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Genetics control and phenotypic variability in morphological characters in *Cymbopogon flexuosus*

Rathia SK, Tirkey A, Kashyap D and Ameen G

Abstract
The genetics control and phenotypic variability in morphological character of twenty accessions of lemongrass (*Cymbopogon flexuosus*) was studied at Raipur, Chhattisgarh for fourteen characters. High value of PCV than GCV indicate influence of environment. Minimum difference in PCV and GCV is found in number of tillers, plant height (cm), leaf length (cm), leaf area (cm^2) show less influence of environment for the expression of such trait. High h^2 and GA % over mean was reported in plant height (cm), number of tillers, leaf length (cm), leaf width (cm), culm length (cm), culm diameter (cm), total chlorophyll (mg/g), spade value, fresh and dry herbage yield per plant (g) indicate additive gene action and selection of such character will be rewarded for yield improvement. These characters are stable and not influence by environment. The frequency curve also show normal distribution hence alleles controlling these characters in gene pool has normal uniform distribution.

Keywords: Lemongrass, PCV, GCV, gene pool

1. Introduction
Lemongrass (*Cymbopogon flexuosus*) is an aromatic and tropical perennial plant which belongs to the poaceae family. It is also considered as to be economically important for the production of essential oil which has medicinal properties due to presence of Citral (Hassan *et al*, 2007) [7].

Lemongrasses are mainly grown in tropical and subtropical South East Asia and Africa (Rangari Vinod D, 2009) [3]. Century back it was grown in India naturally and presently it is grown commercially in different parts of India. The average height of plant is one meter, erect, and consist of leaf sheath, Culm, leaf blade, green and glabrous leaf with 90 cm length and 1.5-2 cm width. The inflorescence has long spike of about one meter in length. (Qadry J.S. 2008-2009) [2].

The essential oil of Lemongrass is obtained by steam distillation of the overnight dried leaves, which takes about 4-5 hours. The oil has strong lemon like aroma due to presence of high percentage (75%) of citral in the oil (Joy *et al*, 2006) [2]. This oil has bright or pale yellow color. It is made with different chemical compounds like citral, geranyl, acetate, neral etc. The leaves are used in the treatment of cough, fever, depression, nervous system disorder and skin irritations. Plant decoction is used popular in digestive complaints, headache and to promote sweating. The characteristic smell of oil makes its use in scenting of soaps, detergents, insect repellent preparation. The major use of oil is as a source of citral, which goes in perfumery, cosmetics, and beverages and is a starting material for manufacture of ionone's, which produces Vit. A (Alam *et al*, 1994) [4].

The genetic variations had a considerable impact on oil output, citral, geranial, and oil content. Herb production and oil content were favourably and substantially correlated with oil yield. The amount of essential oil produced by lemongrass was substantially correlated with morphological characteristics such plant height, the number of tillers per plant and the number of leaves per plant (*Cymbopogon flexuosus*) (Joy *et al.* 2003) [6]. Seed propagation of lemon grass tended to create significant genetic heterogeneity, which negatively impact on yield and oil quality. Instead, propagating lemon grass through the vegetative portions, such as slips or chosen clones, is preferred. Therefore, the aim of this study was to analysis the variability parameters of lemongrass which has been reported for the first time by evaluation of the accessions of lemongrass.

2. Material and Method

2.1 Planting material: Lemongrass **(***Cymbopogon flexuosus*) was collected from the different districts of the Chhattisgarh state, involving 18 accession along with 2 check during 2021-22.

2.2 Planting method: The experiment was conducted in randomized block design. The experimental soil pH was 6.5 to 7 and texture of soil was sandy loam soil. The plant was planting with 60X60 spacing plant to plant and row to row respectively. Lemongrass planted with the help of slips of it.

