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Variability and association studies for yield components in drumstick (*Moringa oleifera* L.)

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Abstract
Analysis of variance revealed that the mean sum of squares due to genotypes were significant for all the characters indicating existence of sufficient variability among the genotypes. The GCV and PCV was observed highest for leave length followed by number of pod per plant, plant height, pod girth, length of pod, number of branches per plant, number of leave per rachis, number of flower per inflorescence, number of seeds per pod, number of leave per rachis, yield per plant and stem girth, which is an indicative of the genetic variability exists in the drumstick germplasm accessions. High heritability coupled with high genetic advance as percentage of mean was observed for plant height followed by leave length, length of pod, number of pod per plant, number of branches per plant, pod girth, stem girth number of flower per inflorescence number of seeds per pod which indicated that the predominance of additive gene action in the expression of these characters which could be utilized for the development of high yielding drumstick genotypes. Correlation studies revealed that the yield per plant showed the maximum significant positive correlation with number of leave per rachis follow by number of branches per plant, number of pods per plant number of flower per inflorescence stem girth, leave length, may be advantageous for selecting the high yielding genotype in drumstick from the available germplasm accessions. The path coefficient study show that the highest positive direct effect contributing to yields per plant was observed due to number of branches per plant followed by length of pod, leave length, pod girth, number of pod per plant, pod weight.

Keywords: Correlation, path analysis, variability, heritability, Moringa

Introduction
Moringa oleifera Lam. belonging to the family Moringaceae, native to India, is fast growing, drought tolerant and easily adapted to varied ecosystems and farming systems. It occupies a unique and consistent position in the Indian vegetable industry. A Moringa, an indigenous plant, is now valued for providing the fruits for vegetable with nutraceutical traits. Leaf, flower, bark, root and even wood are also used. It is also known as 4F plant (Food, Fodder, Fuel and Fertility). Popularly known as ‘‘Drumstick’’ tree, horseradish tree, or Ben tree, *M. oleifera* is a deciduous-to-evergreen shrub or small tree with a height of 5 to 10 m (Morton, 1991) [1]. Almost every part of the moringa plant has nutritional value. The pod is cooked as a vegetable and exported to many countries as fresh or canned. The root can be used as substitute for horse radish. Foliage is eaten as greens, boiled, fried, in soups or for seasoning. Dried leaf powder can be added to any kind of meal as a nutritional supplement. The seed can be roasted and eaten like a peanut. In order to do develop cultivars for increased the yield, genetic variability is the prerequisite since it is the source of variation and base for yield improvement. Assessment of genetic variability is also needed for efficient parental selection in breeding program (Rahman *et al*., 2011) [2], long term selection gain and exploitation of heterosis (Rahman *et al*., 2012) [3]. Furthermore, characters associated with yield are to be determined by correlation and path coefficient analysis to assist selection in yield improvement work. Though correlation analysis indicates the association pattern of component traits with yield, it also represents the overall influence of a particular trait on yield rather than providing cause and effect relationship. The path coefficient analysis technique facilitates the partitioning of genotypic correlation into direct and indirect contribution of various characters on yield (Mahbub *et al*., 2015) [4]. Such information would be of great value in enabling the breeder to specifically identify the important component traits of yield and utilize the genetic stock for improvement in a planned way.

Materials and Methods
The present investigation was carried out at Department of Vegetable Science, Pt. K.L.S. College Horticultural of and Research Station, Rajnandgaon (C.G.) during 2018 -2019. Twenty accessions of Moringa collected from various parts of Chhattisgarh and other state were collected, evaluated for different quantitative traits.

Observations on quantitative characters *viz*., plant height (cm), number of branches per plant, stem girth (cm), leaf length (cm), number of leaves per rachis, length of leaf rachis (cm) number of flowers per inflorescence, length of pod (cm), pod girth (cm), pod weight (g), number of pods per plant, number of seeds per pod, yield per plant (kg), contents were recorded. The variability for different quantitative traits was estimated as per procedure suggested by GCV and PCV as per Sivasubramanium and Madhavamenon (1973) [5], heritability according to Burton and Devane (1953) [6] and genetic advance as per Johnson *et al.* (1955) [7] Correlation coefficient was worked out as per Miller *et al.* (1958) [8] and path coefficient analysis was done according to formula given by Dewey and Lu (1959) [9].

