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Genetic variability, interrelationships and path analysis for growth and yield attributes in F_4 segregating population of Brinjal (*Solanum melongena* L.)

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Abstract
A field experiment was conducted to assess the magnitude of genetic variability present in F_4 segregating population of the Brinjal cross Sarparam Vanga × Harita among 200 plants during *Rabi* Season 2020-21. The experiment was laid out in augmented block design at College of Horticulture, Mudigere. The analysis of data revealed the presence of considerable variability for all the characters among the genotypes. High heritability coupled with high genetic advance as per cent over mean was observed for most of the characters studied suggesting that these characters can be improved through direct selection due to predominance additive gene action. Correlation studies revealed highly significant positive correlation with number of flower clusters per plant, number of fruits per plant and significant positive association with average fruit weight at both phenotypic and genotypic level. Path coefficient analysis showed that maximum positive direct effect of number of fruits per plant followed by average fruit weight, days to first flowering, number of fruits per cluster and fruit length on fruit yield per plant at both phenotypic and genotypic level. Hence, the direct selection may be executed considering these traits as the main selection criteria to reduce indirect effects of the other characters during the development of high-yielding Brinjal varieties/hybrids.

Keywords: Brinjal, genetic variability, correlation coefficient, path coefficient, yield

Introduction
Brinjal (*Solanum melongena* L.) or eggplant or aubergine is an important vegetable crop widely grown in India, originated in the Indo-Burma region (Vavilov, 1928) [18]. It belongs to the family Solanaceae, consisting of 98 genera and over 2700 species (Olmstead and Bohs, 2007) [14]. It is usually self-pollinated, but natural out-crossing has also been reported which varies with the varieties and environments, the average being about 6-7% so, it is also said to be often cross-pollinated crop (Choudhary, 1976) [5]. Heterostyly is the common feature in this crop where, the fruit setting flowers consist of long (70-86.7%) and medium styled (12-55.6%) flowers whereas the non-fruit setting flowers are short-styled and pseudo short-styled flowers (Thamburaj and Singh, 2018) [17]. Major states Growng this crop are West Bengal, Orissa, Gujarat, Bihar, Madhya Pradesh, Chhattisgarh, Karnataka, Maharashtra, Andhra Pradesh and Tamil Nadu.

To improve yield and other characters, information on genetic variability and inter-relationship among different traits is necessary. The improvement in any crop is proportional to the magnitude of its genetic variability present in the germplasm (Dhankhar and Dhankhar, 2002) [8]. Yield, is a complex trait influenced by various yield attributing plant characters, hence direct selection for yield is often misleading. Therefore knowledge about inter-relationship between pairs of these characters and with yield is essential to bring a rational improvement in the desirable traits. Information derived from correlation and path analysis studies will reveal the possibility of simultaneous improvement of various attributes and also helps in increasing the efficiency of selection of complex inherited traits. Keeping this in view, the present investigation was undertaken to assess the genetic variability, characters association, direct and indirect effects of characters on fruit yield in F_4 segregating population of the cross Sarparam Vanga × Harita.

Material and Methods
The present research work was carried out at experimental block of Department of Vegetable Science, College of Horticulture, Mudigere, Keladi Shivappa Nayaka University of

Agricultural and Horticultural Sciences, Shivamogga. The experiment was laid out in augmented block design during *Rabi* 2020-21. The experimental material for the study comprises of 200 F_4 plants derived from the bi-parental cross Sarparam Vanga × Harita along with their parents, F_1 hybrids and four checks *viz.*, Arka Neelanchal Shyama, Arka Keshav, Arka Kusumakar, Devanur Local and were evaluated for different growth and yield components.

Data was recorded on all the F_4 plants, ten randomly selected plants in each of the checks parents and F_1 hybrids. The observations were recorded on days to first flowering, number of flowers per cluster, number of flower clusters per plant, number of primary branches, days to first picking, number of fruits per cluster, fruit set percentage, plant height (cm) at harvest, number of fruits per plant, fruit length (cm), stalk length (cm), average fruit weight (g), fruit diameter (mm) and fruit yield per plant (kg). Phenotypic Coefficient of variation (PCV) and genotypic coefficient of variation was calculated as per the formula suggested by Burton and Devane (1953) [3]. Heritability (broad sense) and genetic advance was estimated using the formula given by Johnson *et al*. (1955) [9]. Data was analyzed to estimate correlation as well as direct and indirect effects as for 11 different yield attributing characters as per the methods of Al-Jiboure *et al.* (1958) [1] and Dewey and Lu (1959) [7] respectively.

