J. Phytol. Res. **20**(1): 119-122, 2007

GENETIC VARIABILITY, CORRELATION AND PATH ANALYSIS IN *WITHANIA SOMNIFERA* (L.) DUN. (ASHWAGANDHA)

MOHSINA IQBAL and ANIMESH K. DATTA*
Department of Botany, Genetics and Plant Breeding Section, Kalyani University, Kalyani – 741235, India.
* email : dattaanimesh@gmail.com.

Genetic variability, character association and path analysis have been computed for yield and 8 yield related traits in 10 genotypes (control and 9 macromutant lines) of *Withania somnifera* (L.) Dun. (Ashwagandha) for undermining attributes contributing maximum to yield for efficient breeding and crop improvement. Results obtained have been discussed.

Keywords : Character association; Genetic variability; Path analysis; *Withania somnifera.*

Introduction

Ashwagandha (*Withania somnifera* (L.) Dun.; family: Solanaceae) is one of the most important medicinal crop plants possessing anticancerous[1] and antioxidant[2] properties. In order to incorporate desirable characters, to maximise economic yield, it is necessary to have the information on the nature and extent of genetic variability present in a population for desirable characters, their association and relative contribution to yield constitutes the basic requirement for efficient breeding programme relating to crop improvement. The present investigation was undertaken to find out the amount of genetic variability present, heritability and genetic advance, the association of different characters and their contribution to define seed yield in ashwagandha considering yield related traits and yield.

Material and Methods

The experiment was laid out with 10 (control and 9 mutants) genotypes of *W. somnifera* at the experimental plots of Kalyani University during September to January in a randomized block design with 3 replications. Data have been estimated for 8 yield related traits and yield from 5 randomly selected plants from each replications for studying genetic variability, character association and path analysis as per the method described by Burton[3], Johnson *et al.*[4] and Dewey and Lu[5].

Results and Discussion

Analysis of variance revealed significant variations (Table 1) for all 9 parameters when assessed among the plant types, indicating the presence of adequate variability. The estimate of genetic parameters (Table 2) demonstrated that phenotypic coefficient of variation (PCV) was higher than the corresponding GCV values suggesting environmental influence. Coefficient of variability (%) both at phenotypic and genotypic level were moderate to high for the trait studied. The heritability estimated ranged from 9.00% (seed yield/plant) to 46.00% (fresh weight of plant) among the traits. Heritability was moderate for the traits (excepting seed yield/plant). Moderate heritability coupled with relatively high genetic gain was estimated for fresh weight of plant, number of berries/plant and fresh weight of leaves. These traits also had high grand mean in the population. Johnson *et al.*[4] reported that selection pressure can be exercised on the character showing higher heritability coupled with genetic gain. In the light of the above results selection pressure can be exercised in the present study mainly on 3 attributes i.e. fresh weight of plant, number of berries/plant and fresh weight of leaves. Further, these results indicated that additive gene action is playing an important role in the expression of these attributes and the selection pressure can profitably be exercised.

Relationship of yield (seed) and its attributes and association of yield attributes are presented in Table 3. Results indicated that seed yield was positive and significant with fresh weight of plant (r = 0.29), fresh weight of root (r = 0.14), number of primary branches/plant (r = 0.40), total branches/plant (r = 0.34), number of berries/plant (r = 0.54) and fresh weight of leaves (r = 0.27). Excepting the correlation between plant height and number of primary branches/plant, all other yield attributes were positively and significantly interrelated between themselves.

In addition to the degree of association, path coefficient analysis takes into account the cause and effect relationship and has been performed to partition correlation matrix into direct and indirect effects for understanding the relative importance of the component characters on yield. Positive direct contribution on seed yield (Table 4) was demonstrated by number of berries/

Table 1. Analysis of variance of different characters in control and mutant plant types of *W. somnifera* at M_3.

Sources	DF	Mean sum of squares (MSS)								
		Fresh weight of plant (gm)	Plant height (cm)	Root length (cm)	Root yield (fresh weight in gm)	No. of primary branches	No. of total branches	No. of berries / plant	Fresh weight of leaves (gm)	Seed yield / plant (gm)
Treatment	9	55398.04	1760.99	173.29	198.77	60.94	690.35	78805.95	2508.01	4.39
Error	87	6017.82	291.13	38.22	33.74	13.58	148.12	13546.06	461.10	2.26
Total	96									
F value		9.21***	6.05***	4.53***	5.89***	4.49***	4.66***	5.82***	5.44***	1.95*

* : significant at 0.05 probability level
*** : significant at 0.001 probability level

Table 2. Estimates of parameters of variability, heritability and genetic gain for different characters in *Withania somnifera*.genotypes.

