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GENETIC VARIABILITY IN DRUMSTICK GENOTYPES

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ABSTRACT

Drumstick (Moringa oleifera Lam.) is one of the important perennial vegetable grown in India. Every part of plant valued for food, but it's also enriched with more nutrition and high minerals and vitamins at cheaper inputs. Leaves, flowers and immature pods are used as a highly nutritive vegetable and for medicinal purpose. In experiment 36 genotypes were evaluated with three replications in complete randomized design during 2011-2012.The results revealed a significant difference in all the characters like pod weight (26.37-66.43 g), pod length (24.43 to 59.47 cm), pod girth (7.33 to 23.67 mm), number of leaflets/leaf (8.00 to 13.33), and leaf length (28.63 to 66.37 cm). Similarly, a wide variation was recorded for nutrients in drumstick leaves. It was 22.07 to 37.47 % for dry matter; 5.33 to 7.87 % for TSS; 0.72 to 1.43 mg/g for chlorophyll. The GCV was greater than PCV for all the characters but the differences were low. High GCV and heritability estimates coupled with greater genetic advance was recorded for pod weight and indicated that these characters had additive gene effects and therefore, they are more reliable for effective selection.

Keywords: Drumstick, food plant, medicinal uses, evaluation, genotypes.

INTRODUCTION

Drumstick [*Moringa oleifera* Lam. (Syn. *M. pterygosperma Gaertn.*)] is one of the best known and most widely distributed and naturalized species of a monogeneric family Moringaceae. The genus *Moringa* has more than 13 species of which two species viz., *M. oleifera* Lam. (syn. *M. pterygosperma* Gaertn.) and *M. concanensis* Nimmo occur in India and the former being the vegetable type (Panday *et al.,* 2011). Drumstick is an important food commodity which has had enormous attention as the 'natural nutrition of the tropics. *Moringa* has many medicinal properties. Almost all parts viz., root, bark, gum, leaf, fruit (pod), flower, seed and seed oil have been used for treatment of various inflammation and infectious diseases along with cardiovascular, gastrointestinal, haematological and hepatorenal, disorders (Singh *et al*., 2011). Flowers are used as stimulant, tonic and diuretic. They are useful in increasing the flow of bile. The seeds of *Moringa* are considered to be antipyretic, acrid, bitter (Oliveira *et al.*, 1999) and reported to show antimicrobial activity. The seeds of *Moringa* are used as water purifier. The oil extracted from the seed, known as "*Ben*", is used as lubricant in watches, for edible purpose and in cosmetics. The kernel of the seed is rich in crude protein, fatty oil and fiber. Leaves contain 4.0% moisture, 38.4% crude protein, 34.17% fatty oil, 3.5% fibre and 3.2% mineral matter. India is the largest producer of *Moringa* with an annual production of 1.1-1.3 million tonnes of tender fruits from an area of 38,000 ha. Much variability has also been reported by Reshmi (2004) in drumstick with respect to morphological characters which are helpful in selection of elite tree for combination breeding programme. In a systematic breeding programme, collection, evaluation and characterization of the germplasm is the first important step for gathering the basic information about variability exists in a particular crop plant. Hence, the present study was initiated.

MATERIALS AND METHODS

The present investigation was conducted during the year 2011-12 at the College of Horticulture and Forestry, Jhalawar. The location of the experimental site is comprised of four districts of the Rajasthan namely Jhalawar, Kota, Ajmer and Udaipur. Jhalawar district falls under sub-humid South Eastern Plains under agro-climatic zone V. The climate of Jhalawar is typically sub-humid and characterized by extremes of temperature both in summer and winter with high rainfall and moderate relative humidity. Udaipur has a sub tropical climate characterized by mild winter and summer. Ajmer and Kota both have hot semi arid climate, with high temperature throughout the year.The experimental material comprised of 36 genotypes of drumstick collected from four districts of the Rajasthan namely Ajmer, Jhalawar, Kota and Udaipur through a survey made during February - March, 2012 with the help of local people. Initially, 15-20 trees of drumstick, growing naturally on road side or planted in open field/ boundary wall or grown in kitchen garden, were identified from each district but finally 9 bearing trees

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showing variability for morphological characteristics were selected for the present investigation .The observations were recorded on 10 different morphological pod, seed and leaf characters *viz.*, pod weight, pod length, pod girth, seeds/pod, 10-seed weight, leaflets/leaf, leaf length, dry matter, TSS, and chlorophyll ,vitamin C, protein, nitrogen, phosphorus, potassium, calcium, iron, magnesium from randomly selected plants and the average was subjected to statistical analysis of variance (Panse and Sukhatme,1978).

