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Genetic variability and associations in shankha pushpi (*Convolvulus microphyllus* Sieb. ex. Spreng)

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Abstract

Nature and amount of genetic variability, co-heritability, path-coefficients and associations were studied on eight economic traits in 52 genetic stocks of Shankha pushpi assembled from different states of India. Genotypic correlation was larger than phenotypic correlation for most of the traits. Days to 50 % flowering was significantly and positively correlated with length of main branch and herb yield (g plot^{-1}) at both genotypic and phenotypic levels but it was negatively correlated with leaf width at environmental level. Spread area and herb yield (g plot^{-1}) were also significant and positively associated at both genotypic and phenotypic levels but it was negatively associated with the main branch length at environmental level. Positive association was also recorded between main branch length and leaf width at genotypic level only. Negative associations were observed between primary branches and leaf width, leaf length and herb yield (g plot^{-1}). All traits exhibited high heritability h^2 (BS) (96.34-99.24%) except leaf width (37.02 %) and days to 50% flowering (71.96%). Genetic advance was high for only spread area and herb yield (g plot^{-1}). Highest direct contribution to herb yield was by days to 50% flowering (0.319) and spread area (0.245) followed by primary branches plant^{-1} (0.052) and main branch length (0.033). Days to 50 % flowering indirectly contributed maximum to herb yield by main branch length. The association between spread area and leaf width showed maximum co-heritability (1.135) followed by that between leaf length and leaf width (1.114) and primary branches plant^{-1} and leaf width (1.072) and hence these traits may form a good selection criteria for improvement of herb yield.

Key words: *Convolvulus microphyllus*, genetic variance, heritability

Shankha pushpi (*Convolvulus microphyllus*, family - Convolvulaceae), is a hairy perennial herb with spreading, prostrate branches arising from small woody root stocks. The shankha pushpi is a common weed in open or grassy places almost throughout India (Kashmir to Deccan). The plants have a slightly bitter alkaloid shankha pushpin (C17 H23 NO3) which is alteractive, anti phlegmatic, anti phlogistic, anthelmintic, cephalic which cures dysentery, insomnia, stomachache and tonic to brain and memory, febrifuge, vermifuge and useful as a hair tonic for promoting hair growth (Koman 1919; Husain *et al.*, 1992; Kirtikar & Basu 1935; Singh 1988). Shankha pushpi plants are also useful for curing skin diseases and also as a hypotensive safe tranquilizer (Anonymous 1952).

The study of genetic variability for diverse economic traits is a prelude to crop improvement. In the present study genetic variations for different traits of assembled genetic stocks of shankha pushpi were evaluated in order to gather the genetic information about associations and contribution of various components to herb yield, for quality improvement in this crop.

Fifty two indigenous collections of diverse origin from 17 states of India (29-Uttar Pradesh, 5-Uttaranchal, 2 each from Bihar, Gujarat, Orissa and 1 each from West Bangal, Jammu and Kashmir, Punjab, Haryana, Himachal Pradesh, Assam, Kerala, Karnataka, Madhaya Pradesh, Andhra Pradesh, Maharastra and Rajasthan) were used in this study.

The genetic stocks were field evaluated in the year 1999-2000 in a randomized block design replicated twice at Central Institute of Medicinal and Aromatic Plants, Lucknow (India), located at 26.5° N, 80.5° E and 120 M above the mean sea level. The climate of the region is semi-arid to sub tropical in nature. The experimental plot was sandy loam in texture with pH 8.1, low in available nitrogen (150 kg ha^{-1}), potash (60 kg ha^{-1}) and medium in phosphorus (11.2 kg ha^{-1}).

Morphometric observations were recorded on five competitive plants in each plot for eight economic traits namely, days to 50% flowering, primary branches $plant^{-1}$, secondary branches $plant^{-1}$, main branch length, spread area, leaf length, leaf width and herb yield. The mean values for all the traits of 52 genetic stocks were subjected to simple analyses for various statistical parameters, correlation coefficients and path- coefficients (Dewey & Lu 1959).

The statistical and genetic parameters for the heritable and non-heritable components of variation were computed for all the eight economic traits. Variations among accessions were highly significant (P = 0.001) for all the characters. The sampling variance expressed as CVg and CVp was high for herb yield (89.26%) followed by secondary branches (77.98%). It was moderate for spread area (50.68%) followed by primary branches (40.44%), main branch length (39.22%) and leaf length (39.17%). Low sampling variance was recorded for days to 50% flowering (19.76%) followed by leaf width (20.74%) at both genotypic and phenotypic levels. However, the critical variance (CV%) was high for leaf width (27.05%) followed by herb yield (16.90%) and medium for days to 50% flower (12.34%), spread area (9.87%) and leaf length (10.96%). It was low for primary branches $plant^{-1}$ (3.66%), main branch length and spread area (4.55%) and secondary branches plant (6.82%), respectively (Table 3).

