Studies on Genetic Variability Parameters and Character Association among Yield and Yield Contributing Traits in Grape (*Vitis vinifera* L.)

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A B S T R A C T

Genetic variability, heritability, genetic advance, and correlation for different characters were studied in five grape genotypes during 2015-16 to identify accessions with useful traits for improvement programme. The study indicated existence of considerable amount of genetic variability for all the traits and demonstrates the usefulness of the genetic material as a donor of important genes for grapevine improvement. The maximum phenotypic and genotypic coefficient (PCV and GCV) was observed for number of bunch. High estimates of heritability (broad sense,) and genetic advance were observed for most of traits indicated that these are under control of additive gene action. Pearson correlation indicated fruit yield per vine showed highly significant correlation between number of bunch and significant correlation with pruning weight and weight of bunch. Number of berries per bunch was found significantly correlated with weight of bunch, days taken to 50% flowering, days taken to 50% fruit set and number of bunch. Hence, purposeful and balanced selection based on these traits would be more rewarding for improvement of grape.

Introduction

The Grape (*Vitis vinifera* L.) is one of the most valuable, demandable and remunerative horticultural crop. *Vitis vinifera* L. is considered to be interspecific hybridization in American species, *V. vulpina* L. and *V. labrusca* L. (Regel, 1973). European grape (*V.vinifera* L.) is considered to have originated in Caucasus region between Caspian and Black sea region (Vavilov, 1951).Viticulture is one of the major horticultural industries of the world. *Vitis vinifera* possesses many varieties. These all varieties having so many variations in their qualitative as well as quantitative attributes. A study of differentiation and characterization of grape germplasm is a basis of its use in a specific region. The aim of this work is to assess the qualitative and quantitative traits and selection of elite genotype for further breeding work.

Existence of sufficient level of genetic variability is a prerequisite for variety development and therefore detailed evaluation of the accessions for different morphological, agronomic and quality traits is necessary in

order to identify accessions with useful traits for improvement programme.

Information on extent of variation, estimates of heritability and expected genetic advance in respect of yield and yield contributing traits constitute the basic requirement for crop improvement programmes. Keeping in view the economic and dietary importance of the fruit, the present study was undertaken to investigate the genotypic evaluation of some juice grape germplasms at horticulture farm, college of Horticulture, RVSKVV, Mandsaur (M.P.) for evaluation and selection of the promising cultivars.

Materials and Methods

The experiment involved five grape varieties of juice purpose *viz*, Bangalore Blue, Country Bangalore, Arka Shyam, Pusa Navrang and Medika. Experiment was laid out in randomized block design (RBD) with three replications at horticulture farm, college of Horticulture, RVSKVV, Mandsaur (M.P.) during the season of 2015-16. A six years old vineyard was established by procuring uniform Grape genotypes, budded on dogridge rootstock and trained on 'Y' trellis system of training at a spacing of 3m x 2m. These budded trees were maintained with uniform horticulture practices.

Data were recorded on pruning weight kg/vine), days taken to 50% flowering, days taken to 50% fruit set, number of bunch, weight of bunch (g), number of berries per bunch, 100 berry weight (g), days to fruit ripening, yield/vine, TSS (%), acidity (%) and juice (%). The data was analysed as per the method suggested by Gomez and Gomez (1983). The phenotypic and genotypic coefficients of variation (PCV and GCV) were obtained by the method suggested by Burton and De Vane (1953) and Johnson *et al.,* (1955). Heritability in broad sense and

genetic advance (GA) were estimated as per the formulae described by Johnson *et al.,* (1955), respectively.

Results and Discussion

The extent of variability present in the grape genotypes was measured in terms of mean, range, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (broad sense), genetic advance and correlation. All the genotypes differed significantly with respect to different attributes studied. The pooled analysis of variance showed significant differences among the cultivars for all the 12 traits (Table 1). Data for range and mean values for juice grape varieties for different agro-morphological traits has been presented in table 2.

The high estimates of PCV and GCV for number of bunch, weight of bunch, number of berries per bunch and yield per vine indicated the presence of adequate genetic variation among the genotypes and suitability of these attributes for further improvement by selection (Table 3). The grape varieties under study have higher phenotypic coefficient of variation than corresponding genotypic coefficient of variation indicating the dominance of environment over genotype in expression of traits under study. The estimation of GCV itself does not help to determine the extent of heritable variation (Figs. 1 and 2).

