EVALUATION OF PHENOTYPIC AND BIOCHEMICAL EXPRESSION IN *LAVANDA SPP.* GENOTYPES. BRED AND PRESERVED AT PGRB BUZĂU

EVALUAREA EXPRESIVITATII FENOTIPICE SI BIOCHIMICE LA GENOTIPURILE DE *LAVANDA SPP.* AMELIORATE SI CONSERVATE LA BRGV BUZĂU

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Abstract. *Lavanda spp. belongs to the Lamiaceae family and has its center of origin in the Mediterranean basin, where it was first cultivated and then spread to England and the rest of Europe. Lavender was initially used for ornamental purposes, and later medicinal properties were discovered, especially in the oil extracted from the plant. The aim of the present work is the phenotypic and biochemical characterization of 6 improved lavender genotypes from the core collection held and conserved by the Plant Genetic Resource Bank Buzau. The germplasm collection includes 42 genotypes, 8 of which are genetically stabilized. Following the evaluation of phenotypic expression, biochemical analyses were performed to determine the chemical composition of lavender volatile oil extracted from plant material by hydro distillation. Chemical compounds were identified using mass spectrophotometric method and gas chromatographic analysis. The G2 genotype belonging to Lavanda angustifolia has been shown to have superior phenotypic and biochemical qualities and is expected to be approved and patented in 2023*.
Key words: cultivar, essential oil, germplasm, linalool, ornamental

Rezumat. *Lavanda spp. face parte din familia Lamiaceae si isi are centrul de origine in bazinul mediterannean, locul unde s-a cultivat pentru prima oara si apoi s-a extins in Anglia si restul Europei. Lavanda a fost folosita initial in scop ornamental, ca mai apoi sa fie descoperite proprietati medicinale, in special in uleiul extras din aceasta planta. Scopul prezentei lucrari este caracterizarea fenotipica si biochimica a 6 genotipuri de lavanda ameliorate, din colectia de baza detinuta si conservata a Bancii de Resurse Genetice Vegetale Buzau. Colectia insumeaza 42 de genotipuri, dintre care 8 stabilizate genetic. In urma evaluarii expresivitatii fenotipice, au fost efectuate analize biochimice pentru a stabili compozitia chimica a uleiului volatil de lavanda extras din material vegetal prin hidrodistilare. Compusii chimici au fost identificati cu ajutorul metodei spectrofotometrice de masa si analizei gaz-cromatografica. Genotipul G2 ce apartine Lavanda angustifolia s-a dovedit a avea calitati superioare, atat fenotipice cat si biochimice, urmand omologarea si brevetarea acestuia in anul 2023.*
Cuvinte cheie: cultivar, germoplasma, linalool, ornamental, ulei esential

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INTRODUCTION

The name lavender is derived from the Latin "lavare", which means to wash. The fragrant flowers were used in ancient Rome and North Africa to scent public baths and were carried by the Roman army for use as a disinfectant1. "Lavenders" in Medieval and Renaissance times were used for the storage of laundry. The Ancient Egyptians are said to have used the flower in the mummification process. Lavender oil, distilled from L. angustifolia was used extensively in Victorian times as a perfume and applied in numerous cosmetics products, but now it is used mainly in combination with other essential oils and aroma chemicals. True lavender oil, consisting mainly of linalool and linalyl acetate, has a very variable composition due to the genetic instability (Maria Lis-Balchin, 2002).

Lavender essential oil is widely used in pharmacy, perfumery and the food industry. It is one of the key essential oils in aromatherapy due to its valuable pharmacological properties. The producers of lavender essential oil are well aware that the greatest quantity of oil is obtained near the end of the inflorescence anthesis and that oil quantity is correlated with the pollination as unpollinated flowers drop down (Hristo *et al*., 2022).

