RESEARCH ARTICLE

Morphological Characterization of Lemon Grass Genotypes under Semi-Arid Conditions of Haryana

RK Arya^{*}, Vipan Kumar, PK Verma and Pawan Kumar

Abstract

Many aromatic plants are under cultivation in the Indian subcontinent and lemongrass is one of the most important aromatic plants. It is used in flavoring cold drinks, in scented soaps, shampoos and detergents, and as a fragrance in cosmetics, creams and perfumes. The present study was conducted for morphological characterization of 33 genotypes of lemongrass during two successive years, 2022 and 2023, at the Research area of Medicinal, Aromatic and Potential Crops Section (GPB), C.C.S. Haryana Agricultural University, Hisar. The results on the morphological characterization of lemongrass revealed that most of the genotypes in lemon grass were semi-spreading to compact type, tall to medium in height, with broad and green leaves having light purple leaf sheath color and medium in leaf length and tillers. About 27 genotypes were non-flowering and only six genotypes (NLG-1, Chirharit, RRL-16, Karishna, CKP-25 and OD-58) were able to bear flowering. On the basis of one or more morphological characters, each genotype is different from others.

Keywords: Lemongrass, Cymbopogon flexuosus, Morphological characterization, Aromatic plants.

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Introduction

Many aromatic plants are under cultivation in the Indian subcontinent and lemongrass is one of most important aromatic plants. Lemon grass has mainly two types, i.e., *Cymbopogon flexuosus* (East Indian/Malabar), and *C. citratus* (West Indian). East Indian lemon grass is native to India and mainly cultivated in Kerala, A.P., Karnataka, T.N., Maharastra and U.P. West Indian lemongrass is native to Ceylon (Yadav *et al.*, 2012). Lemongrass oil yield per plant was found to be higher under sulfate-dominated salinity than chloride-dominated salinity at comparable EC levels. Improvement in oil yield per plant was found with the aging of plants (Kumari and Varshney, 2012).

Lemongrass is commercially cultivated in Guatemala, India, China, Paraguay, Shri Lanka, England, Indonesia, Africa, Central America and Southern America for its essential oil. The quality of lemongrass oil is chiefly governed by the 'citral a' and 'citral b' contents, the compounds responsible for lemon flavor. This lemon flavor is commercially utilized in flavoring cold drinks, in scented soaps, shampoos and detergents, as a fragrance in cosmetics, creams and perfumes (Singh 2010 & Singh *et al.*, 2024). It is also utilized to ride off the unpleasant odors in several industries. Lemongrass oil is used for making skin care creams as it has germicidal properties (Arya *et al.*, 2021a). Spent lemongrass is used as a fuel, good raw material for paper manufacturing and excellent manure after compositing. As a medicinal plant, lemongrass has been considered a carminative and antimicrobial.

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In addition to this, lemongrass green leaves or dried leaves are also popularly utilized as green tea or herbal tea (Behl et al., 2022). The bioactive compound 'Citral' extracted from the oil also used as an additive in alcoholic beverages, baked goods and confectionaries products (Kumar et al., 2024). Cital is also used as a base material to synthesize vitamin A and is also used in aromatherapy (Yadav et al., 2012). Wider adaptability and morphological stability is an important criteria to improve the herbage yield, and quality of oil and economic products. It is always desirable that a good yielding clone must be stable over different locations. Keeping in view the above points of economic importance and increasing demand for essential oils produced from lemongrass, the present study was undertaken with the objective of characterizing the lemongrass for morphological identification of genotypes or varieties.

Materials and Methods

The present study was conducted on the characterization of lemongrass genotypes during two successive years 2022-2023, at the Research area of MAP Section (GPB), CCS Haryana Agricultural University, Hisar in randomized block design. For present study 33 genotypes of lemongrass viz., Chirtarit, Krishana, NLG-1, GRL-1, NLG-2, NLG-3, NLG-4, NLG-5, NLG-6, NLG-7, NLG-8, NLG-9, NLG-10, OD-19, OD-23, OD-58, NLG-84, NLG-118, OD-388, RRL-16, HL-1, HL-2, HL-3, HL-4, HL-5, HL-6, HL-7, HL-8, HL-9, HL-10, HL-11, HL-12, CKP-25 (Table 1). All the good agronomic practices were followed as suggested by Arya et al., 2018. The data were recorded on ten randomly selected plants in each genotype in each replication in each year. The observations were recorded on plant morphological traits, i.e., growth habit (compact, semi-compact, semi-spreading or spreading), leaf sheath color (white, light purple or dark purple), leaf width (narrow or broad) seems to be most important and stable diagnostic plant features followed by plant height (tall, medium, dwarf), leaf length, leaf angle, leaf color, tillers per plant, flowering habit and flower color etc.