Therefore, estimation of heritability indicates effectiveness with which selection may be expected to exploit the genetic variability. The genetic variability is heritable from generation to generation. Hence, heritability and genetic advance is a useful tool for breeders in determining the direction and magnitude of selection. The yield and yield attributes are polygenic in nature and are

subjected to different degree of non-heritable variation (Sivcev *et al.,* 2000). High heritability estimates coupled with high genetic advance for days taken to 50% flowering, days taken to 50% fruit set, number of bunch, weight of bunch, number of berries per bunch, days to ripening, yield per vine, TSS, acidity and juice % conformed that these traits are under the control of additive gene action and phenotypic selection for their improvement will be effective.

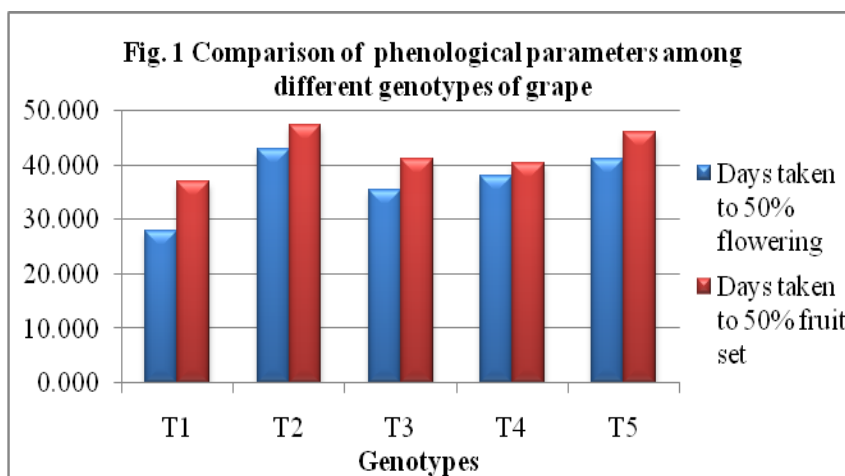**Fig.1** Comparison of phenological parameters among different genotypes of grape

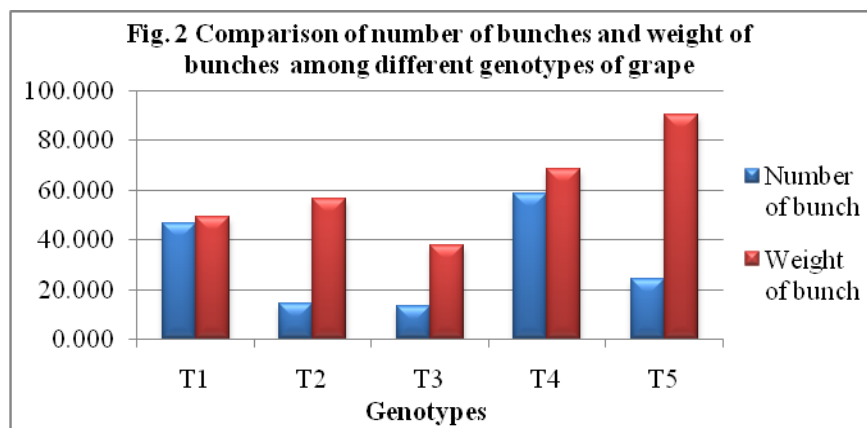**Fig.2** Comparison of number of bunches and weight of bunches among different genotypes of grape

Table.1 Pooled Analysis of Variance of fruit yield and its component in grapes

Source	DF	Mean Square											
		PW(kg/vine)	DF	DFS	NB	WB (g.)	100BW (g.)	NBB	DFR	YPV(kg/vine)	TSS (%)	ACDT (%)	Juice %
Replication	2	0.10	3.26	0.46	62.06	202.84	460.06	358.46	3.26	0.09	2.46	4.67	0.53
Treatment	4	0.45	102.56	54.5	1245.83	1213.89	2644.23	4674.79	404.56	12.13	22.76	0.01	579.43
Error	8	0.09	2.51	0.3	29.98	54.34	376.98	178.32	2.26	0.08	1.21	3	2.10

Table.2 Mean and Range values of juice varieties of grape for different traits

Treatment details	PW (kg/vine)	DF	DFS	NB	WB (g)	NBB	100 BW (g)	DFR	YPV (Kg/vine)	TSS (%)	ACDT (%)	Juice%
T₁(Bangalore Blue)	1.60	28.00	37.00	46.67	49.19	58.20	209.66	148.66	5.73	24.00	0.76	77.56
T₂ (Country Bangalore)	0.72	43.00	47.33	14.33	56.27	100.50	163.00	139.00	2.12	17.33	0.65	74.49
T₃(Arka Shyam)	1.67	35.33	41.00	13.00	37.82	65.33	162.00	141.33	1.87	17.66	0.58	73.49
T₄(Pusa Navrang)	1.40	38.00	40.33	58.66	68.31	135.83	131.33	122.33	6.21	18.33	0.55	64.20
T₅(Medika)	1.12	41.00	46.00	24.00	90.45	144.76	188.66	123.33	3.47	18.33	0.63	83.26
Mean	**1.30**	**37.06**	**42.33**	**31.33**	**60.41**	**100.92**	**170.93**	**134.93**	**3.88**	**19.13**	**0.63**	**74.60**
Range	**0.95**	**15.00**	**10.33**	**45.66**	**52.63**	**85.56**	**78.33**	**26.33**	**4.34**	**6.67**	**0.21**	**19.06**