MATERIAL AND METHOD

PGRB Buzau holds a collection of 42 genotypes of *Lavandula* spp. of which 8 are genetically stabilized. In the present work 6 genotypes of Lavandula spp. with distinct phenotypic expressivity were studied. These have been subjected to intensive breeding and conservative selection since 2002, undergoing repeated individual selection followed by clonal selection. Through individual selection, elite plants with superior traits were chosen. Clonal selection was implemented at the expense of sexual propagation (by seed). Also, propagation by seedling favours a more rapid development of the plants as opposed to sexual propagation, preserving the typicality of the genotype, avoiding cross-pollination, knowing that the species has a high degree of entomophily and is allogamous.

Biometric and phenotypic measurements were carried out according to the UPOV and IPGRI international descriptors. Statistical analysis was performed using SPSS software. Flower colour codes were established using the Royal Horticultural Society Colour Charts.

Genotype 2 was subjected to biochemical analysis to determine the volatile oil composition. GC/MS (gas chromatography coupled with mass spectrophotometry) analysis was used to determine volatile oil compounds. Two volatile oil samples were analysed: P1- oil extracted in 2019 and P2-oil extracted in 2020. The two samples were compared with the control sample, M- oil extracted 4.5 mL/100 g.

RESULTS AND DISCUSSIONS

Following phenotypic analysis of the 6 genotypes, it was found that the plants share the following characteristics: *Lavanda spp*. is a shrub, woody-based perennial, aromatic. Leaves are entire, sessile and the inflorescence is a congested cyme usually bilabiate, tubular with five lobes. The stems are squared. The

inflorescence is branched, a compact terminal spikes of flowers borne within the corolla tube and persistent bracts. Calyx is persistent and two lipped. The 6 genotypes have the following distinct characteristics (tab. 1).

Table 1

Main phenotypic characteristics of the genotypes studied

Genotypes	Intensity of green foliage	Attitude of outer flowering stems	Spike shape	Calyx color	Corolla color*	Time of beginning of flowering
G1	Light	Spreading	Narrow trullate	purpulish	Violet (86B)	late
G2	Medium	Semi erect	Narrow conical	Purple greenish	Violet (N88B)	early
G3	Light	Semi erect	Narrow conical	greenish	Violet (N82A)	early
G4	Light	Spreading	Truncate conical	greenish	Light Violet (N88A)	early
G5	Light	Erect	cylindrical	purpulish	Deep Violet (N86A)	Medium
G6	Medium	Erect	cylindrical	greyish	pink (75B)	medium

*color codes according to RHS (Royal Horticultural Society Color Charts)

G1 is a hybrid between *Lavender* spp.x *intermedia* called Lavandin which has beautifully coloured blooms that keep their color when dry, the plants are over 85 cm in diameter, suitable for large landscapes, not good for oil or culinary, mainly for ornamental purposes and cut flowers.

G2 belongs to *Lavandula angustifolia* and it is characterized by large and flax plants, large inflorescences of 42.5 cm length on average, suitable for high quality volatile oil, super oil yield, great oil quality and very sweet scent. It is the genotype with the highest winter hardiness.

G3 belongs to *Lavandula angustifolia*, with long inflorescences of 38.7 cm on average and large distances between the vertices. The plants can have multiple uses: ornamental, dried inflorescences, good oil quality and culinary products.

G4 belongs to *Lavandula angustifolia* but has compact, sturdy bushes that can be used as decorative plants in pots and planters. The inflorescence has a compact, light purple spike, averaging 6,4 cm. The foliage has a strong greyish appearance.

G5 belongs to *Lavandula angustifolia* and is characterized by dwarf plants which can easily propagate by seed, with deep purple inflorescences, suitable for potted plants and oil.

G6 belongs to *Lavandula angustifolia* which has distinct foliage, with wider leaves compared to the other varieties, greyish and pink calyx. The plants are suitable for the extraction of high quality oil, beautiful alternative colour (white in the bud stage and pink at full bloom).

