrelationships at both genotypic and phenotypic levels. Days to first male flowering, days to first female flowering, node number of first male flower, node number of first female flower, days to 50% flowering, days to first fruit set, and days to first fruit harvest were

positively associated with each other, suggesting that delayed flowering resulted in delayed fruiting and maturity. These traits generally showed negative associations with yield-contributing characters such as fruit girth, average fruit weight, number of fruits per plant, vine length, and yield per plot. Among yield components, fruit length showed strong positive correlations with average fruit weight, number of fruits per plant, number of branches per plant, and vine length. Average fruit weight was positively associated with number of fruits per plant, number of branches per plant, and vine length, whereas it was negatively correlated with crop duration. Number of fruits per plant also exhibited positive associations with number of branches per plant and vine length, highlighting their collective contribution to yield improvement. Fruit girth showed limited associations, displaying a positive relationship with number of fruits per plant at the genotypic level and crop duration at the phenotypic level. Overall, the results suggest that selection for early flowering and harvesting, coupled with improvement in fruit length, average fruit weight, number of fruits per plant, vine length, and number of branches per plant, would be effective for enhancing yield in bottle gourd. Similar observations were reported by Singh *et al.* (1996) [17], Thakur *et al.* (2015) [18], who also observed strong positive correlations of yield with fruit weight and number of fruits per plant. Flowering traits such as days to first male flower, days to first female flower and node number of first flowers showed strong positive associations among themselves and with other phenological traits, suggesting that these characters are closely related in their expression. Similar relationships among flowering traits were reported by Bhardwaj *et al.* (2013) [3].

Table 2: Genotypic and phenotypic correlation coefficient between yield and its component characters in F₂ generation

Character		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	G	1.000	0.999**	0.553**	0.634**	0.760**	0.753**	0.690**	-0.132	-0.560**	-0.181	-0.364**	-0.198	0.275*	-0.446**	-0.295*
	P	1.000	0.968**	0.437**	0.443**	0.298*	0.316**	0.238*	-0.144	-0.207	-0.136	-0.199	-0.151	0.189	-0.150	-0.226
2	G		1.000	0.583**	0.682**	0.899**	0.852**	0.891**	-0.097	-0.564**	-0.191	-0.375**	-0.244*	0.275*	-0.567**	-0.298*
	P		1.000	0.423**	0.451**	0.276*	0.293*	0.222	-0.132	-0.185	-0.135	-0.170	-0.180	0.205	-0.146	-0.211
3	G			1.000	0.922**	0.983**	0.823**	0.837**	-0.057	-0.373**	-0.238*	-0.125	-0.415**	0.513**	-1.577**	-0.206
	P			1.000	0.849**	0.573**	0.559**	0.455**	-0.041	-0.224	-0.225	-0.090	-0.257*	0.411**	-0.241*	-0.212
4	G				1.000	0.998**	0.828**	0.992**	0.029	-0.193	-0.183	-0.001	-0.412**	0.518**	-1.046**	-0.083
	P				1.000	0.606**	0.577**	0.506**	0.061	-0.152	-0.165	0.002	-0.135	0.383**	-0.264*	-0.116
5	G					1.000	0.996**	0.812**	-0.134	-0.227	-0.381**	-0.282*	-0.526**	0.419**	-0.312**	-0.309**
	P					1.000	0.934**	0.887**	-0.050	-0.153	-0.314**	-0.139	-0.036	0.165	-0.066	-0.246*
6	G						1.000	0.692**	-0.051	-0.169	-0.275*	-0.152	-0.450**	0.198	0.039	-0.217
	P						1.000	0.855**	-0.029	-0.077	-0.227	-0.093	-0.012	0.090	-0.031	-0.212
7	G							1.000	-0.249*	-0.555**	-0.524**	-0.317**	-0.329**	0.623**	-0.719**	-0.427**
	P							1.000	-0.100	-0.165	-0.307**	-0.106	0.057	0.207	-0.111	-0.243*
8	G								1.000	0.173	0.927**	0.998**	0.502**	-0.211	0.611**	0.994**
	P								1.000	0.070	0.735**	0.583**	0.367**	-0.181	0.062	0.791**
9	G									1.000	0.140	0.305**	-0.349**	-0.521**	-0.027	0.192
	P									1.000	0.065	0.025	-0.165	-0.146	0.295*	0.077
10	G										1.000	0.811**	0.509**	-0.377**	0.947**	0.962**
	P										1.000	0.462**	0.397**	-0.316**	0.043	0.845**
11	G											1.000	0.649**	-0.216	0.692**	0.917**
	P											1.000	0.394**	-0.168	0.162	0.729**
12	G												1.000	-0.092	0.669**	0.605**
	P												1.000	-0.092	0.168	0.437**
13	G													1.000	-1.288**	-0.240*
	P													1.000	-0.046	-0.229
14	G														1.000	0.710**
	P														1.000	0.101
15	G															1.000
	P															1.000