Table.3 Genetic parameters for juice varieties of grape

Traits	PCV (%)	GCV (%)	Heritability (%)	G A	GA(as% mean)
PW (kg/vine)	35.37	26.50	56.16	53.39	4092.31
DF	16.15	15.57	92.98	1147.14	3094.81
DFS	10.12	10.04	98.36	868.42	2051.38
NB	66.58	64.24	93.11	4001.73	12771.49
WB (g)	34.75	32.54	87.67	3792.16	6277.31
100BW (g)	19.68	16.08	66.71	4625.74	2706.16
NBB	40.57	38.35	89.36	7539.32	7470.10
DFR	8.65	8.58	98.33	2365.60	1753.16
YPV (kg/vine)	52.14	51.59	97.91	408.53	10517.88
TSS (%)	15.14	14.00	85.51	510.56	2668.47
ACDT (%)	12.64	12.61	99.54	16.57	2592.43
JUICE %	9.33	9.30	99.45	1426.27	1911.86

PW: pruning weight (kg/vine); DF: days taken to 50% flowering; DFS: Days taken for 50% fruit set; NB: Number of bunches per vine; WB: bunch weight (g); 100BW: Hundred berry weight (g); NBB: Number of berries per bunch; DFR: days to fruit ripening; YPV: Fruit Yield (kg/vine); TSS: total solubal solids; ACDT: acidity.

Table.4 Phenotypic (r_p) and genotypic (r_g) correlation coefficient of yield and Component characters in grapes

Traits	PW (kg/vine)	DF	DFS	NB	WB (g)	100BW (g)	NBB	DFR	YPV (kg/vine)
PW (kg/vine)	1.000	-0.535 -0.740	-0.589 -0.793	0.239 0.330	-0.291 -0.415	0.073 0.119	-0.322 -0.454	0.187 0.251	0.238 0.321
DF		1.000	0.724 0.757	-0.338 -0.364	0.385 0.426	-0.347 -0.441	0.531 0.583	-0.483 -0.505	-0.382 -0.400
DFS			1.000	-0.501 -0.523	0.364 0.392	-0.125 -0.154	0.415 0.443	-0.315 -0.320	-0.510 -0.520
NB				1.000	0.141 0.156	-0.091 -0.116	0.149 0.164	-0.193 -0.202	0.767 0.803
WB (g)					1.000	0.006 0.007	0.669 0.756	-0.623 -0.671	0.179 0.194
100 BW (g)						1.000	-0.281 -0.364	0.374 0.462	0.011 0.014
NBB							1.000	-0.738 -0.787	0.137 0.147
DFR								1.000	-0.163 -0.166
YPV (kg/vine)									1.000

The heritability will be more effective and meaningful when accompanied by genetic advance and genetic advance as per cent of mean (Johnson 1955). High heritability estimates for berry weight, bunch weight and bunch number were also reported by Wei *et*

al., (2003). The phenotypic and genotypic correlation coefficients between different characters are presented in Table 4. Pearson correlation indicated fruit yield per vine showed significant correlation between number of bunch (r=0.803) and significant correlation with pruning weight (r=0.321), weight of bunch (r=0.194). Number of berries per bunch was found significantly correlated with weight of bunch (r=0.756), days taken to 50% flowering (r=0.583), days taken to 50% fruit set (r=0.443) and number of bunch (r=0.164). These traits also showed high correlation with yield per vine at genotypic level indicating little effect of environment on the expression of such traits. Hence, improving number of bunch, pruning weight, weight of bunch and number of berries per bunch seemed to improve yield per vine. Similar findings were also reported by Giridharan and Jindal (1995) and Gupta *et al.,* (2015). It was concluded that Arka Shyam may be considered as vigorous varieties based on their respective pruning weights. Based on 50% flowering, the varieties can be classified in to early (Bangalore Blue) mid (Arka Shyam, Pusa Navrang and Medika) and late (Country Bangalore) bursting varieties. However, Pusa Navrang, Bangalore Blue and Medika varieties considered to high yielders. Based on juice %, the varieties Medika, Bangalore Blue, Country Bangalore and Arka Shyam considered high juice producing varieties.

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