Results and Discussion

Due to the non-availability of cultivated varieties for commercial cultivation of lemongrass, generally farmers of Haryana cultivate the open-pollinated varieties or locally adapted accessions of lemongrass as like other aromatic grasses. Therefore, morphological characterization on the basis of some morphological descriptors is the first step to developing the standard procedure to help the plant breeders in the early identification of potential cultivars. Among the morphological traits, plant type (compact or spreading), leaf sheath color (white or purple), leaf width seem to be the most important and stable diagnostic plant features, followed by plant height, leaf length, leaf angle, leaf color, tillers, flowering habit, etc.

Table 1: Lemongrass genotypes collected from different sources

S. No.	Genotypes	Source
1.	Krishana	Pantnagar (UK)
2.	Chirharit	Pantnagar(UK)
3.	GRL-1	Pantnagar(UK)
4.	NLG-1	Faizabad (UP)
5.	NLG-2	Faizabad (UP)
6.	NLG-3	Faizabad (UP)
7.	NLG-4	Faizabad (UP)
8.	NLG-5	Faizabad (UP)
9.	NLG-6	Faizabad (UP)
10.	NLG-7	Faizabad (UP)
11.	NLG-8	Faizabad (UP)
12.	NLG-9	Faizabad (UP)
13.	NLG-10	Faizabad (UP)
14.	NLG-118	Faizabad (UP)
15.	NLG-84	Faizabad (UP)
16.	OD-23	Odakalli (Kerala)
17.	OD-388	Odakalli (Kerala)
18.	OD-19	Odakalli (Kerala)
19.	OD-58	Odakalli (Kerala)
20.	RRL-16	Jammu (JK)
21.	HL-1	Hisar (Haryana)
22.	HL-2	Hisar (Haryana)
23.	HL-3	Hisar (Haryana)
24.	HL-4	Hisar (Haryana)
25.	HL-5	Hisar (Haryana)
26.	HL-6	Hisar (Haryana)
27.	HL-7	Hisar (Haryana)
28.	HL-8	Hisar (Haryana)
29.	HL-9	Hisar (Haryana)
30.	HL-10	Hisar (Haryana)
31.	HL-11	Hisar (Haryana)
32.	HL-12	Hisar (Haryana)
33.	CKP-25	Jammu (JK)

On the basis of plant phenotypic observations recorded as per the morphological descriptors, a key for the identification of available genotypes was prepared, which is depicted in Figure 1(A-G). According to the lemongrass descriptor's key traits, all the genotypes were differentiated from each other.

Out of 33 genotypes used in the present study, on the basis of growth habit, 12 (Chirharit, NLG-1, NLG-3, NLG-4, NLG-5, NLG-6, NLG-8, NLG-9, HL-2, HL-3, OD-388) genotypes were of compact type, ten semi-spreading (Krishna, NLG-2, NLG-10, NLG-84, GRL-1, OD-23, HL-1, HL-7, HL-10, HL-12), seven semi-compact (NLG-7, NLG-19, OD-58, HL-4, HL-9,



Compact

A. Growth habit



Semi-compact



Semi-spreading



Spreading



B. Plant height



Medium



Dwarf



Very high C. Tillers per plant



High



Medium



Low



Light purple

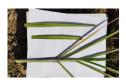
D. Leaf sheath color



Purple



Light green



Green



Long



Medium



Short

E. Leaf length



Broad

F. Leaf width



Non-flowering



Narrow



Flowering

G. Flowering behavior

Figure 1 (A-G.): Morphological variability for different traits in lemon grass

HL-11, CKP-25) and remaining four (NLG-118, HL-5, HL-6, HL-8) were spreading type. On careful visualization of Table 2, it was noticed that the genotypes were classified as compact and semi-spreading types were further divided in tall and medium, while semi-compact was divided into tall, medium, and dwarf, but spreading types were restricted to medium and dwarf types only. On the basis of plant height, there were three groups, i.e., tall (Chirharit, NLG-3, NLG-5, NLG-6, NLG-8, NLG-9, NLG-7, OD-58, HL-9, HL-11, Krishna, NLG-10, OD-23, HL-1, HL-12, NLG-1), medium (NLG-4, OD-388, RRL-16, HL-2, HL-3, CKP-25, OD-19, GRL-1, NLG-2, NLG-84, HL-7, HL-10, HL-8, NLG-118) and dwarf (HL-4, HL-5, HL-6). In the same fashion, Yadav et al., 2013 in raya, Shahaji et al., 2020 in wheat and Arya et al., 2021b in cowpea characterized morphologically the different genotypes for their identification and differentiation purposes.