Result and Discussion

Genetic parameters

The genetic factors *viz*., range, mean, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (h^2), genetic advance (GA) and genetic advance as per cent mean (GAM) were calculated and are presented in the Table 1.

High values of PCV and GCV were registered by number of flowers per cluster, number of flowers clusters per plant, number of primary branches, number of fruits per cluster, fruit set percentage, number of fruits per plant and fruit yield per plant indicating wider variation in the population and the narrow difference between PCV and GCV shows less environmental influence on the expression of these traits. Similar findings were reported by Devaraju *et al.* (2020) [4] for number of flowers per cluster, number of primary branches, number of fruits per cluster, fruit set percentage, number of fruits per plant and fruit yield per plant and Srivastava *et al.* (2019) [16] for number of flower clusters per plant.

High broad sense heritability coupled with high genetic advance as per cent over mean were recorded for number of flowers per cluster, number of flower clusters per plant, number of primary branches, number of fruits per cluster, fruit set percentage, plant height at harvest, number of fruits per plant, fruit length, stalk length, fruit diameter and fruit yield per plant suggested the role of additive gene action and a simple selection can be applied for improvement of these traits. These are in testament to the work of Balasubramaniyam *et al.* (2021) [2] for number of flowers per cluster, number of fruits per cluster, plant height at harvest, number of fruits per plant, fruit diameter and fruit yield per plant, Verma *et al.* (2021) [19] for number of primary branches and fruit length, Srivastava *et al.* (2019) [16] for number of flower clusters per plant, Magar *et al.* (2017) [11] for stalk length, Devaraju *et al.* (2020) [4] and Chithra *et al.* (2020) [4] for fruit set percentage.

Correlation studies

Variability studies provide information on the extent of improvement that could be achieved in different characters, but do not throw light on the extent and nature of relationship existing between various characters. Therefore, correlation analysis helps to examine the possibility of improving yield through indirect selection of its component traits that are highly correlated with yield. The results of correlation coefficient analysis at phenotypic and genotypic level (Table 2) revealed that yield per plant had highly significant positive correlation with number of flower clusters per plant, number of fruits per plant and significant positive association with average fruit weight. These could be used as traits of interest for indirect selection to improve total yield per plant in the further breeding programme. These results are in agreement with Ravali *et al.* (2017) [15] for number of flower clusters per plant, Mamatha *et al*. (2016) [12] for number of fruits per plant and Kumar *et al.* (2020) [10] for average fruit weight.

Path coefficient analysis

The path coefficient technique developed by Wright (1921) [20] helps in estimating direct and indirect contribution of various components towards yield. The results of path coefficient analysis (Table 3) showed that maximum positive direct effect of number of fruits per plant followed by average fruit weight, days to first flowering, number of fruits per cluster and fruit length on fruit yield per plant at both phenotypic and genotypic level. Thus the higher magnitude of the positive direct effect of these traits explains the higher value of association between these traits and fruit yield per plant. Therefore, direct selection for these traits would reward for improvement of yield. These results are in corroboration with the observations of Ravali *et al.* (2017) [15] for days to first flowering, Kumar *et al.* (2020) [10] for number of fruits per cluster, average fruit weight, number of fruits per plant and Nikitha *et al.* (2020) [13] for plant height at harvest and fruit length.

Table 1: Estimates of genetic parameters for growth, flowering and yield parameters in F_4 segregating population of brinjal cross Sarparam Vanga × Harita

SI. No.	Characters	Mean	Range		GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
			Min.	Max.							
1.	Days to first flowering	48.65	34.69	64.68	26.35	35.27	10.57	12.23	74.70	9.13	18.81
2.	Number of flowers per cluster	3.76	1.50	6.24	0.72	0.80	22.76	23.96	90.26	1.66	44.54
3.	Number of flower clusters per plant	12.84	4.52	27.05	21.13	21.97	35.79	36.50	96.17	9.28	72.30
4.	Number of primary branches	5.96	1.45	11.12	2.54	2.76	26.95	28.13	91.85	3.14	53.21
5.	Days to first picking	81.79	62.68	94.31	10.95	20.61	3.81	5.23	47.82	4.71	5.73
6.	Number of fruits per cluster	1.99	0.96	4.25	0.31	0.34	28.46	29.44	93.46	1.12	56.68
7.	Fruit Set Percentage	54.73	27.33	97.97	240.88	246.06	28.35	28.65	97.90	31.63	57.78
8.	Plant height (cm) at harvest	50.59	24.92	79.51	96.42	106.37	19.48	20.46	90.64	19.25	38.21
9.	Number of fruits per plant	21.62	6.86	45.86	51.69	52.46	33.47	33.72	98.53	14.70	68.44

