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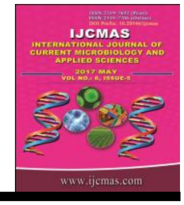

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Genetic Variability, Heritability and Genetic Advance for Seed Yield and its Components in Roselle (*Hibiscus sabdariffa* L.) in North Coastal Zone of Andhra Pradesh, India

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Genetic parameters like variability, heritability and genetic advance were studied in a set of 60 genotypes of roselle (*Hibiscus sabdariffa* L.) during *Kharif*, 2013 and 2014 in North Coastal Zone of Andhra Pradesh at Agricultural Research Station, Ragolu, Srikakulam district for seed yield and its contributing traits and the study revealed significant differences for all the characters. High variability was observed for all the nine characters in both the years concurrently. Phenotypic as well as genotypic coefficients of variability were high for the important productivity characters like seed yield plant^{-1} and pods plant^{-1}; whereas, medium for plant height and test weight; and low for days to 50% flowering in both the years. High heritability coupled with high expected genetic advance was observed for seed yield plant^{-1}, pods plant^{-1} and plant height in both years indicating operation of additive gene action and the ample scope for improvement in these traits through simple selection.

Introduction

Roselle (*Hibiscus sabdariffa* L.) belongs to the family Malvaceae; native to Asia (India to Malaysia) or Africa; and is an annual or biennial plant cultivated in Tropical and Sub-Tropical regions for its stem, fibres, edible calyces, leaves and seeds (Mahadevan *et al.*, 2009). Roselle is a tetraploid species with 2n=4x=72 (Sabiel *et al.*, 2014) and proved its importance in fibre industries, preparation of medicines and in culinaries to make favourable dishes from its edible parts in many countries. Roselle fibre blended with jute is used in the manufacture of jute goods *viz.*, cordage, sacking, hessian, canvas and rough sacks, ropes, twines, fishing nets etc. The stalks were used in making paper pulp, structural boards, as a blend for wood pulp and thatching huts. The seed contains 18-20% oil and is used in soap and other industries (Juhi Agarwal and Ela Dedhia, 2014). Since, roselle is mostly used for its fibre in India, research efforts were made only on fibre yield and its contributing traits by researchers till date and there is every need to study on seed yield and its contributing characters also.

Generally, success of any crop improvement program largely depends on the magnitude of genetic variability, heritability and genetic advance of yield and its attributes. Collection of germplasm and assessment of genetic variability is a basic step in any crop improvement programme. Yield being a complex character, is influenced by a number of yield contributing characters controlled by polygenes and influenced by environment. So, the variability in the collections for these characters is the sum total of heredity effects of concerned genes and influence of the environment. Hence, it becomes necessary to partition the observed variability into heritable and non-heritable components measured as genotypic and phenotypic coefficients of variation (GCV and PCV), heritability and genetic advance expressed as per cent mean. Keeping this in view, the present investigation was undertaken to assess the variability, heritability and genetic advance of the seed yield and its contributing traits of roselle from a set of sixty germplasm.

Materials and Methods

Sixty roselle (*Hibiscus sabdariffa* L.) genotypes consisting of eleven exotic lines; four released varieties and 45 indigenous accessions were evaluated in North Coastal Zone, Andhra Pradesh at Agricultural Research Station, Ragolu (Latitude $18^0 24^{'}$ N; Longitude 83. 84^0 E at an altitude of 27m above mean sea level) during early *kharif* seasons in 2013 and 2014. The experimental trial was laid out in randomized block design with a plot size of four rows of 2m length in two replications with a spacing of 30 x 10cm under rainfed conditions. Recommended package of practices was followed to raise a good crop. Data on the basis of five randomly selected competitive plants were recorded on plant height (cm), base diameter (mm), mid diameter (mm), days to 50% flowering, pods plant^{-1}, seeds pod^{-1}, test weight (g) and seed yield plant^{-1} (g). Genotypic and Phenotypic coefficients of variation were calculated using the formula suggested by Burton and De Vane (1953). Heritability and genetic advance were estimated according to the formulae given by Allard (1960).

