CBCS
http://agrobiol.sggw.waw.pl/cbcs

Communications in Biometry and Crop Science
Vol. 3, No. 2, 2008, pp. 67–71

International Journal of the Faculty of Agriculture and Biology,
Warsaw University of Life Sciences, Poland

REGULAR ARTICLE

Genetic variability and correlation studies for selection criteria in Safed Musli (*Chlorophytum borivilianum*, Santapau)

Ashok Kumar Singh[1]*, Hemendra Pratap Singh[1], Surendra Pratap Singh[2], Alok Kalra[1]

[1] Central Institute of Medicinal and Aromatic Plants, Lucknow - 226 015, India.
[2] Central Institute of Medicinal and Aromatic Plants, Resource Centre, Pant Nagar, P. O. Dairy Farm Nagla, Udhamsingh Nagar -263 149 India.
* Corresponding author: A. K. Singh, E-mail: asoksingh78@gmail.com

CITATION: Singh, A.K., Singh, H.P., Singh, S.P., Kalra, A. (2008). Genetic variability and correlation studies for selection criteria in Safed Musli (*Chlorophytum borivilianum*, Santapau). *Communications in Biometry and Crop Science* 3 (2), 67–71.

Received: 23 January 2008, Accepted: 14 July 2008, Published online: 9 October 2008

ABSTRACT
A variability and association study of *Chlorophytum borivilianum* over two micro-environmental conditions on yield and yield-contributing morphometrical traits revealed the scope for genetic improvement in major yield attributes with some limitations for root length and diameter. An interrelationship among the yield and yield attributes indicated that improvement in yield can be attained through improvement in root numbers, root length, and diameter; however, more emphasis must be paid on root diameter for organic conditions. The cause and effect study on the interrelationship exhibited the importance of productive root yield as a causation to improvement in yield.

Key Words: *variability; interrelationship; path-coefficient; Chlorophytum borivilianum*.

INTRODUCTION

Chlorophytum borivilianum, an endangered plant in its natural habitat belonging to the family Lilliaceae, is an important herbaceous medicinal plant of Central India-Madhya Pradesh, Rajasthan and Gujarat. It becomes perennial, if not uprooted. Its roots are fascicled, sessile, cylindrical and are of variable sizes and shapes. After peeling and drying, these fleshy roots popularly known as *Safed Musli* are used in more than a hundred Ayurvedic preparations and prescribed primarily as a tonic against stress and general debility (Bordia et al., 1995). Good quality musli fetches higher prices ranging from Rs. 500-1800 per kg in Indian markets. Rates are higher still in international markets.

It has been domesticated very recently and is propagated through the crown with attached roots for cultivation. Depending on the size of the crown, several spikes emerge,

and it flowers profusely. It is cross-pollinated in nature and sets seeds in abundance. Propagation through seeds generates enough variability. Due to poor seed germination and slow growth/establishment, seed propagation is restricted. Present genetic material available to the growers has basically originated from seed progeny developed in natural habitats and is, thus, quite variable. Therefore, characterization of variability, working out relationships among yield and its important contributing characters, if any. Partitioning of genotypic correlations of yield with important contributing characters into direct and indirect effects is imperative for initiating genetic improvement.

MATERIALS AND METHODS

Heterogeneous and bulk seed obtained from a farmer's field were multiplied in the CIMAP Resource Centre Pantnagar during 2001-02. A large number (1023) of clones were screened for fresh root yield, number, thickness, length of root, and leaf size and shape. Two hundred fifty clones with better yield contributing characters and multiplication rates were evaluated during 2002-03 for number, length, and fresh yield of root in a progeny row trial at the CIMAP Research Farm, Lucknow. Further, fifty-seven clones selected during 2002-03 including potential seedlings were evaluated for three yield contributing characters, viz. fresh yield, number of roots, and root length in a replicated trial during 2003-04. Thirty better performing accessions were evaluated in a randomized block design in two micro-environmental conditions-integrated nutrient management and organic condition-during 2004-5. Ten sprouted single root cuttings of each clone were space planted at 15 cm on ridges 45cm apart in each replication during the 1st week of July, 2004. For better expression of the characters, two tons of vermicompost with 40:30:25kg NPK ha^{-1} under integrated nutrient management and 5 tons ha^{-1} vermicompost under organic conditions were applied. Required agronomical practices were carried out to grow the crop in both conditions. Roots were harvested during February, 2005, and observations on total fresh root yield g $plant^{-1}$, root length cm, total root number $plant^{-1}$, productive root number $plant^{-1}$, productive fresh root yield g $plant^{-1}$, musli yield g $plant^{-1}$ and maximum root diameter (thickness 1 cm below the crown) were recorded. Mean, range, coefficient of variability, genotypic and phenotypic coefficient of variability, heritability in broad sense, genetic advance, and phenotypic and genotypic correlations were calculated for each environment and on pooled basis. Further, genotypic association of all the yield contributing characters with musli yield and productive root yield were partitioned into direct and indirect effects through path coefficient analysis (Dewey and Lu, 1959) under integrated nutrient management.