10.	Fruit length (cm)	7.97	4.33	16.24	1.25	1.69	14.18	16.48	74.06	1.98	25.14
11.	Stalk length (cm)	3.72	2.41	5.27	0.33	0.40	15.64	17.07	83.94	1.09	29.51
12.	Average fruit weight (g)	49.89	35.05	165.45	32.29	57.37	11.53	15.37	51.84	8.43	17.83
13.	Fruit diameter (mm)	37.38	21.57	68.62	29.45	30.80	14.50	14.82	95.60	10.93	29.19
14.	Fruit yield per plant (kg)	1.14	0.40	4.03	0.18	0.19	37.41	38.68	93.57	0.84	74.55

GV: Genotypic variance GCV: Genotypic coefficient of variance h^2: Heritability (broad sense) GA: Genetic advance
PV: Phenotypic variance PCV: Phenotypic coefficient of variance GAM: Genetic advance as per cent of mean

Table 2: Estimates of correlation coefficients for 11 characters in F_4 segregating population of brinjal cross Sarparam Vanga× Harita at phenotypic and genotypic level

Traits	Type of Correlation	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
X_1	P	1.000	0.151*	0.090	-0.027	-0.020	-0.147*	0.146*	0.122	-0.044	-0.028	0.130
	G	1.000	0.140*	0.093	-0.053	-0.023	-0.143*	0.149*	0.125	-0.043	-0.038	0.135
X_2	P		1.000	-0.323**	0.038	0.461**	-0.406**	0.020	0.004	0.002	0.136	0.001
	G		1.000	-0.345**	0.011	0.464**	-0.400**	0.019	0.009	0.0003	0.125	0.0008
X_3	P			1.000	-0.008	-0.571**	-0.308**	-0.081	0.697**	-0.012	-0.198*	0.546**
	G			1.000	0.021	-0.582**	-0.308**	-0.084	0.715**	-0.009	-0.199*	0.562**
X_4	P				1.000	0.011	0.020	-0.080	0.012	0.006	0.160*	0.048
	G				1.000	0.0001	0.027	-0.083	0.015	0.005	0.145*	0.048
X_5	P					1.000	0.590**	-0.042	0.076	0.042	0.128	0.057
	G					1.000	0.595**	-0.041	0.077	0.041	0.127	0.056
X_6	P						1.000	-0.062	0.067	0.057	0.011	0.040
	G						1.000	-0.061	0.065	0.057	0.017	0.041
X_7	P							1.000	-0.148*	-0.084	-0.163*	-0.218*
	G							1.000	-0.150*	-0.085	-0.165*	-0.222*
X_8	P								1.000	-0.028	-0.079	0.804**
	G								1.000	-0.028	-0.082	0.807**
X_9	P									1.000	-0.067	-0.014
	G									1.000	-0.067	-0.014
X_{10}	P										1.000	0.223*
	G										1.000	0.224*
X_{11}	P											1.000
	G											1.000

Critical r_p value at 5% = 0.1374 *Significant at p = 0.05 Critical r_p value at 1% = 0.2287 ** Significant at p = 0.01
X_1=Days to first flowering X_2=Number of flowers per cluster X_3=Number of flower clusters per plant
X_4=Number of primary branches
X_5=Number of fruits per cluster
X_6=Fruit set percentage
X_7=Plant height at(cm) harvest
X_8=Number of fruits per plant
X_9=Fruit length (cm)
X_{10}=Average fruit weight (g)
X_{11}=Fruit yield per plant (kg)

Table 3: Direct and indirect effects of various characters on total yield per plant in F_4 segregating population of brinjal cross Sarparam Vanga× Harita at phenotypic and genotypic level