3. Oil extraction

For the oil extraction, fresh leaves of all accessions were harvested and kept for overnight to observe better result. Firstly, 500gm leaves of lemongrass were chopped into small pieces and then hydro-distillated for 3-4 Hrs. in Clevenger apparatus for oil extraction. All the oil samples collected in glass bottles

Fig 1: Field overview

Fig 2: Oil extraction process

4. Statistical analysis

Morpho-physiological characters *viz*. plant height (cm), no of tillers, leaf length (cm), leaf width (cm), culm length (cm), culm diameter (cm), leaf area (cm^2), chl a (mg/g), chl b (mg/g), SPAD value, oil content (%), dry weight (g) and fresh weight (g) of all 20 accessions taken under study were statistically analyzed using indostat software service 9.2. Statistical analyzed data result showed in the ANOVA table of all ancillary characters.

5. Result

The statistical procedure to separate total variance into different component is known as analysis of variance. It is estimated through ANOVA Table. 1. the treatment/ accessions for different characters studied showed significant for all the characters except chl a (mg/g) chl b (mg/g), oil % and fresh leaf weight per plant (g). Hence it shows enough variability present among the accessions and can be utilized for analysis of variability.

The mean performance of all accession had significant. The plant height (cm) varied between 97.495-184.295, with the mean of 147.83, no of tillers varied between 34.91-120.18, with the mean of 71.842, leaf length (cm) varied between 40.025-122.575, with the mean of 82.924, leaf width (cm) varied between 1.105-1.855, with the mean of 1.398, culm length (cm) varied between 19.03-44.45, with the mean of 29.125, culm diameter (cm) varied between 0.345-0.695, with the mean of 0.564, leaf area (cm^2) varied between 191.38-654.68, with the mean of 382.485, chl a (mg/g) varied between 0.19-0.49, with the mean of 0.3368, chl b (mg/g) varied between 0.27-0.615, with mean of 0.4238 total chlorophyll (mg/g) varied between 0.22-0.53 with the mean of 0.38, sped value varied between 31.475-46.575, with the mean of 40.435, oil % varied between 0.006-0.0485, with the mean of 0.011, dry weight (g) varied between 140.5-258.63, with the mean of 188.492, fresh weight (g) varied between 510.2-974.66, with the mean of 719.382 (Table 1).

The percentage of genotypic coefficient of variance (GCV %) and phenotypic coefficient of variance (PCV %) were calculated along with the heritability (h^2) and GA % table 2. The PCV (%) was higher than GCV (%) which show the environmental affect in expression of characters. PCV (%) and GCV (%) was categorized between low (<10%), moderate (10-20%) and high (>20%).

The minimum difference between genotypic coefficient of variation (%) and phenotypic coefficient of variation (%) was recorded in number of tillers (0.013), plant height (cm) (0.01), leaf length (cm) (0.059) and leaf area (cm^2) (0.06). This represents characters is less influence by the environment and selection of such characters for genetic improvement may be rewarded.

The moderate phenotypic coefficient variation and genotypic coefficient variation was observed for characters leaf width (cm) (14.003-15.964), culm diameter (cm) (16.226-19.093). The maximum amount of phenotypic coefficient of variation (%) was displayed in chl a (mg/g) (41.86-12.17), chl b (30.09-13.80), total chlorophyll (30.46-28.22), oil % (139.91%-20.19) shows that environment play major role in expression of characters.