RESULTS AND DISCUSSION

Perusal of Table 1 suggests that all the yield and yield contributing characters had better expression under integrated nutrient management except root diameter, which showed better mean performance under organic conditions. The difference in mean performance of productive root number and productive root yield from both the experimental conditions is narrow in comparison to total root number and total root yield including musli yield. It has clearly indicated that additional amounts of nutrients are required for the better expression of the characters. All the characters have expressed considerably high variability except root length, where too much? variability at the genotypic level is worth giving attention (Kirtikar and Basu, 1995; Ram Dhan Jat, 1993; Bhagat and Jadeja, 2003). Heritability (broad sense) has indicated a better scope of improvement in almost all the characters through selection. Genetic advance in total root yield and productive root yield is appreciable for gains through breeding efforts.

Musli yield is positively correlated with all the characters in all the situations except root length in organic conditions. Total root yield and productive root yield is positively correlated with each other and with all the characters except total root yield with root length

in organic conditions and root diameter in integrated nutrient management conditions. Results of associations have indicated that musli yield can be improved through an increase in any of the major yield contributing characters, viz. number, length and diameter of the root (1). However, while selecting under organic conditions root diameter should be given more weight than length as root length has not shown any relationship with any of the yield contributing characters in organic conditions.

Partitioning correlation values of yield and yield contributing characters with musli yield in direct and indirect effects (Table 3) suggests that productive root yield is the most useful character as it has given path to all the characters to contribute indirectly through it with its own direct contribution while selecting for musli yield. But, when correlation values of yield contributing characters with productive root yield is partitioned into direct and indirect effects, productive root number has enabled other characters to contribute indirectly through its maximum direct contribution (Table 4). This suggests that productive root number is the most important selection criterion for improving the musli productivity.

Table 1. Estimates of genetic parameters for seven economic traits in *Chlorophytum borivilianum* evaluated in under organic conditions, integrated nutrient management conditions, and pooled over both environments.

Character	Environ-ment	Mean	SE	Range	CV	GCV	PCV	Heritability (BS)	Genetic advance
Total root yield, g plant^{-1}	Organic	37.25	±4.27	19.19-63.99	14.06	35.84	38.50	86.6	25.6
	Integrated	54.76	±6.78	24.64-124.13	15.17	38.15	41.06	86.3	39.99
	Pooled	46.00	±4.01	24.37-90.96	15.10	22.32	26.95	68.6	17.52
Root length, cm	Organic	11.47	±1.01	8.24-15.05	10.74	12.93	16.81	59.1	2.35
	Integrated	11.52	±0.97	9.0-14.0	7.31	12.15	14.18	73.4	2.47
	Pooled	11.51	±0.91	9.54-14.6	9.18	3.07	9.69	10.1	0.23
Total root number plant^{-1}	Organic	14.53	±2.06	7.67-23.67	17.36	24.38	29.93	66.3	5.95
	Integrated	20.56	±2.26	11.0-40.67	18.91	36.63	41.23	78.9	13.79
	Pooled	17.55	±1.98	9.67-28.17	18.69	15.39	24.21	40.4	3.54
Productive root number plant^{-1}	Organic	26.66	±4.10	4.67-18.0	17.28	30.02	34.64	75.1	4.64
	Integrated	36.39	±5.15	4.67-38.33	14.65	39.75	42.37	88.0	8.71
	Pooled	31.52	±5.06	5.67-33.67	15.81	9.45	18.42	26.3	1.0
Productive root yield, g plant^{-1}	Organic	5.49	±0.78	10.21-54.41	18.82	40.31	44.49	82.1	20.06
	Integrated	8.93	±0.75	15.26-88.70	15.85	39.61	42.66	86.2	27.56
	Pooled	7.21	±0.81	14.85-68.06	17.15	28.31	33.10	73.1	15.72
Safed Musli yield, g plant^{-1}	Organic	4.71	±0.51	2.06-11.08	17.43	41.93	45.41	85.3	4.38
	Integrated	4.48	±0.45	3.86-18.41	16.53	34.85	38.58	81.6	5.80
	Pooled	4.59	±0.43	3.38-13.91	17.25	25.31	30.63	68.3	3.11
Root diameter, mm	Organic	8.65	±0.30	2.89-7.61	13.14	17.80	22.19	64.9	1.40
	Integrated	11.33	±0.50	2.93-5.72	8.90	16.73	18.95	77.9	1.36
	Pooled	9.99	±0.35	2.91-6.53	11.33	12.42	16.82	54.6	0.87

Table 2. Estimates of genotypic (G) and phenotypic (P) correlations among seven economic traits in organic cultivation, integrated nutrient management conditions, and pooled over both environments.