The heritable portion of phenotypic variance reflected by the size of $\hat{\sigma}^2p$ relative to σg^2 expressed as heritability in broad sense heritability broad sense percent ($\hat{h}^2$BS %) and respective genetic advance (GA) were generally medium to very large [$\hat{h}^2$ (BS) %: 37.02-99.24%; GA: 0.064-315.61%]. The phenotypic variance ($\hat{\sigma}p^2$) were high (0.019-11213.84) than genotypic ($\hat{\sigma}g^2$) (0.007 – 25287.98) and environmental variance ($\hat{\sigma}e^2$) (0.012-959.57) for all the traits studied (Table 3). In other words, all traits were apparently little to moderately influenced by environmental factors.

It should be emphasized that $\hat{h}^2$ (BS) applies most suitably to situations where crops are vegetatively propagated. It is not appropriate to use $\hat{h}^2$(BS) to estimate selection response when sexual propagation is to be used. In the latter case $\hat{h}^2$ (ns) = A^2/p^2 (where- A^2 is additive variance) should be used. If estimates of $\hat{h}^2$ (ns) are not available, the use of h^2 (ns) provides an upper estimate of expected response to selection genetic advance (GA). However, a high $\hat{h}^2$ (BS) estimate with correspondingly high genetic advance (GA) is more reliable for selection than that with low genetic advance (Panse 1957). The six most important traits viz. secondary branches $plant^{-1}$ (99.24%), primary branches $plant^{-1}$ (99.19%), main branch length (98.67%), herb yield (96.54%), spread area (96.34%) and leaf length (92.73%) had high h^2 (BS). Medium h^2 (BS) was recorded for days to 50% flower-

Table 1. Genotypic (rG), phenotypic (rP), environmental (rE) correlation coefficients and coheritability (COH) of economic traits of shankha pushpi accessions

Character	Correlations and coheritability	Days to 50% flowering	Primary branches plant^{-1}	Secondary branches plant^{-1}	Main branch length (cm)	Spread area (sq cm)	Leaf length (cm)	Leaf width (cm)	Herb yield (g plot^{-1})
Day to 50% flowering	rG	-	-0.098	0.120	0.407**	0.092	0.076	0.064	0.298*
	rP		-0.098	0.098	0.351**	0.074	0.068	-0.052	0.291*
	rE		-0.178	-0.074	0.140	-0.024	0.045	-0.201*	0.436**
	COH		0.907	1.035	0.976	1.033	0.906	-0.637	0.852
Primary branches plant^{-1}	rG		-	0.173	-0.130	0.064	-0.166	-0.296*	0.133
	rP			0.172	-0.130	0.061	-0.157	-0.168	0.132
	rE			-0.021	-0.063	-0.095	0.060	0.169	0.070
	COH			1.001	0.995	1.027	1.010	1.072	0.991
Secondary branches plant^{-1}	rG			-	0.074	0.105	-0.002	-0.002	-0.058
	rP				0.071	0.106	-0.003	0.006	-0.059
	rE				0.170	0.151	0.003	0.110	-0.074
	COH				0.976	0.976	0.750	-0.248	0.980
Main branch length (cm)	rG				-	0.159	-0.039	0.218*	0.131
	rP					0.149	-0.036	0.131	0.130
	rE					-0.274	0.024	-0.009	0.095
	COH					1.040	1.021	1.006	0.984
Spread area	rG					-	0.066	0.183	0.201*
	rP						0.061	0.096	0.191*
	rE						-0.027	-0.086	-0.081
	COH						1.023	1.135	1.015
Leaf length (cm)	rG						-	-0.196*	-0.142
	rP							-0.103	-0.128
	rE							0.055	0.129
	COH							1.114	1.050
Leaf width (cm)	rG							-	-0.188*
	rP								-0.106
	rE								0.043
	COH								1.06
Herb yield g plot^{-1}	rG								-
	rP								
	rE								
	COH								

*, ** - $P < 0.05$ and $P < 0.01$, respectively

Table 2. Direct (in bold) and indirect effects of yield components on herb yield in shankha pushpi