Traits	Type of path analysis	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	P	0.0549	0.0083	0.0049	-0.0015	-0.0011	-0.0080	0.0080	0.0067	-0.0025	-0.0016
	G	0.0583	0.0082	0.0054	-0.0031	-0.0014	-0.0083	0.0087	0.0073	-0.0025	-0.0023
X_2	P	-0.0332	-0.2203	0.0711	-0.0085	-0.1015	0.0895	-0.0045	-0.0010	-0.0005	-0.0301
	G	-0.0373	-0.2664	0.0919	-0.0031	-0.1236	0.1066	-0.0053	-0.0026	-0.0001	-0.0335
X_3	P	-0.0042	0.0151	-0.0468	0.0004	0.0267	0.0144	0.0038	-0.0326	0.0006	0.0093
	G	-0.0146	0.0541	-0.1568	-0.0034	0.0913	0.0483	0.0133	-0.1121	0.0014	0.0312
X_4	P	0.0000	0.0000	0.0000	-0.0009	0.0000	0.0000	0.0001	0.0000	0.0000	-0.0001
	G	-0.0002	0.0000	0.0001	0.0041	0.0000	0.0001	-0.0003	0.0001	0.0000	0.0006
X_5	P	-0.0031	0.0704	-0.0872	0.0018	0.1528	0.0902	-0.0064	0.0116	0.0064	0.0196
	G	-0.0030	0.0594	-0.0746	0.0000	0.1282	0.0762	-0.0053	0.0099	0.0053	0.0163
X_6	P	0.0310	0.0858	0.0650	-0.0043	-0.1246	-0.2110	0.0132	-0.0142	-0.0120	-0.0025
	G	0.0362	0.1015	0.0781	-0.0070	-0.1507	-0.2536	0.0157	-0.0166	-0.0146	-0.0043
X_7	P	-0.0084	-0.0012	0.0047	0.0047	0.0024	0.0036	-0.0577	0.0085	0.0049	0.0094
	G	-0.0087	-0.0012	0.0050	0.0049	0.0025	0.0036	-0.0588	0.0088	0.0050	0.0097
X_8	P	0.1038	0.0040	0.5914	0.0107	0.0645	0.0570	-0.1252	0.8490	-0.0243	-0.0677
	G	0.1174	0.0093	0.6699	0.0147	0.0724	0.0612	-0.1401	0.9368	-0.0263	-0.0773
X_9	P	-0.0015	0.0001	-0.0004	0.0002	0.0014	0.0019	-0.0027	-0.0009	0.0326	-0.0022
	G	-0.0016	0.0000	-0.0003	0.0002	0.0015	0.0021	-0.0032	-0.0010	0.0369	-0.0025
X_{10}	P	-0.0083	0.0394	-0.0572	0.0461	0.0371	0.0034	-0.0469	-0.0230	-0.0194	0.2886

	G	-0.0111	0.0359	-0.0569	0.0415	0.0363	0.0049	-0.0470	-0.0236	-0.0194	0.2857
X_{11}	P	0.1309	0.0015	0.546**	0.0486	0.0577	0.0409	-0.218*	0.804**	-0.0142	0.223*
	G	0.1353	0.0008	0.562**	0.0488	0.0564	0.0411	-0.222*	0.807**	-0.0143	0.224*

Diagonal values indicate direct effect
Residual effect=0.501
X_1=Days to first flowering
X_2=Number of flowers per cluster
X_3=Number of flower clusters per plant
X_4=Number of primary branches
X_5=Number of fruits per cluster
X_6=Fruit set percentage
X_7=Plant height (cm)at harvest
X_8=Number of fruits per plant
X_9=Fruit length (cm)
X_{10}=Average fruit weight (g)
X_{11}=Fruit yield per plant (kg)

Conclusion

In the present investigation, high GCV and PCV were observed for parameters like, number of flowers per cluster, number of flowers clusters per plant, number of primary branches, number of fruits per cluster, fruit set percentage, number of fruits per plant, fruit yield per plant. It indicated existence of broad geneticbase, which would be useful for further selection. Higher estimates of broad sense heritability coupled with high genetic advance as per cent over mean were recorded for number of flowers per cluster, number of flower clusters per plant, number of primary branches, number of fruits per cluster, fruit set percentage, plant height at harvest, number of fruits per plant, fruit length, stalk length, fruit diameter and fruit yield per plant suggested the role of additive gene action and a simple selection can be applied for improvement of these traits.