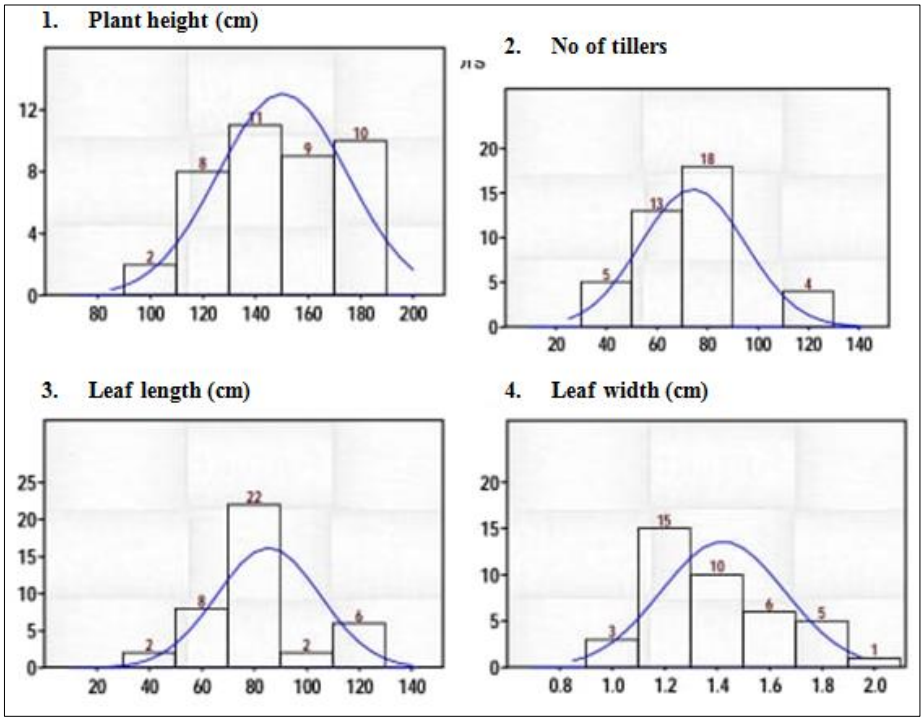
High heritability and high genetic advance was estimated for plant height (cm), no of tillers, leaf length (cm), leaf width (cm), culm length (cm), culm diameter (cm), leaf area (cm^2), total chlorophyll (mg/g), spade value, dry weight (g) and fresh weight (g) indicate that heritability is due to additive gene effect or selection of such character is effective. High heritability and low genetic advance chl a (mg/g), chl b (mg/g) and oil content (%) was indicate non additive gene action and section of such character is not useful. Similar finding were also reported by Singh *et al.* (2005) [5].

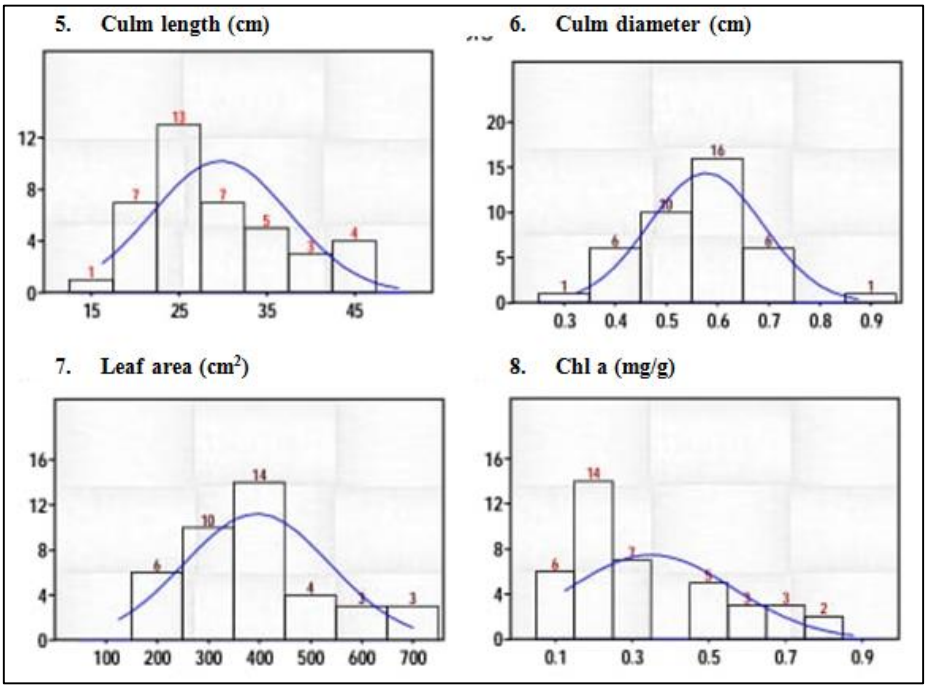
Table 1: Analysis of variance for fresh herbage yield and its components of lemongrass

