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BEHAVIOR IN DIFFERENT CULTURAL SYSTEMS OF A GENETICALLY STABILIZED *CYMBOPOGON CITRATUS* (LEMONGRASS) GENOTY AT PGRB BUZAU

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Abstract

PGRB Buzau focused on acclimatizion and breeding of new species that can be grown as vegetable crops in Romania. Since 2010, the Bank's specialists have been studying the species Cymbopogon citratus, accumulating a valuable genetic resource. Two genotypes with distinct phenotypic expressiveness have been genetically stabilized, G1 with strong anthocyanin coloration at leaves base and G2, the subject of this study has the entire plant with light green leaves. It was found that in greenhouse the species can be grown as a perennial and in the field, due to negative temperatures over winter, it requires protection or annual establishment of the crop. In terms of quantitative characters expressiveness, significantly higher values were recorded in the greenhouse, the maximum green mass yield obtained being 4182 g/plant of which 45% represents the production of edible stems. The species can be successfully cultivated both in greenhouse and in the field in Romania. No diseases or pests have been found to affect the crop and the species is appreciated for its strong lemon aroma and multiple uses as ornamental, medicinal, aromatic.

***Key words**: aromatic, acclimatization, breeding, germplasm, lemon grass.*

INTRODUCTION

Cymbopogon citratus is native to Sri Lanka and South India, and is now widely cultivated in the tropical areas of America and Asia (Shah et al., 2011).

Lemon grass, popularly known as citronella grass is a member of the *Poaceae* family and belongs to the genus *Cymbopogon*. The genus *Cymbopogon* constitutes of approximately 140 species that show widespread growth across the semi-temperate and tropical regions of Asian, American and African continents (Ranade et al., 2015).

The history of this aromatic plant shows way it has travelled on almost all the continents of the world, from its area of origin, India, being then extended to America and Africa and later to Europe, conquering so many different nations with its aroma.

Lemongrasses (*Cymbopogon* spp., *Poaceae*) are a group of commercially important C_4 tropical grasses (Lewinsohn, E. et al., 1998).

"The properties which recommended the grass to the native gardener of India also contributes to its early introduction into the colonies of those European Powers which then had possessions in India. The lemon-grass was introduced into Jamaica most probably in 1739. From there it was soon spread to the other British islands in the West Indies as an elegant and powerful diaphoretic under the popular name of lemon-grass." (Otto Stapf., 1906).

The name *Cymbopogon* is derived from the Greek words "kymbe" (boat) and "pogon" (beard), referring to the flower spike arrangement. *Cymbopogon citratus*, Stapf (Lemon grass) is commonly used in teas, soups and curries. It is also suitable for poultry, fish and seafood (Shah et al., 2011).

The plant belongs to the *Poaceae* family, having a pendulous habit, with lanceolate leaves, rough to the touch.

Lemon grass is a perennial monocotyledonous grass which can grow up to about 180 cm in height and 125 cm in width.

It grows in clusters. It has long, slender, drooping bright green leaves that measures from 1.3-2.5 cm in width and 92 cm in length. Leaves are simple with entire margins. Flowers grow on spikes (Ranade et al., 2015).

However, it has many bulbous stems that increase the clump size as the plant grows (O.A. Lawal et al., 2017).

The plant can multiply both by seeds and assesual by dividing the bush.

Lemongrass is generally propagated through seeds. Seed is mixed with dry river sand in the ratio of 1:3 and sown in the field at the rate of 20 to 25 kg/ha. Alternatively, seedlings can be raised in a nursery in one-tenth of the area of the main field and transplanted after 45 days (Joy et al., 2006).

The essential oils contained in this plant provide both a strong lemon aroma and multiple medicinal, therapeutic and culinary properties. As a vaporizer, the oil works as an effective panacea against bacteria, flu and colds (Shah et al., 2011). A strong lemon fragrance, a predominant feature of this grass, is due to the high citral content in its oil. The redolence of the oil enables its use in soaps, detergents and perfumes. It also finds an application in the pharmaceutical industry (Ranade et al., 2015).

Since the beginning of its cultivation, this plant has surprised with its sweet and distinct aroma. "This is a most delicate sort of fragrant Grass which being rubbed smells like Baume and Lime or Limon peel together. The Portuguese woman fume their children with it and give the Decoction of it with other things for Fevers and to strengthen weak stomachs; but the Natives use it not, which together with its growing in gardens on the Sea coast and not up the country, as I can yet observe, makes me think the Portuguese brought this from other parts and planted it here." (Petiver, 1702)

Lemongrass contains several important bioactive compounds which are useful in several health issues. These active compounds are normally found in the leaves (Olorunnisola, S. K. et al., 2014).

Among the many properties of this plant are: antiviral, anti-inflammatory, anxiolytic, anti-cancer, etc. (Figure 1).