		Root length		Total root number		Productive root number		Productive root yield		Safed Musli yield		Root diameter	
Character	Environment	G	P	G	P	G	P	G	P	G	P	G	P
Total fresh root yield	Organic	0.33	0.26	0.67**	0.61**	0.72**	0.65**	0.94**	0.89**	0.92**	0.86**	0.57**	0.48**
	Integrated	0.38*	0.33	0.80**	0.72**	0.80**	0.75**	0.89**	0.84**	0.91**	0.82**	0.35	0.29
	Pooled	1.81**	0.54**	0.46**	0.42*	1.22**	0.66**	1.04**	0.89**	1.06**	0.25	0.31	0.24
Root length	Organic			0.30	0.19	0.32	0.26	0.31	0.26	0.31	0.45*	0.01	0.11
	Integrated			0.24	0.24	0.54**	0.47**	0.54**	0.48**	0.51**	0.41*	–0.07	–0.09
	Pooled			1.62**	0.41**	2.07**	0.47**	1.23**	0.42**	1.27**	0.43*	0.29	0.11
Total root number	Organic					0.90**	0.77**	0.50**	0.45**	0.47**	0.61**	0.17	0.135
	Integrated					0.82**	0.75**	0.69**	0.62**	0.69**	0.45*	–0.07	0.05
	Pooled					1.21**	0.69**	0.55**	0.42*	0.59**	0.65**	–0.06	0.25
Productive root number	Organic							0.66**	0.66**	0.65**	0.83**	0.16	0.20
	Integrated							0.90**	0.87**	0.84**	0.87**	0.14	0.24
	Pooled							1.31**	0.87**	1.34**	0.99**	–0.31	0.28
Productive fresh root yield	Organic									0.99**	0.96**	0.42*	0.39*
	Integrated									0.97**	0.96**	0.38*	0.33
	Pooled									0.98**	0.96**	0.30	0.28
Safed Musli yield	Organic											0.42*	0.38*
	Integrated											0.42*	0.38*
	Pooled											0.38*	0.33

*,** significant at $P = 0.05$ and $P = 0.01$, respectively.

Table 3. Partitioning of the genotypic correlation of yield contributing characters with musli yield into direct and indirect effects. Direct effects are given in bold on the diagonal and residual effect = 0.0264.

Character	Total fresh root yield	Root length	Total root number	Productive root number	Productive fresh root yield	Root diameter	Genotypic correlation with musli yield
Total fresh root yield	**–0.048**	0.043	0.268	–0.368	0.977	0.039	0.911
Root length	–0.018	**0.113**	0.083	–0.247	0.592	–0.009	0.513
Total root number	–0.038	0.028	**0.334**	–0.375	0.575	–0.009	0.697
Productive root number	–0.039	0.061	0.274	**–0.456**	0.991	0.018	0.849
Productive fresh root yield	–0.043	0.062	0.232	–0.415	**1.090**	0.047	0.973
Root diameter	–0.015	–0.009	–0.025	–0.066	0.420	**0.123**	0.428

The correlation of musli yield with any one of its contributing traits viz. Total fresh root yield, root length... etc. are presented with the direct contribution of that particular trait on musli yield on diagonal in bold face while their contribution through the other contributing traits (indirect effect) in other boxes in the same row.

Table 4. Partitioning of genotypic correlation of yield contributing characters with productive root yield into direct and indirect effects. Direct effects are given in bold on the diagonal and residual effect = 0.0146.

Character	Total fresh root yield	Root length	Total root number	Productive root number	Safed Musli yield	Root diameter	Genotypic correlation with Productive fresh root yield
Total fresh root yield	0.213	–0.019	–0.242	0.408	0.549	–0.012	0.897
Root length	0.081	–0.049	–0.075	0.274	0.309	0.003	0.543
Total root number	0.171	–0.012	–0.302	0.415	0.420	0.003	0.694
Productive root number	0.172	–0.027	–0.248	0.506	0.512	–0.006	0.909
Safed Musli yield	0.194	–0.025	–0.211	0.430	0.602	–0.017	0.973
Root diameter	0.067	0.004	0.023	0.073	0.258	–0.039	0.386

REFERENCES

Bhagat, C., Jadeja, G.C. (2003). Variation and correlation in root yield and biochemical traits of Safed musli (*Chlorophytum borivilianum*). *Journal of Medicinal and Aromatic Plant Sciences* 25, 33–36.

Bordia, P.C., Joshi, A., Simlot, M.M. (1995). Safed Musli. In: Chadha, K.L., Gupta, R. (Eds.) *Advances in Horticulture*. *Vol.11-Medicinal and Aromatic Plants*. Malhotra Publishing House, New Delhi.

Dewey, D.R., Lu, K.H. (1959). A correlation and path coefficient analysis of components of crested wheatgrass seed production. *Agronomy Journal* 51, 515–518.

Kirtikar, K.R., Basu, B.D. (1995). Liliaceae Chlorophytum. In: Singh, B., Singh, M.P. (Eds.) *Indian Medicinal Plants*. Dehradun, India.

Ram, D.J. (1993). *Study on variabitlity and micropropagation in Safed Musli* (*Chlorophytum borivillianum)* M. Sc. Thesis, Rajsthan College of Agriculture, Udaipur.