Source of variation	DF	Plant Height (cm)	No of tillers	Leaf length (cm)	Leaf width (cm)	Culm length (cm)	Culm diameter (cm)	Leaf area (cm^2)	Chl A (mg/gm)	Chl B (mg/gm)	Total Chloro phyll	SPAD value	Oil Content (%)	Dry weight (gm)	Fresh weight (gm)
Replication	1	122.85**	18.09**	14.39**	0.24**	84.10**	0.03**	817.21**	1.014**	1.85**	0.011	4.9*	0.00044	9302.5**	722.5
Treatment	19	1214.82**	870.01**	790.94**	0.08**	117.82**	0.02**	41252.56**	0.02171	0.019	0.0249**	34.35**	0.00024	2424.62**	38989.37
Error	19	4.32	0.39	0.48	0.011	2.49	0.003	65.65	0.01804	0.012	0.0019	0.65658	0.00026	13.0263	286.711

Table 2: Estimation of morpho-physiological parameters for all characters of lemongrass

S. No.	Character	Mean	Range		GCV %	PCV%	h^2 (%)	Genetic advance	GA as % of mean
			Min.	Max.					
1	Plant Height (cm)	147.83	97.50	184.30	16.64	16.70	95.00	64.72	43.78
2	No of tillers	71.84	34.91	120.18	29.03	29.04	92.89	55.02	76.59
3	Leaf length (cm)	82.92	40.03	122.58	23.97	23.99	92.45	52.45	63.25
4	Leaf width (cm)	1.40	1.11	1.86	14.00	15.96	94.87	0.45	32.43
5	Culm length (cm)	29.13	19.03	44.45	26.07	26.63	93.65	19.63	67.39
6	Culm diameter (cm)	0.56	0.35	0.70	16.23	19.09	94.69	0.21	36.41
7	Leaf area (cm^2)	382.49	191.38	654.68	37.52	37.58	92.72	378.25	98.89
8	Chl a (mg/gm)	0.34	0.19	0.49	12.71	41.86	92.56	0.03	10.19
9	Chl b (mg/gm)	0.42	0.27	0.62	13.80	30.09	94.43	0.07	16.71
10	Total Chlorophyll	0.38	0.22	0.53	28.22	30.46	93.27	0.26	69.02
11	SPAD value	40.44	31.48	46.58	10.15	10.35	94.31	10.63	26.29
12	Oil Content (%)	0.01	0.01	0.05	20.19	139.91	92.84	0.00	7.69
13	Dry weight (gm)	188.49	140.50	258.63	18.42	18.52	93.59	91.18	48.37
14	Fresh weight (gm)	719.38	510.20	974.66	19.34	19.48	94.90	364.56	50.68