Results and Discussion

Results indicated considerable variability for all the traits under study (Table 1). The PCV values were slightly greater than GCV values for most of the traits. The close relationship between genotypic and phenotypic coefficient of variability for most of the traits indicated that there was very little influence of environment on their expression. The higher estimates of genotypic and phenotypic coefficients of variation were observed for. The GCV and PCV was observed highest for leave length followed by number of pod per plant, plant height, pod girth, length of pod, number of branches per plant, number of seeds per pod number of leave per rachis, number of flower per inflorescence, yield per plant, which is an indicative of the genetic variability exists in the drumstick Germplasm accessions., indicating that the variability existing in these traits is due to the presence of genetic constitution. These related result were also reported by Venkatesan *et al*. (2003) [10], Nigude *et al.* (2004) [11], Prasanthi (2004) [12], Kumawat *et al.* (2005) [13]. Moderate estimates of genotypic coefficients of variation were however length of leave rachis and pod weight. High heritability coupled with high genetic advance as per cent of mean was observed for the characters *viz*, leave length, length of pod, number of pod per plant, number of branches per plant, pod girth, stem girth number of flower per inflorescence number of seeds per pod which indicated that the predominance of additive gene action in the expression of these characters which could be utilized for the development of high yielding drumstick genotypes. Phenotypic and genotypic correlations of 13 characters in all possible combinations were calculated to know the relationship among them. In general, genotypic correlation coefficients were higher than corresponding phenotypic correlation coefficients for most of the traits (Table 2). yield per plant exhibit the maximum significant positive correlation with number of leave per rachis (r = 0.949, 0.674) at genotypic and phenotypic level follow by number of braches per plant (r = 0.935, 0.776), number of pods per plant (r = 0.909, 0.756), number of flower per inflorescence (r= 0.800, 0.558), stem girth (r = 0.668, 0.397), leave length (r = 0.601,0.459), length of leave rachis (r= 526,0.368) Pod weight (r=0.016,0.005)and maximum significant negative correlation in plant (r= -0.694, -0.567) at genotypic and phenotypic levels. Such association were also reported by Venkatesan (2003) [10], Singh *et al*. (2004) [14], Lal *et al.* (2007) [15], Suganthi *et al.* (2008) [16].

Path coefficient analysis revealed that the results of presented in Table 3 showed that the highest positive direct effect contributing to yield per plant was observed due to number of branches per plant (r = 5.444) followed by length of pod (r = 1.938), leave length (r = 1.751), pod girth (r = 1.212), number of pod per plant (0.461) pod weight (r = 0.271), Hence direct selection for these traits may be advantageous. Number of branches per plant exhibited positive indirect effect contributing to yield per plant was observed due to leave length (0.885), number of pods per plant (0.383), plant height (0.209), number of seeds per pod (0.124) and length of pod (0.003). Number of pod per plant exhibited positive indirect effect contributing to yield per plant was observed due to number of braches per plant (4.513), leave length (0.458) number of seeds per pod (0.177), plant height (0.127) and pod weight (0.025). Similar results were also earlier reported by Choudhary and Sharma (2003) [17], Mittal and Singh (2005) [18], Saini *et al.* (2005) [19], Lal *et al.* (2007) [15].

Table 1: Genetic parameters of variation for pod yield and its components characters in drumstick

Characters	Mean	Range		GCV%	PCV%	h^2% (bs)	Genetic Advance	GA as % of mean
		Min	Max					
Plant height (m)	4.37	2.30	7.52	37.39	37.49	99.48	3.36	76.83
Number of Branches per Plant	14.29	8.24	22.54	30.27	31.91	89.96	8.45	59.14
Stem girth (cm)	21.27	13.81	28.28	20.80	24.70	70.89	7.67	36.07
Leave length (cm)	35.30	16.44	62.04	39.70	40.81	94.62	28.08	79.55
Number of leave per rachis	48.72	21.63	78.34	28.38	37.82	56.33	21.38	43.89
Length of leave rachis (cm)	13.85	8.73	18.34	19.24	23.14	69.14	4.56	32.96
Number of flowers per inflorescence	29.51	12.89	42.67	27.31	30.61	79.57	14.81	50.18
Length of pod (cm)	47.43	18.61	67.21	29.64	30.74	92.96	27.92	58.87
Pod girth (cm)	7.88	3.55	12.86	35.10	37.53	87.47	5.33	67.63
Pod weight (g)	30.87	21.97	40.00	13.35	21.76	37.65	5.21	16.88
Number of pods per plant	61.39	18.91	98.05	37.62	39.10	92.59	45.79	74.58
Number of seeds per pod	15.39	7.86	23.85	30.25	33.62	80.99	8.63	56.09
Yield per plant (kg)	2.56	1.56	3.56	21.65	26.55	66.54	0.93	36.39

Table 2: Path coefficient of various characters influencing on pod yield trait in Drumstick