Measurable characteristics according to the international UPOV and IPGRI descriptors are shown in fig. 1.

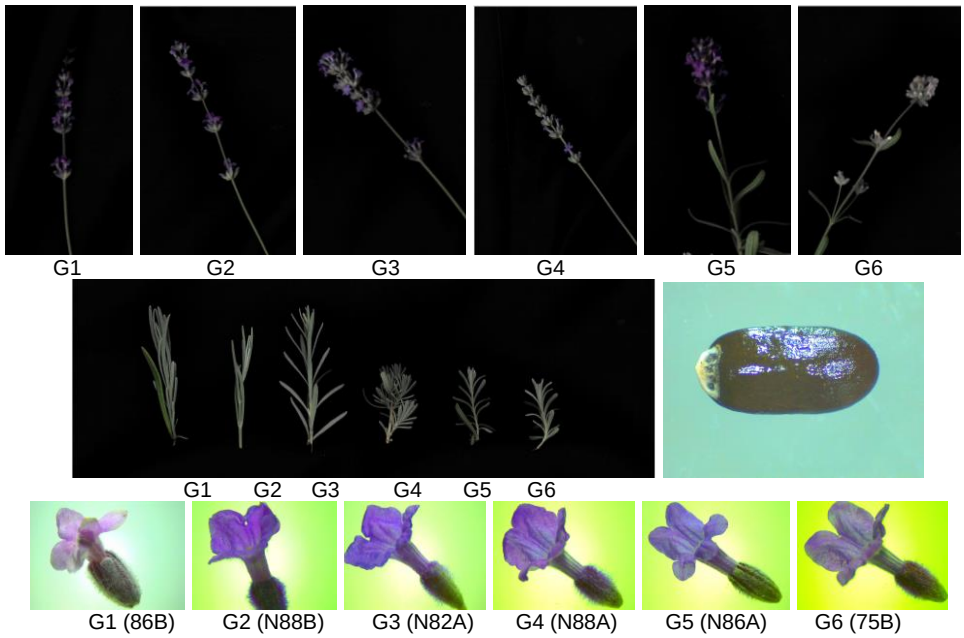

Fig. 1. Cymes, leaves, seed and corolla morphology of the studied genotypes

Table 2

Main measurable characteristics of the genotypes studied

Genotypes	Plant height (cm)	Canopy diameter (cm)	Flower stem lenght (cm)	Spike lenght (cm)	Distance between whorls (cm)	Number of whorls (unit)	Number of flowers/whorl (unit)
G1	83.4±4.9^{a}	106.9±12.7^{a}	70.9±3.0^{a}	14.4±4.0^{b}	0.9±0.4^{c}	8.8±0.4^{c}	10.8±1.2^{a}
G2	57.5±5.5^{c}	83.0±6.2^{c}	42.5±2.1^{b}	14.6±2.8^{b}	1.8±0.3^{b}	7.4±0.5^{b}	10.6±1.1^{b}
G3	68.8±2.3^{b}	92.4±12.8^{bc}	38.7±1.2^{c}	20.2±3.8^{a}	2.7±0.5^{a}	7.4±0.5^{a}	9.6±1.1^{b}
G4	45.7±0.9^{d}	97.6±6.8^{ab}	33.9±2.5^{d}	6.4±1.4^{d}	0.9±0.2^{c}	7.4±0.5^{c}	10.8±0.8^{b}
G5	49.6±4.2^{c}	56.8±1.3^{d}	13.6±2.4^{f}	3.7±0.7^{d}	0.7±0.1^{c}	7.4±0.5^{c}	6.8±0.8^{b}
G6	51.6±4.0^{a}	66.8±2.9^{d}	24.4±2.9^{e}	10.6±1.1^{c}	0.2±0.1^{d}	3.4±0.5^{d}	12.2±1.5^{c}

*Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$, 95% confidence level)

The Duncan test applied on the variables measured in the 6 genotypes shows that there are significant differences between them, demonstrating a very high variability of the main traits (tab. 2).