Results and Discussion

The analysis of variance revealed significant difference among the genotypes for all the nine characters studied for both the years (Table 1) suggesting presence of wide variability in the studied germplasm which was also depicted by the range values of all the nine traits (Table 2) in both the years. In the first year, *kharif* 2013, plant height ranged from 196.00 to 370.00cm; base diameter from 14.75 to 24.51mm; mid diameter from 11.93 to 18.81mm; nodes plant^{-1} from 51.00 to 74.00; days to 50% flowering from 153.00 to 162.50; pods plant^{-1} from 9.00 to 57.50; seeds pod^{-1} from 16.50 to 34.50; test weight from 1.76 to 3.15g; seed yield plant^{-1} from 3.55 to 27.59g. Similarly, in the second year, *kharif* 2014 also, plant height ranged from 163.75 to 396.25 cm; base diameter from 9.76 to 24.26mm; mid diameter from 7.66 to 15.31mm; nodes plant^{-1} from 53.00 to 93.00; days to 50% flowering from 168.50 to 195.50; pods plant^{-1} from 5.10 to 27.00; seeds pod^{-1} from 21.10 to 33.50; test weight from 1.75 to 3.11g; seed yield plant^{-1} from 2.31 to 13.47g. These concurrent results for two years have depicted that large amount of variability are present in the germplasm under study. In both the years, the characters seed yield plant^{-1} and pods plant^{-1} showed high genotypic and phenotypic coefficient of variance (GCV and PCV) suggesting that these characters are under the influence of genetic control (Table 2). Moderate values of genotypic and phenotypic coefficient of variation were found for the characters plant height and test weight for both the years. Base diameter and seeds pod^{-1} showed moderate PCV for both years, whereas, for GCV showed moderate for one year and low for the other year. Mid diameter and nodes plant^{-1} showed low GCV and medium PCV in both the years revealing the influence of environment. Days to 50% flowering showed low GCV and PCV values for both the years.

Further, the estimates of PCV were generally higher than their corresponding GCV for all the characters studied suggesting thereby the important role of environment in the expression of these traits. Hence, phenotypic selection may not hold good for genetic improvement in these traits. These findings are in agreement with Dastidar *et al.*, (1993), Islam *et al.*, (2002), Palve *et al.*, (2003), Echekwu and Showemino (2004), Ibrahim and Hussein (2006), Ghodke and Wadikar (2011); Nwangburuka *et al.*, (2012) and Ibrahim *et al.*, (2013).

Practically, heritability estimates are of greater value to the breeder, since, they indicate the degree of dependence of genotypic value on phenotypic value. During the first year, 2013, the characters plant height, days to 50% flowering, pods plant^{-1}, seeds pod^{-1}, test weight and seed yield plant^{-1} showed highest estimates of heritability. Moderate estimates of heritability were recorded for base diameter; low for mid diameter and nodes plant^{-1}. In the second year, 2014, the characters plant height, pods plant^{-1}, seeds pod^{-1}, tests weight and seed yield plant^{-1} showed highest estimates of heritability. Moderate estimates of heritability were recorded by the characters base diameter, mid diameter, nodes plant^{-1} and days to 50% flowering.

Similar results were also reported by Dastidar *et al.*, (1993), Mostofa *et al.*, (2002), Echekwu and Showemino (2004), Ghodke and Wadikar (2011); Nwangburuka *et al.*, (2012) and Ibrahim *et al.*, (2013). High heritability for the traits of economic importance *viz.*, plant height, pods plant^{-1}, seeds pod^{-1}, test weight and seed yield plant^{-1} indicated that the direct selection would be effective for improvement of these characters. The estimates of heritability, however, indicate only the effectiveness with which the selection of genotypes can be made based on their phenotypic performance, but fail to indicate the amount of progress expected from selection. For an effective selection, the knowledge alone on the estimates of heritability is not sufficient and genetic advance (%) of mean if studied along with heritability is more useful. High estimates of heritability does not always mean high genetic advance.

High heritability coupled with high genetic advance of mean was observed for the traits plant height, pods plant^{-1} and seed yield plant^{-1} in both the years. These findings were corroborated with the results of Dastidar *et al.*, (1993), Islam *et al.*, (2002), Ghodke and Wadikar (2011); Nwangburuka *et al.*, (2012) and Ibrahim *et al.*, (2013). High heritability coupled with high genetic advance as percent of mean for plant height, pods plant^{-1} and seed yield plant^{-1} indicates the operation of additive genes and offer the best possibility for improvement of this trait through mass selection, progeny selection, family selection to any other suitable modified selection procedure aiming to exploit the additive gene effects Bhakuni (Bhakuni Vandana) (Vandana *et al.*, 2017).