Characters	Plant Height (Mt.)	No. of branches / plant	Stem girth (cm.)	Leave length (cm)	Number of leave per rachis	Length of leave rachis (cm.)	Number of flowers per inflorescence	Length of pod (cm.)	Pod girth (cm)	Pod weight (g.)	Number of pods per plant	No. of seeds per pod	Genotypic Yield per plant (Kg.)
Plant Height (m)	-0.356	-3.198	0.289	-0.709	1.744	1.107	0.942	0.352	-0.233	-0.036	-0.165	-0.43	-0.694**
Number of branches per plant	0.209	5.444	-0.574	0.885	-2.227	-1.613	-1.558	0.003	-0.078	-0.063	0.383	0.124	0.935**
Stem girth (cm)	0.108	3.292	-0.949	0.242	-1.201	-0.598	-0.755	0.150	-0.015	0.084	0.281	0.026	0.668**
Leave length (cm)	0.144	2.753	-0.131	1.751	-1.578	-2.022	-0.357	0.019	-0.001	-0.066	0.120	-0.031	0.601**
Number of leave per rachis	0.262	5.130	-0.482	1.169	-2.364	-1.990	-1.193	-0.216	0.151	-0.039	0.322	0.198	0.949**
Length of leave rachis (cm)	0.154	3.435	-0.222	1.385	-1.840	-2.556	-0.030	-0.109	0.140	-0.095	0.130	0.134	0.526**
Number of flowers per inflorescence	0.148	3.752	-0.317	0.227	-1.247	-0.340	-2.260	0.459	-0.242	-0.062	0.360	-0.032	0.800**
Length of pod (cm)	-0.064	0.010	-0.73	0.018	0.263	0.144	-0.535	1.938	-0.898	-0.061	-0.030	-0.693	0.016
Pod girth (cm)	0.0.68	-0.351	0.012	-0.002	-0.294	-0.296	0.451	-1.435	1.212	-0.028	-0.005	0.555	-0.056
Pod weight (g)	0.048	-1.276	-0.296	-0.428	0.341	0.897	0.520	-0.442	0.127	0.271	0.042	0.210	0.016
Number of pods per plant	0.127	4.513	-0.579	0.458	-1.647	-0.720	-1.764	-0.129	-0.013	0.025	0.461	0.177	0.909**
Number of seeds per pod	-0.185	-0.823	0.030	0.065	0.567	0.416	-0.089	1.628	-0.816	-0.069	-0.099	-0.825	-0.201

Residual value: 0.3008 Diagonal and bold underline figures shows direct effect on fruit yield

Table 3: Phenotypic (P) and Genotypic (G) correlation coefficients among different yield traits of drumstick genotypes

Character		Plant Height (Mt.)	Number of branches/ Plant	Stem Girth (cm)	Leave length (cm)	Number of leave per rachis	Length of leave rachis (cm.)	Number of flower per Inflorescence	Length of pod (cm.)	Pod girth (cm.)	Pod weight (gm)	Number of pods per plant	Number of seeds per pod	Yield per plant (Kg.)
Plant Height (Mt.)	P	1.000	-0.562**	-0.256	-0.396	-0.670**	-0.360	-0.366	0.174	-0.186	-0.100	-0.344	0.470*	-0.567**
	G	1.000	-0.588**	-0.305	-0.405	-0.738**	-0.433	-0.417	0.182	-0.193	-0.136	-0.359	0.522*	-0.694**
Number of branches/plant	P		1.000	0.523**	0.460*	0.811**	0.450*	0.593**	0.009	-0.070	-0.112	0.755**	-0.118	0.776**
	G		1.000	0.605**	0.506*	0.942**	0.631**	0.689**	0.002	-0.065	-0.235	0.829**	-0151	0.935**
Stem girth (cm.)	P			1.000	0.116	0.420	0.158	0.277	0.060	-0.026	0.099	0.492*	-0.030	0.397*
	G			1.000	0.139	0.508**	0.234	0.334	0.078	-0.013	0.312	0.61**	-0.032	0.668**
Leave length (cm.)	P				1.000	0.587**	0.627**	0.147	0.003	0.014	-0.121	0.237	0.024	0.459*
	G				1.000	0.668**	0.791**	0.158	0.010	-0.001	-0245	0.262	0.038	0.601**
Number of leave per rachis	P					1.000	0.564**	0.441*	-0.072	0.068	-0.027	0.611**	-0.202	0.674**
	G					1.000	0.778**	0.528*	-0.112	0.125	-0.144	0.697**	-0.240	0.949**
Length of leave rachis (cm.)	P						1.000	-0.030	-0.033	0.128	-0.197	0.199	-0.152	0.368
	G						1.000	0.013	-0.057	0.116	0.351	0.282	-0.163	0.526**
Number of flower per inflorescence	P							1.000	0.214	-0.168	- 0.154	0.693**	-0.005	0.558**
	G							1.000	0.237	-0.020	-0.23	0.781**	0.04	0.800**
Length of pod (cm.)	P								1.000	-0.696**	-0.137	-0.070	0.737**	-0.010
	G								1.000	-0.741**	-0.228	-0.067	0.84**	0.016
Pod girth (cm.)	P									1.000	0.077	-0.021	-0.578**	-0.038
	G									1.000	0.105	-0.011	-0.673**	-0.056
Pod weight (g.)	P										1.000	0.011	-0.262	0.005
	G										1.000	0.092	-0.255	0.016
Number of pods per plant	P											1.000	-0.187	0.756**
	G											1.000	-0.215	0.909**
Number of seeds per pod	P												1.000	-0.123
	G												1.000	-0.201
Yield per plant (kg.)	P													1.000
	G													1.000