In the present study, sufficient variability was observed for the number of tillers per plant, and all the genotypes were grouped into four categories, i.e., very high, high, medium and low. Only one genotype, CKP-25 revealed profuse tillering, and only ten genotypes (Chirharit, NLG-9, HL-9, Krishna, NLG-10, HL-12, NLG-1, HL-8, OD-58, GRL-1) with high tillering and majority (20) of genotypes (NLG-2, NLG-3, NLG-5, NLG-6, NLG-7, NLG-8, NLG-118, NLG-84, OD-23, OD-388, OD-19, RRL-16, HL-1, HL-3, HL-4, HL-5, HL-6, HL-7, HL-10, HL-11) with medium tillering, and with low tillering only two genotypes (NLG-4, HL-2) were observed. Likewise, differences in tillering among rice genotypes were reported by Mani and Kumar (2018). For leaf sheath color character, majority of genotypes (18) revealed light purple color viz., Chirharit, NLG-3, NLG-5, NLG-6, NLG-9, NLG-7, OD-58, HL-9, CKP-25, Krishna, NLG-10, OD-23, HL-12, GRL-1, NLG-2, HL-5,

Plant descriptor	Range of expression	Frequency	Genotypes/varieties
Growth habit	Compact	12	Chirharit, NLG-1, NLG-3, NLG-4, NLG-5, NLG-6, NLG-8, NLG-9, HL-2, HL-3, OD-388
	Semi-compact	7	NLG-7, NLG-19, OD-58, HL-4, HL-9, HL-11, CKP-25
	Semi-spreading	10	Krishna, NLG-2, NLG-10, NLG-84, GRL-1, OD-23, HL-1, HL-7, HL-10, HL-12
	Spreading	4	NLG-118, HL-5, HL-6, HL-8
Plant height	Tall	16	Chirharit, NLG-3, NLG-5, NLG-6, NLG-8, NLG-9, NLG-7, OD-58, HL-9, HL-11, Krishna, NLG-10, OD-23, HL-1, HL-12, NLG-1
	Medium	14	NLG-4, OD-388, RRL-16, HL-2, HL-3, CKP-25, OD-19, GRL-1, NLG-2, NLG-84, HL-7, HL-10, HL-8, NLG-118
	Dwarf	3	HL-4, HL-5, HL-6
Tillers/plant	Very high	1	CKP-25,
	High	10	Chirharit, NLG-9, HL-9, Krishna, NLG-10, HL-12, NLG-1, HL-8, OD-58, GRL-1,
	Medium	20	NLG-2, NLG-3, NLG-5, NLG-6, NLG-7, NLG-8, NLG-118, NLG-84, OD-23, OD- 388, OD-19, RRL-16, HL-1, HL-3, HL-4, HL-5, HL-6, HL-7, HL-10, HL-11,
	Low	2	NLG-4, HL-2,
Leaf sheath color	Light purple	18	Chirharit, NLG-3, NLG-5, NLG-6, NLG-9, NLG-7, OD-58, HL-9, CKP-25, Krishna, NLG-10, OD-23, HL-12, GRL-1, NLG-2, HL-5, HL-6, NLG-118
	Purple	5	NLG-8, HL-11, OD-19, NLG-84, NLG-1
	Light green	6	NLG-4, OD-388, RRL-16, HL-4, HL-7, HL-8
	Green	4	HL-2, HL-3, HL-1, HL-10,
Leaf length	Long	4	NLG-5, NLG-9, HL-9, HL-12,
	Medium	21	Chirharit, NLG-3, NLG-8, NLG-7, Krishna, NLG-10, OD-23, NLG-2, NLG-118, HL-11, OD-19, NLG-1, OD-388, HL-7, HL-2, HL-3, HL-1, NLG-6, OD-58, CKP-25, GRL-1,
	Short	8	NLG-4, NLG-84, RRL-16, HL-4, HL-5, HL-6, HL-8, HL-10,
Leaf width	Broad	28	Chirharit, NLG-5, NLG-3, NLG-9, NLG-8, NLG-7, HL-9, Krishna, NLG-10, OD-23, HL-12, NLG-2, HL-5, HL-6, NLG-118, HL-11, OD-19, NLG-84, NLG-1, NLG-4, OD-388, RRL-16, HL-4, HL-7, HL-8, HL-2, HL-3, HL-1,
	Narrow	5	NLG-6, OD-58, CKP-25, GRL-1, HL-10,
Flowering habit	Non-flowering	27	NLG-5, NLG-3, NLG-9, NLG-8, NLG-7, HL-9, NLG-10, OD-23, HL-12, NLG-2, HL-5, HL-6, NLG-118, HL-11, NLG-84, NLG-4, OD-388, HL-4, HL-7, HL-8, HL-2, HL-3, HL-1, NLG-6, OD-58, GRL-1, HL-10,
	Flowering	6	Chirharit, Krishna, NLG-1, OD-19, RRL-16, CKP-25,