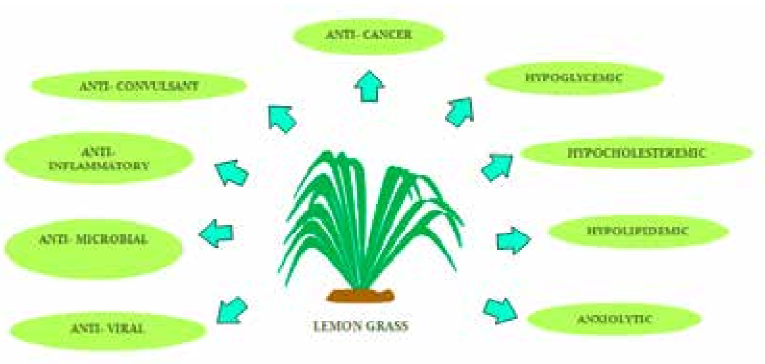

Figure 1. Activities shown by lemon grass that contribute to its therapeutic value (Ranade et al., 2015)

MATERIALS AND METHODS

Two genotypes were selected from the PGRB Buzau germplasm collection, G1 belonging to *Cymbopogon nardus* which has anthocyanin coloured leaflets at the base of the plant and G2, genotype which has all vegetative parts coloured green, belonging to *Cymbopogon citratus* (Figure 3)

G2 is genetically stabilized and is the subject of the present study. It was grown in two experimental variants, both under greenhouse-V1 S and open field-V2 C conditions.

Seedling production was carried out by seeding, even though the growth rate is much slower after germination and the germination capacity is low, below 80%. It is recommended, however, for a more accelerated rate of plant growth and much earlier crop establishment, to propagate plants by bush division. The plant behaves as a perennial in protected areas and as an annual in the field. Thus, seedling production can only take place in protected areas.

The research has three main objectives: acclimatization of the species to pedoclimatic conditions, improvement of the species in order to obtain genotypes with distinct phenotypic expression and development of culture technology, both in greenhouse and in the field for the improved genotype.

In order to develop the appropriate cultivation technology, several technological variants of crop establishment were used, both in terms of plant density per row and distance between rows. The research found that for this genotype, the optimal cropping pattern is 120 cm between rows and 50 cm between plants/row in greenhouse and 70 cm between rows and 40 cm between plants/row in the field. This cultivation technology provides the necessary surface area for nutrition and harmonious plant development, both in the root system and the aerial part. Manual and mechanical maintenance as well as harvesting can easily be carried out (Figure 2).

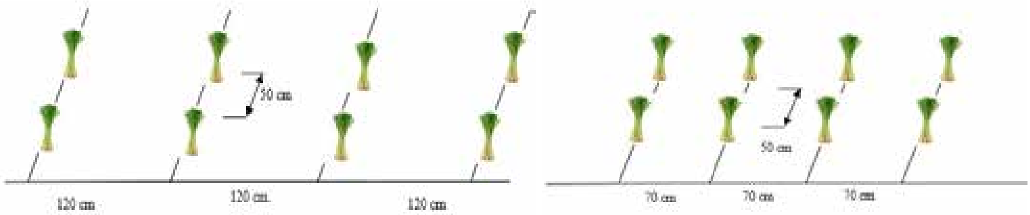

Figure 2. Greenhouse cropping scheme (left) and field cropping scheme (right)

Phenotypical and biometrical measurements of the main qualitative and quantitative plant characters were performed according to UPOV (https://www.upov.int/portal/index.html.en) and IPGRI descriptors (https://www.bioversityinternational.org/e-library/publications/categories/descriptors/).

Statistical calculations were performed using SPSS software, Pearson correlation coefficients were determined for the experimental variants, V1 S and V1 C as well as variance analysis by ANOVA test followed by DUNCAN test with 95% confidence interval and p-value < 0.05%.

Figure 3. G1 (left) and G2 (right)

RESULTS AND DISCUSSIONS

The plant was characterized qualitatively, phenotypically and quantitatively. According to the descriptors followed, the plant has a globular bush, lanceolate leaves, slightly spatulate, covered with glandular peristyles, rough and oriented towards the leaf tip (Figure 4). Leaf thickness is 0.2-0.3 mm on average. The average leaf vein thickness is 3-4 mm.

Figure 4. Plant and leaf details

Quantitative plant characteristics measured for the open field variant-V1C recorded significantly lower values compared to the average values recorded for the V2S variant, grown in protected areas, thus demonstrating the requirements of the plant for the respective growing environment (Table 1). In the case of leaf width and number of leaves/plant, the values for leaf width and number of leaves/plant were approximately similar and were not influenced by the growing medium.

The protected growing environment resulted in a vegetative mass of edible stems of 45% of the total plant mass, which is quite high for the potential of the plant.