Character	Days to 50% flowering	Primary branches plant^{-1}	Secondary branches plant^{-1}	Main branch length (cm)	Spread area (sq. cm)	Leaf length (cm)	Leaf width (cm)	Correlation (rG) with herb yield
Days to 50% flowering	**0.319**	-0.005	-0.016	0.013	0.023	-0.017	-0.019	0.298*
Primary branch plant^{-1}	-0.031	**0.052**	-0.024	-0.004	0.016	0.038	0.086	0.133
Secondary branch plant^{-1}	0.038	0.009	**-0.136**	0.002	0.026	0.001	0.001	-0.058
Main branch length	0.130	-0.007	-0.010	**0.033**	0.039	0.009	-0.063	0.131
Spread area (sq cm)	0.029	0.003	-0.014	0.005	**0.245**	-0.015	-0.053	0.201*
Leaf length (cm)	0.024	-0.009	0.0003	-0.001	0.016	**-0.230**	0.057	-0.142
Leaf width (cm)	0.020	-0.016	0.0003	0.007	0.045	0.045	**-0.291**	-0.188*

Residual effect R = 0.749, * = $P<0.05$.

Table 3. Variance components and genetic parameters in shankha pushpi accessions

Variance component /Genetic parameter	Days to 50% flowering	Primary branches plant^{-1}	Secondary branches plant^{-1}	Main branch length (cm)	Spread area (sq cm)	Leaf length (cm)	Leaf width (cm)	Herb yield (g plot^{-1})
$\hat{\sigma}g^2$	248.25	399.84	287.66	694.02	25287.98	2.272	0.007	10825.71
$\hat{\sigma}p^2$	344.99	403.13	289.86	703.37	26247.55	2.450	0.019	11213.84
$\hat{\sigma}e^2$	96.735	3.28	2.198	9.35	9.35	959.57	0.012	388.13
GCV	19.76	40.44	77.98	39.22	50.677	39.173	20.737	89.259
PCV	23.30	40.60	78.28	39.49	51.629	40.679	34.08	90.845
GA	23.36	40.86	34.67	53.55	315.61	2.88	0.064	206.92
h^2 (BS)	71.96	99.19	99.24	98.67	96.34	92.73	37.02	96.54
CV %	12.34	3.66	6.82	4.552	9.87	10.97	27.047	16.90

$\hat{\sigma}g^2$, $\hat{\sigma}p^2$ and $\hat{\sigma}e^2$ - Genetic, phenotypic and environmental variance; GCV and PCV – Genotypic and phenotypic coefficient of variation; CV- Coefficient of variation; GA- Genetic advance, h^2 (BS)-Heritability in broad sense

ing (71.96%) and low for leaf width (37.02%), respectively (Table 3). High genetic advance was noted for only spread area (sq, cm) (315.61) and herb yield (g plot^{-1}) (206.92) and low for leaf width (0.064) followed by leaf length (2.88), respectively (Table 3). Therefore these traits might be highly amenable to direct selection for their genetic improvement over a short span of time.

In addition to heritability in broad sense ($\hat{h}^2$ BS) and genetic advance (GA), the genetic correlations among characters also have a direct bearing on success of selection. The genotypic correlations were larger than phenotypic correlations for most of the traits examined (Table 1). The correlation coefficients among diverse traits revealed that days to 50% flowering was significantly and positively correlated with the main branch length (0.407**, 0.351**) and herb yield g plot^{-1} (0.298*, 0.291*) at both genotypic and phenotypic levels but it was antagonistically correlated with leaf width (-0.201*) and positive association with herb yield (0.430**) at environmental level.

Positive associations were also noted between spread area and herb yield (0.201*, 0.191*) at both genotypic and phenotypic level and negative association with main branch length (-0.274) at environmental level, respectively. Main branch length was also positively correlated with leaf width (0.218*) and negative correlation were noted between primary branches x leaf width (-0.296*), leaf length and leaf width (-0.196*), leaf width and herb yield (-0.188*) at genetic level only.

Association between spread area and leaf width had maximum co-heritability value (1.135) followed by leaf length and leaf width (1.114) and primary branches $plant^{-1}$ and leaf width (1.072). Least co-heritability was found for the association of days to 50% flowering and leaf width (-0.637) (Table 1). Since higher co-heritability value of a character combination suggests that the increases in one of the characters of that combination will be coupled with increasing trend in its co-heritable characters (Singh 1988; Lal 1999; 2000). It suggests that leaf length with leaf width and primary branches/plant with leaf width should be taken into consideration for improvement in spread area because of the higher co-heritability value between these characters.

The path- coefficient study revealed highest direct contribution to herb yield by days to 50% flowering (0.319) and spread area (0.245) followed by primary branches $plant^{-1}$ (0.052) and main branch length (0.033). Secondary branches $plant^{-1}$ (-0.136), leaf length (-0.230) and leaf width (-0.291) made negative direct contributions (Table 2). Days to 50% flowering indirectly contributed maximum to herb yield by main branch length. Therefore, days to 50% flowering and main branch length as a selection criterion for improvement of herb yield might be a rewarding proposition in shankha pushpi.

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