Attributes	Population mean ± S.E.	Genotypic variance	Phenotypic variance	Co-efficient of variability (%)		Heritability (%)	Genetic gain as % of mean
				GCV	PCV		
Fresh weight of plant (gm)	156.96±24.53	5167.70	11185.52	45.80	67.38	46.00	64.13
Plant height (cm)	73.98±5.39	153.82	444.95	16.76	28.51	35.00	20.31
Root length (cm)	19.77±1.95	14.14	52.36	19.02	36.60	27.00	20.36
Root yield (fresh weight in gm)	11.29±1.84	17.27	51.01	36.81	63.26	34.00	44.12
No. of primary branches	8.89±1.17	4.96	18.54	25.05	48.43	27.00	26.69
No. of total branches	25.72±3.85	56.75	204.87	29.29	55.65	28.00	31.76
No. of berries/plant	167.30±36.81	6829.52	20375.58	49.40	85.32	34.00	58.91
Fresh weight of leaves (gm)	33.23±6.79	214.21	675.31	44.04	78.20	32.00	51.10
Seed yield/plant (gm)	1.23±0.47	0.22	2.48	38.04	127.64	9.00	23.35

Table 3. Correlation matrix on the basis of replicated observed data.

Characters	Fresh weight of plant (gm)	Plant height (cm)	Root length (cm)	Root yield (fresh weight in gm)	No. of primary branches	No. of total branches	No. of berries / plant	Fresh weight of leaves (gm)	Seed yield / plant (gm)
Fresh weight of plant (gm)		0.77	**0.41**	**0.75**	**0.30**	**0.65**	0.66	**0.93**	**0.29**
Plant height (cm)			**0.27**	**0.51**	0.07	**0.44**	**0.35**	**0.72**	0.08
Root length (cm)				**0.52**	**0.48**	**0.52**	**0.39**	**0.38**	0.10
Root yield (fresh weight in gm)					**0.36**	**0.63**	**0.56**	**0.69**	**0.14**
No. of primary branches						**0.69**	**0.53**	**0.27**	**0.40**
No. of total branches							0.71	**0.63**	**0.34**
No. of berries/plant								**0.61**	**0.54**
Fresh weight of leaves (gm)									**0.27**

Bold coefficients are significant at 5% level.

Table 4. Direct and indirect effects of contributing characters on seed yield /plant of *W. somnifera.*

Characters	Fresh weight of plant (gm)	Plant height (cm)	Root length (cm)	No. of primary branches	No. of total branches	No. of berries/ plant	Fresh weight of leaves (gm)
Fresh weight of plant (gm)	**0.0120**	-0.0484	-0.0724	0.0942	-0.1371	0.3685	0.0773
Plant height (cm)	0.0092	**- 0.0628**	-0.0477	0.0220	-0.0928	0.1954	0.0567
Root length (cm)	0.0049	-0.0170	**- 0.1766**	0.1507	-0.1097	0.2177	0.0299
No. of primary branches	0.0036	-0.0044	-0.0848	**0.3140**	-0.1456	0.2959	0.0213
No. of total branches	0.0078	-0.0276	-0.0918	0.2167	**- 0.2110**	0.3964	0.0496
No. of berries/plant	0.0079	-0.0220	-0.0689	0.1664	-0.1498	**0.5583**	0.0481
Fresh weight of leaves (gm)	0.0112	-0.0452	-0.0671	0.0848	-0.1329	0.3405	**0.0788**

Residual effect = 0.6426

plant (0.5583), number of primary branches/plant (0.3140), fresh weight of leaves (0.0788) and fresh weight of plant (0.0120). Contribution of other traits was low and negative. Indirect contribution via number of berries/plant on seed yield was substantial. Residual effect was noted to be 0.6426. As the roots are medicinally important in ashwagandha, direct contribution on root yield (fresh weight) was also assessed and it was emphasized that fresh weight of plant (0.7739) had maximum positive direct effect. Root length (0.2152) and total branches/plant (0.2195) had low but positive direct contribution. Direct contribution of other traits were low and negative. Indirect contribution via fresh weight of plant on root yield was also high. Residual effect was observed to be 0.3615.

References

1. Banduvula P, Rath P C, Rao A R and Singh R P 2005, Roots of *Withania somnifera* inhibit forestomach and skin carcinogenesis in mice. *Evidence Based Complementary Alt. Med.* 2 99 – 105.
2. Bhattacharya S K, Satyan K S, Ghosal Shibnath and Ghosal S 1997, Antioxidant activity of glycowithanolides from *Withania somnifera*. *Indian J. Expt. Biol.* 35 236 – 239.
3. Burton G W 1952, Quantitative inheritance of grass. Proc 6th Int. Grassland Cong. held at Pennsylvania State College, Pa. U.S.A. 174 – 183.
4. Johnson H W, Robinson H F and Comstock R E 1995, Estimates of genetic and environmental variability in soybean. *Agron. J.* 47 314 – 318.
5. Dewey J R and Lu K H 1959, A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.* 47 477 – 483.