Figure 5. Leaf/plant inserts

Table 1. Mean values of the main quantitative characteristics of the two variants

Characteristics	V1 S	CV%	V1 C	CV%
Plant height (cm)	202,2± 11,65 [a]	5,76	69,6±8,4[b]	12,08
Plant diameter-top (cm)	158,2± 5,91 [a]	3,74	79,2±10,4 [b]	13,13
Plant diameter -base (cm)	27,6± 2,73 [a]	9,88	21,4±2,7 [b]	12,40
Stem lenght (cm)	60,4± 11,89 [a]	19,69	29,8±5,9 [b]	19,84
Leaf lenght (cm)	104,4± 36,01 [a]	34,50	53,6±11,6 [b]	21,68
Leaf width (mm)	20,6± 7,94[a]	38,54	14,6±7,2[a]	49,50
Stem no./ plant (piece)	37,6± 4,88 [a]	12,99	28,4±5,6 [b]	19,62
Leaves no./stem (piece)	6,6± 1,851[a]	28,10	5,6±1,4[a]	24,22
Stem weight (g)	47,6± 4,18 [a]	8,77	28,8±5,7 [b]	19,93
Total weight of stems (g)	1690,2± 136,20 [a]	8,06	864,2±157 ,2 [b]	18,19
Total weight of leaves/plant (g)	2404,2± 128,09 [a]	5,33	1081,4±111,0 [b]	10,27
Leaves no./plant (piece)	253,4± 9,07 [a]	3,58	185±16,0 [b]	8,65
Plant weight (g)	4033,2± 95,74 [a]	2,37	2028,6±215,8 [b]	10,64

*letters represent Duncan test results with 95% confidence interval and p<0.05%; CV-coefficient of variation

Considering the correlations established between the quantitative characters determined in the open field variant, a maximum of 0.996 is obtained between plant height and stem length, which means a strong correlation between the two characters. Also, a high coefficient of 0.957 was obtained between total plant weight and leaf length. The same coefficient of 0.940 was obtained between total stem weight and leaf length as well as the number of leaves/plant, meaning that they are directly proportional in a positive trend (Table 2).

Table 2. Matrix of Pearson correlation coefficients for the main quantitative plant traits in V1 C

Characteristics	*H*	*D*	*Ls*	*Ll*	*Sno/pl*	*Lno/S*	*TwS*	*PlW*
Plant height (cm)-H	**1**							
Plant diameter -D	0,336	**1**						
Stem lenght (cm)-Ls	**0,974**	0,122	**1**					
Leaf lenght (cm)-Ll	0,600	0,215	0,565	**1**				
Stem no./ plant (piece)-Sno/pl	0,817	-0,147	**0,895**	0,754	**1**			
Leaves no./stem (piece)-Lno/S	**0,883**	0,063	**0,911**	0,839	**0,975**	**1**		
Total weight of stems (g)-TwS	0,641	0,224	0,607	**0,999**	0,779	0,864	**1**	
Plant weight (g)-PlW	0,635	0,277	0,587	**0,997**	0,746	0,844	**0,998**	**1**

In terms of establishing correlations between the main quantitative characters of plants grown in V1 S, the highest correlation coefficient of 0.999 was recorded between total stem weight and leaf length. A strong correlation was also recorded between total plant weight and total stem weight, resulting in a correlation coefficient of 0.998. A strong interdependence was observed

between total plant weight and leaf length, resulting in a coefficient of 0.997 (Figure 3, Table 3).

Table 3. Matrix of Pearson correlation coefficients for the main quantitative plant traits in V1S

Characteristics	*H*	*D*	*Ls*	*Ll*	*Sno/pl*	Lno/S	*TwS*	*PlW*
Plant height (cm)-H	**1**							
Plant diameter -D	**0,890**	**1**						
Stem lenght (cm)-Ls	**0,996**	**0,925**	**1**					
Leaf lenght (cm)-Ll	0,781	0,413	0,727	**1**				
Stem no./ plant (piece)-Sno/pl	**0,900**	0,627	0,865	**0,917**	**1**			
Leaves no./stem (piece)-Lno/S	0,867	0,670	0,847	0,858	0,771	**1**		
Total weight of stems (g)-TwS	0,723	0,397	0,677	**0,940**	0,765	**0,940**	**1**	
Plant weight (g)-PlW	0,653	0,241	0,588	**0,957**	**0,900**	0,673	0,817	**1**

Even though the mean values of the main characters were reduced in V1C compared to V1S, both growing environments give favorable results, and the plant can be grown in both protected and open fields. No diseases or pests affecting the crop were recorded throughout the growing season. The strong point of this species is its novelty for the range of aromatic plants cultivated in Romania.

Lemon grass has proven to be a multi-purpose plant, which can be cultivated both in the field and especially in protected areas to obtain superior edible stems.

CONCLUSIONS

A genotype belonging to *Cymbopogon citratus*, lemongrass, was introduced in the study from the PGRB Buzau germplasm collection.

The G2 genotype was cultivated in two experimental variants, both in open field and greenhouse conditions.

The plant behaves as a perennial in protected areas and as an annual in the field. Thus, seedling production can only take place in greenhouse.

Biometrical and phenotypical measurements of the main quantitative characters showed that the mean values of V1C were significantly different from those of V1S, the latter having much higher quantitative values.

The G2 genotype is genetically stabilized and represents a novelty for the range of aromatical and medicinal plants cultivated in our country, being able to be grown both in protected areas and in the field.

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