References

1. Morton JF. The horseradish tree, Moringa Pterygosperma (Moringaceae): A boon to arid lands? Economic Botany. 1991; 45:318-333.
2. Rahman MM, Rasul MG, Bashar MK, Syed MA, Islam MR. Parent selection for transplanted Aman rice breeding by morphological, physiological and molecular diversity analysis. Libyan Agriculture Research Center J International. 2011; 2(1):29-35.
3. Rahman MM, Bashar MK, Rasul MG. Molecular Characterization and Genetic Variation in Rice. LAP Lambert Academic Publishing GmbH & Co. KG, Saarbrucken, Germany, 2012, 1-45.
4. Mahbub MM, Rahman MM, Hossain MS, Mahmud F, Mir Kabir MM. Genetic variability, correlation and Path Analysis for yield and yield components in soybean. American Sci. Eurasian J Agri. & Environ. Sci. 2015; 15(2):231-236.
5. Sivasubramanium J, Madhavamenon P. Genotypic and phenotypic variability in rice. Madras Agriculture Journal. 1973; 12:15-16.
6. Burton GW, Devane EM. Estimation of heritability in tall fescue. Agron. Journal. 1953: 45:478-481.
7. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variability in soybeans. Agronomy journal. 1955; 47(7):314-318.
8. Miller PA, Williams JE, Robinson HF, Comstock RE. Estimates of variance and co-variance in upland cotton and their implications in selection. Agron Journal. 1958: 50:126-131.
9. Dewey DR, Lu K. A Correlation and Path-Coefficient Analysis of Components of Crested Wheatgrass Seed Production. Agronomy journal. 1959; 51(9):515-518.
10. Venkatesan M, Prakash M, Ganesan J. Correlation and path analysis in Cowpea (*Vigna unguiculata* L). Legume Research. 2003: 26 (2): 105108.

11. Nigude AD, Dumbre AD, Sushir KV, Patil HE, Chavhan AD. Correlation and path coefficient analysis in cowpea. Annals of Plant Physiology. 2004: 18(1):71-75.
12. Prasanthi L. Variability and heritability studies in cowpea. Journal of Maharashtra, Agriculture University. 2004: 29(3):362-363.
13. Kumawat KC, Raje RS, Kumhar BL. Genetic variation in yield and yield components in cowpea (*Vigna unguiculata* (L) Walp.). Annonyms Agriculture Bio Research. 2005: 10(1):21-23.
14. Singh SP, Kumar R, Joshi AK, Singh Bhagat. Genetic architecture of yield traits in Cowpea (*Vigna unguiculata* (L.) Walp.). Advances in Plant Sciences. 2004: 17(2):495-502.
15. Lal H, Rai M, Karan S, Verma A, Ram D. Multivariate hierarchical clustering of cowpea germplasm (*Vigna unguiculata* (I.) Walp). Acta Horticulture. 2007: 21(2):413-416.
16. Suganthi S, Murugan S. Association analysis in cowpea (*Vigna unguiculata* L. Walp). Legume Research. 2008; 31(2):130-132.
17. Chaudhary DK, Sharma RR. Genetic variability, correlation and path analysis for green pod yield and its components in garden pea. Indian Journal of Horticulture. 2003; 60(3):251-256.
18. Mittal VP, Singh Paramjit. Component analysis of seed yield and other characters in cowpea. Journal-of-Arid-Legumes. 2005; 2(2):408-409.
19. Saini DD, Chaudhary SPS, Singh N, Singh, RV, Singh Jabar. Estimation of genetic parameters in cluster bean (*Cyamopsis tetragonoloba* (L.) Taub.). Arid legumes for sustainable agriculture and traditional, 2005, 106-110.