RESULTS AND DISCUSSION

A healthy vegetative growth is an ideal indicator of the plant ability to survive under moisture stress condition. In the present study, among the eighteen morphometric and nutrient parameters studied, all the characters showed significant variation indicating they being influenced by the genotype. The extent of variabilitypresent in the drumstick genotypes was measured in term of mean, coefficient of variance, critical difference, and genetic coefficient of variance(GCV), phenotypic coefficient of variance(PCV),genetic advance (GA) and heritability(broad sense) (table 1 and table 2). Among the vegetative parameters a wide range of variation was observed in plant height. The genotypes used for present study were of 6 yrs (JWRM-2) to 35 yrs (JWRM- 29) of age and height and girth of the tree varied from 6.5 m to 12.5 m and 30 to 78 cm, respectively. Bitterness (Bitter/Non Bitter) is a quality attribute and recorded by tasting the immature pods of 36 genotypes. Wide variations with respect to bitterness of pods were noted during the survey of the genotypes. On the basis of taste, the genotypes were grouped into three categories i.e. non-bitter, slightly bitter and bitter.

Table 1: Range and mean values of pods and leaves characteristics in drumstick

Characters	Range	Mean
Pods		
Pod weight (g)	26.3-66.4	46.5±1.5
Pod length (cm)	26.7-59.4	41.5±2.0
Pod girth (mm)	7.3-23.6	15.3±1.4
Seeds/pod	10.0-23.0	17.0±1.4
10 seed weight (g)	2.1-6.4	4.0±0.1
Leaves		
Leaflets/ leaf	8.0-13.3	10.8±0.8
Leaf length (cm)	28.6-66.3	48.3±1.8
Dry matter content (%)	22.0-37.4	31.3±0.6
T.S.S.(%)	5.3-7.8	6.5±0.29
Chlorophyll (mg/g)	0.7-1.4	1.06±0.05
Vitamin –C (mg/100g)	155.4-220.2	188.6±1.8
Protein (%)	22.5-26.6	24.4±0.19

Analysis of variation revealed that the genotypes JWRM-6, JWRM-7 were superior in respect of pod weight as compared to other genotypes and ranged from 26.37 to 66.43 g. The genotypes showed variation in fruit characters as they were selected from different geographical locations. As far as drumstick is concerned, fruit length is an important character, which decides the consumer attraction. The medium fruit length (<60cm) is preferred in the local market, where the fruit (>1.0m) is suitable for processing industry. The maximum pod length was found in JWRM-4 (59.47 cm) followed by JWRM-10 (52.37 cm) it's ranged from 26.70 to 59.47 cm. Results are in agreement with the findings of Varalakshmi and Devaraju (2007) in drumstick. The pod girth varied from 7.33 to 23.67 mm. Kernal oil of drumstick seeds is used as a lubricant in precision equipments. This shows the economic and industrial importance of drumstick seeds. Additionally, the oil cake has been used as water purifier in industry. Therefore, industry prefers fruits with more seeds while culinary preference was directed to selection of fruits with less seeds. The number of seeds per pod in the present study ranged from 10.00 (JWRM-17) to 23.00 (JWRM-31). It was noted that large sized fruit had more number of seeds. 10-seed weight of 36 genotypes varied from 2.14 g (JWRM- 23) to 6.48 g (JWRM- 28). Raja *et al.* (2011) recorded the highest seed weight i.e. 12.8 g along with 23.5 seeds per fruit in drumstick.

