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Genetic variability and character association in lemongrass (*Cymbopogon flexuosus* L. Stapf)

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Abstract

The variability and association of genetic parameters of nine genotypes of lemongrass (*Cymbopogon flexuosus*) was studied at Lucknow (Uttar Pradesh). The genetic differences were highly significant for oil, citral, geraniol and geranyl acetate contents and herb and oil yield. High heritability estimates in broad sense were observed for all the characters. High heritability with low genetic advance recorded for oil and geranyl acetate contents indicated that these characters are under non-additive gene action. Oil yield was positively and significantly associated with herb yield and oil content. Maximum direct effect of herb yield on oil content and oil yield was also observed.

Key words: *Cymbopogon flexuosus*, heritability, lemongrass, path analysis.

The variability and association of genetic parameters in selected genotypes of lemongrass (*Cymbopogon flexuosus* L. Stapf) was studied at Central Institute of Medicinal and Aromatic Plants, Lucknow, during 2000–01. Nine genotypes of lemongrass were grown in a Randomized Block Design with three replications in a plot size of 4 m x 4 m with a spacing of 50 cm between rows and 40 cm between plants. Standard cultural practices were followed. Data were recorded on herb yield, oil, citral, geraniol and geranyl acetate contents. The oil content was estimated on fresh weight basis. The major components of lemongrass oil namely, citral, geraniol and geranyl acetate were estimated by gas-liquid chromatography. The variability parameters and path analysis were worked out as per the methods suggested by Burton (1952), Johnson *et al.* (1955) and Dewy & Lu (1959), respectively.

Genetic differences were highly significant for all the characters indicating that selection might be effective for these characters (Table 1). The variation for oil yield *per se* was high. These observations were in agreement with the findings of Singh & Singh (1999). This might be due to the fact that most of the genotypes were developed from a cross pollinated population and thus might have included the entire spectrum of variability at least for oil yield *per se*. The magnitudes of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were of highest order in case of geraniol followed by citral and geranyl acetate contents

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indicating the presence of high amount of variation for these essential oil quality components (Table 2). Oil yield, oil content and herb yield had GCV and PCV magnitudes of medium range. Among these components, herb yield had the lowest magnitude indicating the minimum role of environment in the expression of this character.

The heritability estimates were of high magnitude for all the characters (Table 3). High heritability value was recorded by Kulkarni & Rajagopal (1986) for oil content. According to Panse (1957), the characters governed predominantly by additive gene action could be improved through individual plant selection. Since lemongrass is a cross pollinated crop, once a single plant is selected, it can easily be propagated vegetatively. High heritability accompanied with low genetic gain was found for oil and geranyl acetate contents indicating that these traits are more likely under the control of non-additive gene action and selection for this character would be less effective. Hence, for a more efficient improvement, selection should be made for components of economic characters. The relationship of plant characters with oil yield thus assumes a special importance as the basis for selecting high yielding genotypes.

Phenotypic correlation coefficients were computed in all possible combinations for all the characters (Table 3). Oil yield was significantly correlated with herb yield and oil content. These two components are more effective for economic yield (oil yield) in lemongrass. Rao *et al.* (1995) have also reported

Table 1. Phenotypic variation for six characters in lemongrass

Character	Range	Mean ± SE	Significance of F value for genotypes
Oil content (%)	0.40 – 0.91	0.62 ± 0.01	**
Citral content (%)	51.30 – 91.09	46.33 ± 0.09	**
Geraniol content (%)	2.16 – 63.43	28.50 ± 0.07	**
Geranyl acetate content (%)	3.33 – 18.18	9.19 ± 0.10	**
Herb yield (q ha^{-1})	574.92 – 1015.46	679.48 ± 20.88	**
Oil yield (kg ha^{-1})	244.30 – 798.79	412.57 ± 68.22	**

** Significant at P=0.01

Table 2. Genotypic and phenotypic coefficient of variance, heritability in broad sense and genetic advance in lemongrass

Character	GCV (%)	PCV (%)	h^2BS (%)	GA
Oil content (%)	27.25	27.34	99.30	0.35
Citral content (%)	78.84	78.84	100.00	75.26
Geraniol content (%)	99.55	99.55	100.00	58.45
Geranyl acetate content (%)	55.77	55.78	99.40	10.56
Herb yield (q ha^{-1})	21.91	21.91	100.00	306.61
Oil yield (kg ha^{-1})	40.74	40.79	99.80	345.79

GCV=Genotypic coefficient of variance; PCV=Phenotypic coefficient variance; h^2BS=Heritability in broad sense; GA=Genetic advance

Table 3. Phenotypic correlation coefficient among different characters in lemongrass

Character	Citral content (%)	Geraniol content (%)	Geranyl acetate content (%)	Herb yield (q ha^{-1})	Oil yield (kg ha^{-1})
Oil content (%)	0.221	0.253	0.235	0.196	0.683*
Citral content (%)	–	-0.987**	-0.644*	0.075	-0.057
Geraniol content (%)	–	–	0.559	0.100	0.049
Geranyl acetate content (%)	–	–	–	0.174	0.082
Herb yield (q/ha^{-1})	–	–	–	–	0.808*

*=Significant at P=0.05; **=Significant at P=0.01

Table 4. Path coefficient of oil yield with other characters at the phenotypic level in lemongrass

Character	Citral content (%)	Geraniol content (%)	Geranyl acetate content (%)	Herb yield (q ha^{-1})	Oil yield (kg ha^{-1})	Correlation with oil yield (kg ha^{-1})
Oil content (%)	**0.567**	-0.078	0.055	0.002	0.136	0.683
Citral content (%)	0.125	**-0.352**	0.216	0.007	-0.052	0.057
Geraniol content (%)	-0.143	0.348	**-0.219**	-0.006	0.067	0.049
Geranyl acetate content (%)	-0.133	0.277	-0.122	**-0.010**	0.121	0.082
Herb yield (q ha^{-1})	-0.111	0.026	-0.022	-0.002	**0.694**	0.808

Residual effect=0.044; Bold figures show direct effect

similar findings. Citral content, the main quality component of lemongrass, showed negative but significant association with other quality components namely, geraniol and geranyl acetate contents. On the other hand, oil content had positive association with citral, geraniol and geranyl acetate contents. Geraniol and geranyl acetate contents were positively associated. Lack of significant association between oil content and herb yield and between oil content and citral content, is highly encouraging to lemongrass breeders as high herb yield could be combined with both high oil and citral contents.

Path coefficient analysis was used to partition the correlation coefficients into direct and indirect effects of different characters on oil yield. Path analysis revealed that herb yield had maximum positive direct effect on oil yield followed by oil content indicating true and perfect association among these traits (Table 4). Citral content had highest negative direct effect on oil yield followed by geraniol content. It may therefore, be argued that if other factors are constant, an increase in oil content and herb yield individually would be reflected in increased oil yield. Thus selection could be directed towards highly positive correlated characters to achieve high oil yield in lemongrass.

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