1-Days to First Male Flower, 2-Days to First Female Flower, 3-Node Number of First Male Flower, 4-Node Number of First Female Flower, 5-Days to 50% Flowering, 6-Days to First Fruit Set, 7-Days to First Fruit Harvest, 8-Fruit Length, 9-Fruit Girth, 10-Average Fruit Weight, 11-Number of Fruits per Plant, 12-Number of Branches per Plant (90 days), 13-Duration of Crop (Sowing to Harvest), 14-Vine Length (cm), 15-Yield per Plot (q/ha)

Path coefficient analysis in F₂ generation

Direct and indirect effects of different characters on yield per quintal are presented in Table 3. Path coefficient analysis was carried out to partition the genotypic correlation coefficients into direct and indirect effects, thereby identifying the traits that contributed most effectively to yield per plot. Among the characters studied, days to 50% flowering (1.536) exhibited the highest positive direct effect on yield, followed by average fruit weight (1.440), days to first female flowering (1.245), number of branches per plant (1.045), fruit girth (0.680), crop duration (0.304), and node number of first female flower (0.136). Vine length showed only a negligible positive direct effect (0.021). In contrast, days to first male flowering (-1.374), days to first fruit set (-0.749), fruit length (-0.597), days to first fruit harvest (-0.332), number of fruits per plant (-0.319), and node number of first male flower (-0.080) exhibited negative direct effects on yield. Most traits

influenced yield indirectly through average fruit weight, days to 50% flowering, number of branches per plant, and days to first female flowering, demonstrating the complex interrelationships among yield components. Fruit length, number of fruits per plant, and vine length exerted substantial positive indirect effects through average fruit weight and number of branches per plant. The residual effect (0.0731) was very low, indicating that the traits included in the analysis explained the majority of the variability in yield and are therefore reliable selection criteria for improving yield in bottle gourd breeding programmes. Similar observations were reported by Thakur *et al.* (2015) ^[18], who also found that fruit weight and fruit size traits had strong direct effects on yield in bottle gourd. Duhan *et al.* (2022) ^[9] also reported that certain traits exhibited strong direct effects on yield, while others influenced yield indirectly through important yield components.

Table 3: Path coefficient analysis of yield and its components in F₂ generation

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-1.374	1.245	-0.044	0.086	1.167	-0.564	-0.23	0.079	-0.381	-0.261	0.116	-0.207	0.084	-0.009	-0.295
2	-1.373	1.245	-0.047	0.093	1.382	-0.638	-0.296	0.058	-0.383	-0.274	0.12	-0.255	0.084	-0.012	-0.298
3	-0.76	0.727	-0.08	0.125	1.51	-0.616	-0.278	0.034	-0.253	-0.343	0.04	-0.434	0.156	-0.033	-0.206
4	-0.871	0.85	-0.074	0.136	1.534	-0.62	-0.33	-0.017	-0.131	-0.264	0	-0.431	0.158	-0.022	-0.083
5	-1.044	1.12	-0.079	0.136	1.536	-0.747	-0.27	0.08	-0.154	-0.548	0.09	-0.55	0.127	-0.007	-0.309
6	-1.035	1.061	-0.066	0.113	1.531	-0.749	-0.23	0.03	-0.115	-0.396	0.048	-0.471	0.06	0.001	-0.217
7	-0.949	1.11	-0.067	0.135	1.247	-0.518	-0.332	0.148	-0.378	-0.755	0.101	-0.344	0.189	-0.015	-0.427
8	0.182	-0.121	0.005	0.004	-0.206	0.038	0.083	-0.597	0.117	1.335	-0.318	0.525	-0.064	0.013	0.994
9	0.77	-0.702	0.03	-0.026	-0.348	0.126	0.185	-0.103	0.68	0.202	-0.097	-0.365	-0.158	-0.001	0.192
10	0.249	-0.237	0.019	-0.025	-0.585	0.206	0.174	-0.553	0.095	1.44	-0.258	0.532	-0.115	0.02	0.962
11	0.5	-0.468	0.01	0	-0.433	0.114	0.105	-0.596	0.208	1.168	-0.319	0.678	-0.066	0.014	0.917
12	0.273	-0.304	0.033	-0.056	-0.809	0.337	0.109	-0.3	-0.238	0.733	-0.207	1.045	-0.028	0.014	0.605
13	-0.377	0.342	-0.041	0.07	0.643	-0.148	-0.207	0.126	-0.355	-0.543	0.069	-0.096	0.304	-0.027	-0.24
14	0.612	-0.707	0.127	-0.142	-0.48	-0.029	0.239	-0.364	-0.018	1.363	-0.221	0.7	-0.392	0.021	0.71