Table 2: Range and mean values of nutrient content in drumstick leaves

Content	Range	Mean
Nitrogen (mg/100gm)	3461.4-4091.7	3766.1±28.9
Phosphorous (mg/100 g)	126.7-203.4	167.5±1.7
Potassium (mg/100g)	654.2-1281.7	968.4±11.5
Calcium (mg/100 g)	1460.7-2044.2	1858.6±16.3
Iron (mg/100g)	14.0-26.8	21.3±1.5
Magnesium (mg/100 g)	245.4-350.0	302.6±1.9

The data were recorded on leaf characteristics namely number of leaflets/leaf, leaf length, dry matter content, chlorophyll, TSS, vitamin C, protein, nitrogen, phosphorus, potassium, calcium, iron, magnesium of 36 genotypes of drumstick (Table 1 and 2). The coefficients of variation for these characters were observed very low which ranged from 1.33 % (Protein) to 13.11 (leaflets/leaf). The ranges were from 8.0 to 13.0 for leaflets per leaf, 28.6 to 66.3 cm for leaf length, 22.0 to 37.4 % for dry matter, 5.3 to 7.8 % for TSS, 0.72 to 1.43mg/g for chlorophyll, 155.4 to 220.2 mg/100g for vitamin C, 22.5 to 26.6 % for protein, 3461.4 to 4091.7

mg/100g for nitrogen, 126.7 to 203.4 mg/100g for phosphorus, 654.2 to 1281.7 mg/100g for potassium, 1460.7 to 1281.7 mg/100g for calcium, 14.0 to 26.8 mg/100g for iron, 245.4 to 350.0 mg/100g for magnesium.

The coefficient of variation for different characters was in the range of 1.13 % (magnesium content) to 15.81 % (pod girth). The maximum CV was recorded for pod girth (15.81%) followed by number of seeds per pod (14.73%), number of leaflets per leaf (13.11) and iron (12.30%). This result was in agreement with the findings of Varalakshmi and Devaraju (2007) who recorded high coefficient of variation for fruit weight (27.06%) followed by fruit girth (20.07%) and fruit length (19.77%). The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for different characters are presented in Table 3. In general, the estimates of PCV for all the characters were higher than their corresponding GCV. However, the difference between GCV and PCV was of low under for all the characters. In the present investigation, the values of GCV and PCV for different characters were observed from low to moderate. The maximum value of GCV (31.53 %) and PCV (35.37 %) was recorded for pod girth followed by 10-seed weight (31.1 % and 32.0 %). Moderate values of GCV and PCV were noted for pod weight (28.4 % and 29.0 %), leaf length (19.8 % and 20.8 %), pod length (18.2 % and 20.2 %), potassium (17.1 % and 17.2 %), number of seeds per pod (17.1 % and 22.7 %), iron (16.8 % and 20.9 %) and chlorophyll (14.8 % and 16.9 %g) whereas the low values of GCV and PCV were recorded for remaining characters like dry matter content (13.6 % and 14.0 %), number of leaflets per leaf (11.2 and 17.4), total soluble solids (10.3 % and 12.8 %), phosphorous (10.3 % and 10.4 %), magnesium (9.1 % and 9.2 %), vitamin C (8.7 % and 8.9 %), calcium (7.5 % and 7.6 %), nitrogen and protein (5.4 % and 5.5 %).

The estimates of heritability in broad sense in per cent for different characters are given in Table 3. The heritability estimates were categorized as low (from 5 to 10 %), medium (from 11 to 30 %) and high (above 30 %) as suggested by Robinson (1966). In the present study, the heritability was recorded in the range of low (41.90%) to high (98.51%). The low heritability estimates were observed for number of seeds per pod (56.72 %) and number of leaflets per leaf (41.90%) and moderate for pod length (81.59 %), pod girth (79.46 %), chlorophyll (76.29 %), total soluble solids (64.70 %) and iron (64.53 %). The high heritability estimates were recorded for potassium (98.51 %), magnesium (98.46 %), phosphorous (96.95 %), vitamin C (96.22 %), calcium (95.96 %), pod weight (95.92 %), 10-seed weight (94.47 %), dry matter (94.22 %), protein (94.15 %), nitrogen (94.14 %) and leaf length (90.10 %).