High heritability coupled with moderate genetic advance of mean was observed for the traits seeds pod^{-1} and test weight in both the years. This indicated substantial improvement for these characters could be achieved through direct selection and these traits could govern by additive type of genes. Moderate heritability coupled with moderate genetic advance of mean was observed for base diameter in the second year.

Table.1 Analysis of variance for nine characters in roselle (*Hibiscus sabdariffa* L.) during 2013 and 2014

Source of variations	df	Year	Plant height (cm)	Base diameter (mm)	Mid diameter (mm)	Nodes plant^{-1}	Days to 50% flowering	Pods plant^{-1}	Seeds pod^{-1}	Test weight (g)	Seed yield plant^{-1} (g)
			Mean sum of squares								
Replications	1	2013	104.533	2.189	1.587	18.408	1.408	1.633	0.033	0.008	0.641
		2014	342.616	1.859	0.126	11.408	10.208	4.256	0.8	2.269	0.063
Genotypes	59	2013	2985.83**	7.50**	3.67*	44.83*	118.05**	237.11**	27.00**	18.24**	55.05**
		2014	3560.94**	11.77**	3.98**	117.17**	52.10**	56.79**	15.88**	18.01**	14.76**
Error	59	2013	295.615	3.152	2.082	28.697	13.292	6.386	1.784	1.572	1.332
		2014	348.236	3.117	1.628	43.174	20.145	3.779	3.135	2.756	0.814

Table.2 Genetic variability parameters in roselle (*Hibiscus sabdariffa* L.) for seed yield and its contributing characters

Character	Year	Mean	Range	GCV (%)	PCV (%)	Heritability	GA	GAM
Plant height (cm)	2013	307.85	196.00 – 370.00	11.91	13.16	81.98	68.41	22.22
	2014	309.03	163.75 – 396.25	12.51	14.71	72.42	67.80	21.93
Base diameter (mm)	2013	20.61	14.75 – 24.51	6.41	11.65	30.21	1.49	7.25
	2014	18.00	9.76 – 24.26	10.86	15.66	48.08	2.79	15.51
Mid diameter (mm)	2013	15.76	11.93 – 18.81	1.08	12.11	0.79	0.03	0.20
	2014	11.90	7.66 – 15.31	8.20	14.59	31.60	1.13	9.50
Nodes plant^{-1}	2013	63.04	51.00 – 74.00	1.76	10.48	2.81	0.38	0.61
	2014	71.51	53.00 – 93.00	7.62	13.08	33.89	6.53	9.13
Days to 50% flowering	2013	157.84	153.00 – 162.50	4.73	5.01	89.09	14.50	9.19
	2014	180.03	168.50 – 195.50	2.17	3.37	41.33	5.17	2.87
Pods plant^{-1}	2013	30.48	9.00 – 57.50	34.40	36.99	86.45	20.08	65.88
	2014	13.79	5.10 – 27.00	37.34	39.91	87.56	9.93	71.98
Seeds pod^{-1}	2013	27.22	16.50 – 34.50	13.05	13.94	87.64	6.85	25.17
	2014	28.07	21.10 – 33.50	9.00	10.99	67.11	4.26	15.19
Test weight (g)	2013	2.21	1.76 – 3.15	13.66	13.70	99.37	0.62	28.05
	2014	2.24	1.75 – 3.11	11.92	14.73	65.52	0.45	19.87
Seed yield plant^{-1}(g)	2013	13.65	3.55 – 27.59	37.20	39.67	87.92	9.80	71.85
	2014	6.49	2.31 – 13.47	40.72	43.01	89.63	5.15	79.41

PCV=Phenotypic Coefficient of Variation, GCV= Genotypic Coefficient of Variation, GA= Genetic advance and GAM=Genetic advance as per cent mean

In conclusion, the analysis of variance showed significant differences among sixty germplasm of roselle for all characters studied indicating wider variability and high diversity among genotypes. The genotypic coefficient of variation for all characters studied was lesser than the phenotypic coefficient of variation suggesting the influence of environment. High PCV coupled with high GCV, observed for pods plant^{-1} and seed yield plant^{-1} indicating the presence of wider variability for these traits in the germplasm studied. High heritability coupled with high genetic advance as percent of mean was observed for plant height, pods plant^{-1} and seed yield plant^{-1} indicates the operation of additive gene action in the inheritance of these traits and improvement in these characters is possible through simple selection.

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