Table 2: Frequency distribution with some important traits of 33 genotypes/varieties of lemon grass

HL-6, NLG-118, only five genotypes were under purple color (NLG-8, HL-11, OD-19, NLG-84, NLG-1), only six genotypes in light green category (NLG-4, OD-388, RRL-16, HL-4, HL-7, HL-8) and only four genotypes (HL-2, HL-3, HL-1, HL-10) were green in sheath color. Similar findings were also reported in sorghum by Shafiqurrahaman *et al.* (2022).

The grouping of genotypes on the basis of leaf length revealed that only four genotypes exhibited long leaves, i.e., NLG-5, NLG-9, HL-9, HL-12 and maximum (21) genotypes were under the medium group (Chirharit, NLG-3, NLG-8, NLG-7, Krishna, NLG-10, OD-23, NLG-2, NLG-118, HL-11, OD-19, NLG-1, OD-388, HL-7, HL-2, HL-3, HL-1, NLG-6, OD-58, CKP-25, GRL-1) and only eight genotypes was categorized under short leaf group (NLG-4, NLG-84, RRL-16, HL-4, HL-5, HL-6, HL-8, HL-10). On the basis of leaf width, all 33 genotypes

were categorized only in two groups, i.e., broad and narrow bearing genotypes. In the present investigation, the majority of genotypes (28) were categorized as broad leaf genotypes, namely, Chirharit, NLG-5, NLG-3, NLG-9, NLG-8, NLG-7, HL-9, Krishna, NLG-10, OD-23, HL-12, NLG-2, HL-5, HL-6, NLG-118, HL-11, OD-19, NLG-84, NLG-1, NLG-4, OD-388, RRL-16, HL-4, HL-7, HL-8, HL-2, HL-3, HL-1 opposite to this, only five genotypes (NLG-6, OD-58, CKP-25, GRL-1, HL-10) were grouped as narrow leaf genotypes. Similar findings were also reported by Singh (2010) in lemon grass, Shahaji *et al.* (2020) in durum and Veluru *et al.* (2023) in rose. Bhosale *et al.* (2021) also reported significant variability for leaf characters in anjan grass.

Generally, all the flowering bears flowers according to their flowering season and under a set of environmental

conditions. If any plant species or variety/genotype does not receive the required environmental condition, it does not come in flowering. In the present investigation, out of 33 genotypes, only six genotypes were found able to bear flowering and remaining 27 genotypes were not come in flowering and grouped as non-flowering (NLG-5, NLG-3, NLG-9, NLG-8, NLG-7, HL-9, NLG-10, OD-23, HL-12, NLG-2, HL-5, HL-6, NLG-118, HL-11, NLG-84, NLG-4, OD-388, HL-4, HL-7, HL-8, HL-2, HL-3, HL-1, NLG-6, OD-58, GRL-1, HL-10). Similar differences were reported by a different worker in sugar cane under north Indian conditions due to differences in their thermal and photoperiod requirements of the genotype. Moreover, the precision of the above morphological descriptors characterization may be enhanced through electro-phonetic studies in the future. But, for this precise study advanced laboratory techniques are required (Singh, 2010).

Conclusion

It may be concluded on the basis of morphological characterization of lemongrass that most of the genotypes studied were tall to medium in plant height, semi-spreading to compact type with broad and green leaf having light purple leaf sheath color and medium in leaf length and tillers. Only six genotypes, *viz.*, NLG-1, Chirharit, RRL-16, Karishna, CKP-25 and OD-58, were found able to bear flowering and the majority of genotypes (27) were unable to flower. The morphological characterization in lemongrass was found effective in making differentiation among genotypes under investigation.

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