Table 3: Estimates of GCV, PCV, GA and heritability for different characters studied in 36 genotypes of drumstick

Characters	GCV (%)	PCV (%)	h^2 (%)	GA (%)
Pod weight (g)	28.43	29.03	95.92	26.67
Pod length (cm)	18.27	20.22	81.59	14.13
Pod girth (mm)	31.53	35.37	79.46	8.86
Number of seeds/pod	17.10	22.70	56.72	4.52
10 seed weight (g)	31.18	32.08	94.47	2.53
No. of leaflets/leaf	11.29	17.44	41.90	1.64
Leaf length (cm)	19.83	20.89	90.10	18.74
Dry matter (%)	13.62	14.03	94.22	8.52
TSS (%)	10.36	12.88	64.70	1.13
Chlorophyll (mg/g)	14.82	16.97	76.29	0.28
Vitamin C in leaves (mg/100g)	8.76	8.93	96.22	33.39
Protein content (%)	5.41	5.58	94.15	2.65
Nitrogen (mg/100gm)	5.41	5.58	94.14	407.32
Phosphorous (mg/100 g)	10.30	10.46	96.95	34.99
Potassium (mg/100g)	17.12	17.24	98.51	338.91
Calcium (mg/100 g)	7.51	7.67	95.96	281.72
Iron (mg/100g)	16.83	20.95	64.53	5.95
Magnesium (mg/100 g)	9.15	9.23	98.46	56.63

In general, phenotypic coefficient of variation (PCV) was greater than the corresponding genotypic coefficient of variation (GCV) for all the characters indicating the importance of environment in expression of characters. However, the differences between the GCV and PCV for all the characters were narrow suggesting that the characters were less affected by environment. The genotypic coefficient of variation does not offer full scope to estimate the variation that is heritable and therefore, estimation of heritability becomes necessary. Burton (1952) suggested that GCV along with heritability give a better idea about the efficiency of selection. In the present study high heritability was recorded for potassium, magnesium, calcium, phosphorus, vitamin C and pod length. High heritability along with high GCV was recorded for 10-seed weight only suggesting that this trait can be improved by selection. The estimate of heritability along with genetic advance is more reliable than heritability alone for predicting the effect of selection (Johnson *et al.*, 1955). In the present study, high GCV and heritability estimates associated with greater genetic advance was observed for potassium followed by calcium, nitrogen and pod weight indicated that these characters had additive gene effect and therefore, they are more reliable for effective selection.

REFERENCES

Burton, G.W. (1952) Quantitative inheritance in grasses. *Proc. 6th International Grassland Congress* **1**: 277-283.

Johnson, H.W., Robinson, H.F., Comstock, R.E. (1955) Estimation of genetic and environmental variability in soybeans, *Agronomy Journal* **47**: 314–318.

Oliveira, J. T. A., Silveira, S. B., Vasconcelos, I. M., Cavada, B. S., Moreira,R. A. (1999) Compositional and nutritional attributes of seeds from the multipurpose tree *Moringa oleifera* Lamarck. *Journal of the Science of Food and Agriculture* **79**: 815–820.

Palada, M. C. and Changl, L. C. (2003) Suggested cultural practices for Moringa. *International Cooperators' Guide AVRDC*. AVRDC pub#03–545.

Pandey, A., Prudheep, K., Gupta, R., Nayar, E.R. and Bhandari D.C. (2011) Drumstick tree (*Moringa oleifera* Lam.): A multipurpose potential species in India. *Genetic Resources and Crop Evolution* **58**:453-460.

Panse, V.G. and Sukhatme, P.V. (1978) Statistical Methods for Agricultural Workers. ICAR, New Delhi.

Raja, S., Bagle, B.G. and More, T.A. (2011) Evaluation of drumstick genotypes sutiable for semi arid ecosystem of western india. *Indian Journal of Horticulture* **68**(1):79-85

.Resmi, D.S. (2004) Characterisation of landraces of Drumstick (*Moringa oleifera* Lam.) Thesis of Kerala Agriculture University, Thrissur.

Robinson, H.F. (1966) Quantitative genetics in relation to breeding on the centennial of Mendelism. *Indian Journal of Genetics and Plant Breeding* **26** (1): 171-187

Singh, B.K., Sharma S.R., Kalia, P. and Singh, B. (2011) Genetic variability for antioxidants and horticultural traits in cabbage. *Indian journal of Horticulture* **68**(1): 51-55

Varalakshmi, B. and Devaraju (2007) Genetic diversity in drumstick (*Moringa oleifera*) germplasm. *Acta horticulture* **752**: 411-412.