Correlation studies showed that yield per plant had highly significant positive association with number of flower clusters per plant, number of fruits per plant and significant positive association with average fruit weight. The results of path coefficient analysis indicated maximum positive direct effect of number of fruits per plant followed by average fruit weight, days to first flowering, number of fruits per cluster and fruit length on fruit yield per plant. Hence, the direct selection may be executed considering these traits as the main selection criteria to reduce indirect effects of the other characters during the development of high-yielding brinjal varieties/hybrids.

References

1. Al-jibouri HA, Miller PA, Robinson HV. Genotypic and environmental variance and co-variances in an upland cotton cross of interspecific origin. Agron. J. 1958;50:633-636.
2. Balasubramaniyam K, Haripriya K, Kumar TB, Elangaimannan R. Assessment of genetic variability, heritability and genetic advance in brinjal (*Solanum melongena* L.). Plant Arch. 2021;21(1):1784-1786.
3. Burton GW, Devane EH. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. Agron. J. 1953;45:418-481.
4. Chithra K, Devaraju, Srinivasa V, Varalakshmi B, Shashikala SK. Correlation and path analysis in segregating population of brinjal (*Solanum melongena* L.). J. Pharmacogn. Phytochem. 2020;9(5):2457-2459.
5. Choudhary B. Vegetable. National Book Trust, New Delhi (INDIA), 1976.
6. Devaraju, Indiresh KM, Srinivasa V, Lakshmana D, Singh TH, Devappa V, *et al*. Studies on variability components for yield and its attributes in Brinjal (*Solanum melongena* L.) under hill zone of Karnataka. J Pharmacognosy. Phytochemical 2020;9(2):2200-2203.
7. Dewey DH, Lu KH. A correlation and path analysis of components of crested wheatgrass production. Agron. J. 1959;51:515-518.
8. Dhankhar BS, Dhankhar SK. Genetic variability, correlation and path analysis in okra (*Abelmoschus esculentus* (L.) Moench). Veg. Sci. 2002;29(1):63-65.
9. Johnson HW, Robinson HF, Constock RE. Estimate of genetic and environmental variability in Soyabeans. Apron. J. 1955;47:314-318.
10. Kumar MK, Mishra HN, Manas P, Nayak DP. Genetic variability and correlation studies in brinjal (*Solanum melongena* L.). The Pharm. Innov. 2020;9(2):416-419.
11. Magar PG, Shinde KG, Bhalekar MN, Magar VG. Genetic variability studies in brinjal (*Solanum melongena* L.). Contemp. Res. India 2017;7(4):2231-2137.
12. Mamatha A, Devaraju, Premchand U, Srinivasa V. Genetic correlation and path coefficient analysis in Chilli (*Capsicum annuum* L.) genotypes under hill zone of Karnataka. The Bioscan 2016;11(3):1995-1998.
13. Nikitha M, Prabhakar BN, Padma M, Bhat, Sivaraj N. Correlation and path coefficient analysis of yield and yield attributed characters in brinjal (*Solanum melongena* L.). J. Pharmacogn. Phytochem. 2020;9(5):1997-2002.
14. Olmstead RG, Bohs L. A summary of molecular systematic research in Solanaceae: 1982-2006. Acta. Hortic. 2007;745:255-268.
15. Ravali B, Saidaiah P, Reddy KR, Shivraj N, Geetha A. Study on character association and path analysis in brinjal (*Solanum melongena* L.). J. Pharmacogn. Phytoch em. 2017;6(6):393-397.
16. Srivastava S, Saidaiah P, Shivraj N, Ravinder RK. Study of genetic variability, heritability and genetic advance for yield and yield related components of Brinjal [*Solanum melongena* (L.)] genotypes. J. Pharmacon. Phyt ochem. 2019; 8(4): 917-919.
17. Thamburaj S, Singh N. Texbook of vegetables, tubercrops and spices. Indian Council of Agriculture Research, New Delhi. 2018, pp. 30-31.
18. Vavilov NI. Proceedings of 5th International Congress of Genetics, New York. 1928, 342-369.
19. Verma SR, Mishra SK, Roy S, Singh RK, Singh MK. Genetic studies for parental selection among brinjal (*Solanum melongena* L.) varieties. The Pharm. Innov. 2021; 10 (2): 209-213.
20. Wright S. Correlation and causation. J. Agric. Res. 1921;20:557-587.