1-Days to First Male Flower, 2-Days to First Female Flower, 3-Node Number of First Male Flower, 4-Node Number of First Female Flower, 5-Days to 50% Flowering, 6-Days to First Fruit Set, 7-Days to First Fruit Harvest, 8-Fruit Length, 9-Fruit Girth, 10-Average Fruit Weight, 11-Number of Fruits per Plant, 12-Number of Branches per Plant (90 days), 13-Duration of Crop (Sowing to Harvest), 14-Vine Length (cm), 15-Yield per Plot (q/ha)

Residual Effect Square: 0.0731

Conclusion

The present study revealed considerable genetic variability among the F₂ population of bottle gourd for yield and its component traits, indicating good scope for genetic improvement through selection. High heritability coupled with high genetic advance for yield per plot, fruit length, average fruit weight, and node number of first male flower suggested the predominance of additive gene action, making these traits reliable selection criteria. Correlation analysis showed that yield was positively associated with fruit length, average fruit weight, number of fruits per plant, vine length and number of branches per plant, while flowering and maturity traits were negatively associated with yield, highlighting the importance of early flowering and harvesting. Path coefficient analysis identified average fruit weight, number of branches per plant, fruit girth, and days to 50% flowering as the major traits contributing directly to yield. Therefore, simultaneous selection for early flowering, superior fruit size and weight, increased branching, and higher fruit number would be an effective breeding strategy for developing high-yielding bottle gourd genotypes.

References

- Al-Jibouri HA, Miller PA, Robinson HF. Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. *Agronomy Journal*. 1958;50(10):633-636.
- Allard RW. Principles of plant breeding. 2nd ed. New York: John Wiley & Sons; 1999.
- Bhardwaj DR, Singh A, Singh U. Genetic variability of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] by multivariate analysis. In: Proceedings of the National Symposium on Abiotic and Biotic Stress Management in Vegetable Crops. Indian Society of Vegetable Science; 2013. p. 370.
- Burton GW, DeVane EH. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agronomy Journal*. 1953;45(10):478-481.
- Choudhary BR, Kumar S, Sharma SK. Genetic improvement and production technology of cucurbit vegetables in India. *Indian Journal of Horticulture*. 2017;74(4):493-501.
- Damor AS, Patel JN, Parmar HK, Vyas ND. Studies on genetic variability, heritability and genetic advance for yield and quality traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] genotypes. *International Journal of Scientific and Environmental Technology*. 2016;5(4):2301-2307.
- Deepthi B, Reddy PSS, Satyaraj Kumar AS, Reddy AR. Studies on PCV, GCV, heritability and genetic advance in bottle gourd genotypes for yield and yield components. *Plant Archives*. 2016;16(2):597-601.
- Dewey DR, Lu KH. A correlation and path coefficient analysis of components of crested wheatgrass seed production. *Agronomy Journal*. 1959;51(9):515-518.
- Duhan DS, Gill V, Panghal VPS, Karande PJ. Studies on genetic variability, heritability, genetic advance and character association for various quantitative traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] genotypes. *Vegetable Science*. 2022;49(2):204-210.
- Falconer DS, Mackay TFC. Introduction to quantitative genetics. 4th ed. Harlow: Longman; 1996.
- Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variability in soybean. *Agronomy Journal*. 1955;47(7):314-318.
- Kumar A, Singh V, Yadav R. Genetic variability and character association studies in bottle gourd (*Lagenaria siceraria*). *Vegetable Science*. 2022;49(2):210-216.
- Minocha S, Kumar D, Singh R. Nutritional and medicinal importance of bottle gourd (*Lagenaria siceraria*): A review. *International Journal of Current Microbiology and Applied Sciences*. 2015;4(8):566-571.
- Paris HS. Origin and emergence of the sweet dessert watermelon, bitter dessert watermelon and bottle gourd. *Horticultural Reviews*. 2016;44:1-45.
- Robinson RW, Decker-Walters DS. Cucurbits. Wallingford: CAB International; 1997.
- Singh P, Sharma A, Verma S. Advances in bottle gourd breeding for yield and quality improvement. *Journal of Pharmacognosy and Phytochemistry*. 2020;9(5):1801-1806.
- Singh SP, Singh NK, Maurya LB. Genetic variability and correlation studies in bottle gourd [*Lagenaria*

- siceraria* (Mol.) Standl.]. PKV Research Journal. 1996;20:88-89.
18. Thakur P, Sharma D, Visen VK, Dash SP. Character association studies in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Progressive Research-An International Journal Society for Scientific Development. 2015;10(1):459-463.
 19. Vaidya AV, Singh PK, Mallikarjunarao K, Wani KP, Sarvan R. Genetic variability, heritability and genetic advance studies in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Ecology, Environment and Conservation. 2016;22:87-90.