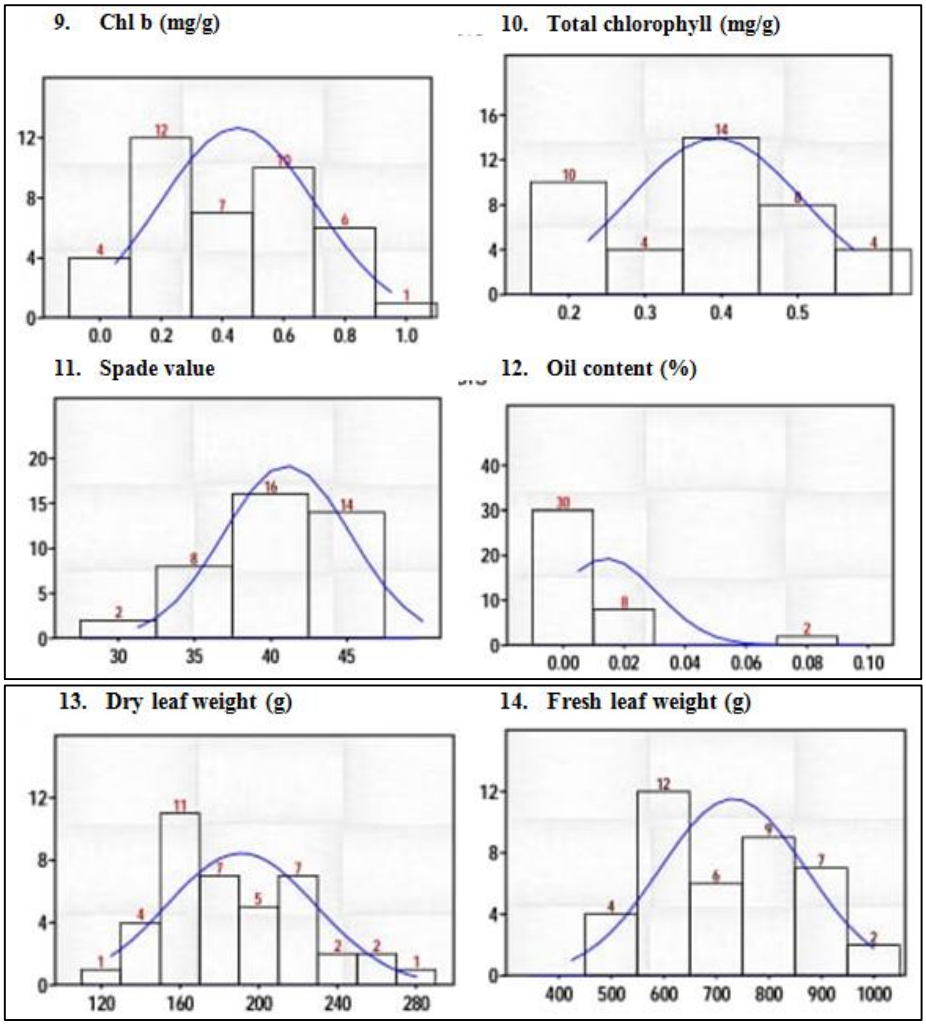


Fig 3: Graphs for the character studied

Genetic control of the 14 characters was analyzed based on the nature of frequency distribution of the characters is presented in Table. 2 and Fig. 3.

Frequency curve with normal bell shaped curve were obtained in all the character except chl a (mg/g) and oil content (%) which indicate that almost uniform distribution of the alleles controlling there characters in their gene pools.

In case of chl a (mg/g) and oil content (%) the curve showed skewness towards the lower extreme of the distribution, which depict that the mode. Value fall around the minimum and no near the mean. This indicates rare occurrence of dominant alleles controlling there two characters in the gene pool of the population and it is more valuable one.

Statistical parameter under studied except chl a (mg/g) and oil content (%) are most stable among the quantitative characters. The extent of variability of quantitative characters depends upon the number of contributing alleles involved. Differential variability of quantitative characters in medicinal plants has also reported by Mishra *et al.* (1998) [8], Chandramohan and Mohanan (2005) [9].

6. Conclusion

The PCV was higher than GCV showed influence of environment in expression of characters. Minimum difference in PCV and GCV is found in number of tillers, plant height (cm), leaf length (cm), leaf area (cm^2) show less influence of environment for the expression of such characters and if these characters selected for genetic improvement of the crop, selection will be rewarded. High h^2 and GA % over mean was reported in plant height (cm), number of tillers, leaf length (cm), leaf width (cm), culm length (cm), culm diameter (cm), total chlorophyll (mg/g), spade value, fresh and dry herbage yield per plant (g) indicate additive gene action and selection of such character will be rewarded for yield improvement. These characters are stable among quantitative characters studied and not influence by environment. Whereas high heritability and low genetic advance % was reported for character chl a (mg/g), chl b (mg/g) and oil % which indicate non additive gene action and selection of such characters will not be effective.

The frequency curve for all the characters except chl a, chl b and oil % indicated normal bell shaped graph which depict normal uniform distribution of alleles controlling these characters in gene pool, whereas chl a, chl b and oil % showed skewness towards lower extreme of the distribution thus mode value fall around minimum and not near the mean. This indicate occurrence of dominant alleles controlling the characters in gene pool of population and may be absence of recessive alleles for the gene. The extent of variability of quantitative characters depends upon number of contributing alleles involved. Such findings were also reported in medicinal crop by Mishra *et al,* 1998 [8] and Chandramohan and Mohanan, 2005 [5].

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