Following GC/MS analysis of the oil extracted from G2, it was identified that it is characterized by a high linalool content, 26.3% (2019) and 28.3% (2020). (tab. 3).

Table 3

Composition of lavender volatile oil determined by GC/MS analysis

P1 (2019)	P2 (2020)			
Aria %		M	Compuşi	TR (min)
0.35	0.25	0.23	α-pinene	5.85
0.38	0.25	0.67	camphene	6.24
1.73	1.35	1.09	3-octanone	7.19
0.81	0.73	1.23	β-myrcene	7.39
0.64	0.37	0.35	α-terpinene	8.05
0.71	0.28	-	limonene	8.67
4.4	3.18	7.74	eucalyptol	8.7
3.38	3.62	2.5	trans-β-ocimene	8.9
0.68	0.8	1.1	cis-β-ocimene	9.32
26.28	28.3	30.2	linalool	11.26
0.38	0.38	1	camphor	12.98
1.67	1.1	3.7	lavandulol	13.87
5.7	5.3	4.9	4-terpineol	14.36
1.4	0.5	5.6	α-terpineol	14.89
38.3	41.6	19.7	linalyl acetate	17.8
3.9	3.6	3.7	lavandulyl acetate	19.14
5.2	4.4	1.4	β-caryophyllene	24.51
0.56	0.5	0.2	cis-β-farnesene	26

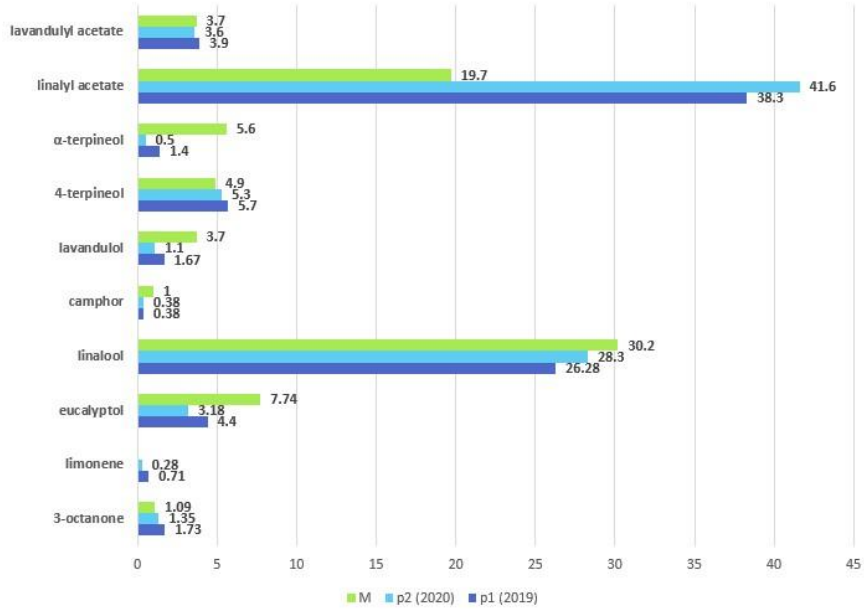

Fig. 2. Volatile oil compounds of G2 (%)

Also, the graph in fig.1. shows the parameters of the compounds lavandulol, lavandulol acetate and linalool acetate which are found in optimal

amounts in the oil extracted from G2 and can be used in pharmaceutical preparations, food supplements and aromatherapy (fig. 2).

CONCLUSIONS

1. The 6 genotypes were analyzed phenotypically, biometrically, revealing distinct expressivity and a high degree of variability of the main characters.

2. G2 is the genotype that demonstrates a superior quality of volatile oil composition and can be exploited for this purpose.

3. The genotypes studied have superior characteristics, have multiple uses: ornamental, culinary, oil extraction, cut flowers, dried flowers.

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