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Comparative evaluation of different valerian (*Valeriana officinalis* L.) lines

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Summary: Research project to establish a Hungarian valerian cultivar with acceptable production, biological and chemical properties of five promising *Valeriana officinalis* L. lines were studied. The populations were not homogeneous especially with regard to leaf shape and colour. Line 'IV/1' showed the strongest vigour, was characterised by the highest root-yield (381.79 g/plant), volatile-oil (0.60 ml/100 g) and valtrat content (1.15%). However, the highest valeric-acid content (0.20%) was measured in another line, 'I/5'. According to our results, the above-mentioned lines ('I/5', 'IV/1') could be the basic material of breeding work in the future.

Key words: valerian, *Valeriana officinalis* L., line, volatile oil, valtrate, valeric acid

Introduction

Nowadays, approximately 30% of world population is suffering from insomnia (*Murray & Pizzorno,* 1988). Valerian is a well-known remedy against sleeplessness and it is also indicated for hysterical state, excitability, hypochondriasis, migraine, cramp and rheumatic pain (*British Herbal Pharmacopoeia,* 1983). This plant has been used as a sedative since ancient Greek and Roman times, but even today it has preserved its good reputation. Although there are several highly effective synthetic tranquillizers containing benzodiazepines (Valium, Librium), patients prefer natural sourced, over-the-counter (OTC) products which have milder side-effects. And the main constituent of these pharmaceutical preparations is still valerian.

Valeriana officinalis L. belongs to the family *Valerianaceae*. It is a perennial herb with opposite, compound leaves and white or pale pink flowers standing in terminal corymbs (*Bentham & Hooker,* 1954). The whole plant, but mainly the root, has a penetrant, strong odour which is unpleasant for the human nose. Otherwise, it is very attractive for tom cats. The drug of the plant is the root – *Valerianae rhizoma et radix* – that is found in almost every Pharmacopoeia in the world included Ph. Eur. and Ph. Hg. VII.

The identification of the real active agent of valerian is accompanied by some difficulties since not only one chemical component is responsible for the sedative effect. Volatile oil and its substances such as valeric acid and its derivatives or the valepotriates both play a role in establishing the calming effect. This kind of complexity makes the herb suitable for the application of phytotherapy (*Houghton*, 1997).

Due to the increasing demand on valerian the lack of a Hungarian cultivar with standard chemical composition and appropriate root-yield has become a serious problem. Upon realising the situation, investigations were started by Corvinus University of Budapest, Faculty of Horticultural Sciences, Department of Medicinal and Aromatic Plants in order to select the most adequate valerian lines which could be used for breeding in the future.

Material and method

Five *Valeriana officinalis* L. lines – I/5, II/2, III/3, III/8, IV/1 – were chosen from the breeding stock of the Department. The seeds were sown in late August, 2002 using propagation trays in greenhouse. The seedlings were transplanted into the open field in October to a plant density of 60 × 30 cm.

The field experiment was carried out at the Research Station of Corvinus University of Budapest, Department of Medicinal and Aromatic Plants, Soroksár (Budapest).

The soil conditions of the experimental field were examined by the Central Laboratory, Faculty of Food Sciences, Corvinus University of Budapest in 2003. According to the results the calciferous loose sandy soil is

characterised by very good P_2O_5 (297–311 mg/kg) medium K_2O (199 mg/kg) content and by poor accessible N_2 (0.47%) supply.

The weather conditions of the growing season are shown in *Table 1* using the data of the Budapest – Pestlőrinc Meteorological Station.

Table 1 Weather conditions in the growing season of *Valeriana officinalis* L. (Pestlőrinc, 2003)

Months	Mean temperature (°C)	Sum of sunny hours	Average precipitation (mm)
February	–3.0	132	30
March	5.9	149	1
April	10.7	197	20
May	19.8	216	13
June	23.6	325	15
July	22.8	286	57
August	24.8	304	15
September	17.8	238	26
October	9.7	122	34

Field experiment

Ten, not randomly chosen individuals have been measured to assess obtain plant growing characteristics at each sampling time according to *Figure 1*. Morphological and production biological characteristics were studied on 3–3 samples chosen randomly per line.

Analysis of active components

Chemical analysis was carried out on 3 samples chosen randomly per line. The essential oil was extracted by hydrodistillation using a Clevenger-type apparatus in accordance with the requirements of Ph.Hg. VII. in the Central Laboratory of the Department. The amount of it is expressed in the ratio of dry matter (ml/100g). The valeric acid and valtrate content was analised by HPLC using the method of *Bos* et al. (1996) at P. J. Safárik University, Kosice.

Methods of statistical evaluation

To evaluate the differences between the lines one-way analysis of variance was used by applying Statgraphics 5.1 software.

Results and discussion

Plant growing characteristics

Line 'IV/1' showed the best plant growing characteristics as it can be seen in *Figure 1*. At the end of the vegetative cycle its plant height (39.60 cm), leaf rosette-size in diameter (58.40 cm) and leaf-number (92.00) were significantly higher than those of the other lines.

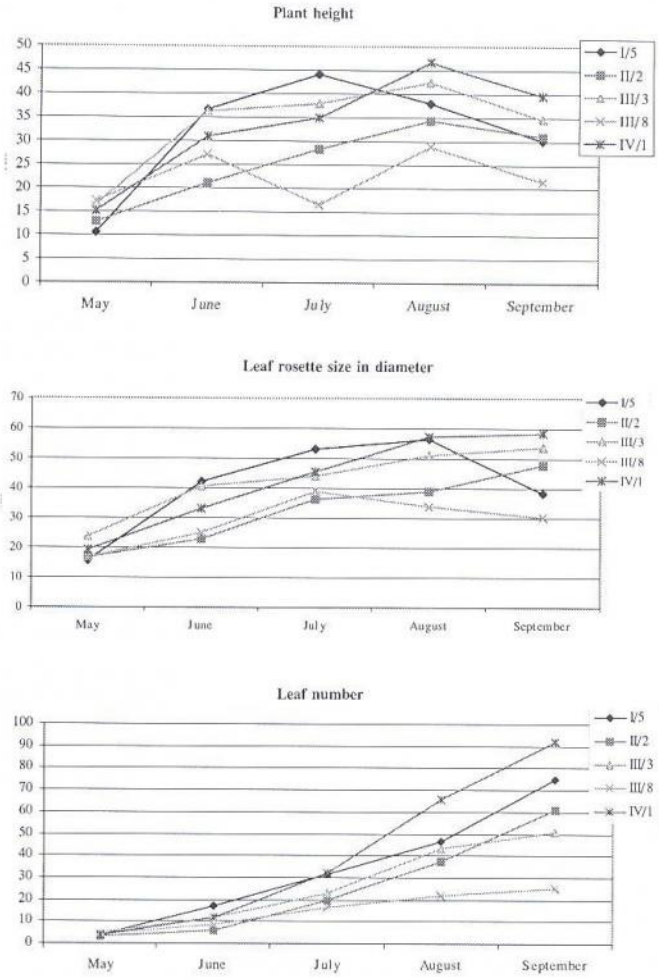

Figure 1 Comparison of plant growing characteristics between the studied Valeriana officinalis L. lines

Table 2 Main characteristics of *Valeriana officinalis* L. root morphology

	I/5	II/2	III/3	III/8	IV/1	SD 5%
Average root-length (cm)	19.8	16.3	18.0	13.7	26.0	4.9
Maximum root-length (cm)	31.3	24.3	30.3	19.3	43.3	7.1
Number of root-heads	4.3	5.0	5.7	2.3	9.0	2.6
Diameter of the rhizome (cm)	2.3	2.7	2.7	2.0	3.3	1.1
Diameter of side-roots at the rhizome (cm)	1.6	1.7	2.4	2.2	1.5	0.6

Table 3 Production biological characteristics of the studied *Valeriana officinalis* L. lines

	I/5	II/2	III/3	III/8	IV/1	SD 5%
Green mass (g)	233.0	150.0	130.0	20.0	863.3	379.3
Fresh root mass (g)	218.7	112.3	150.0	33.3	381.7	168.1
Dry root mass(g)	53.5	33.0	40.0	11.3	85.7	37.1
Mass of the rhizome (g)	13.3	9.5	10.0	4.5	23.0	9.4
Mass of side roots (g)	28.8	19.1	24.3	4.4	52.7	19.2

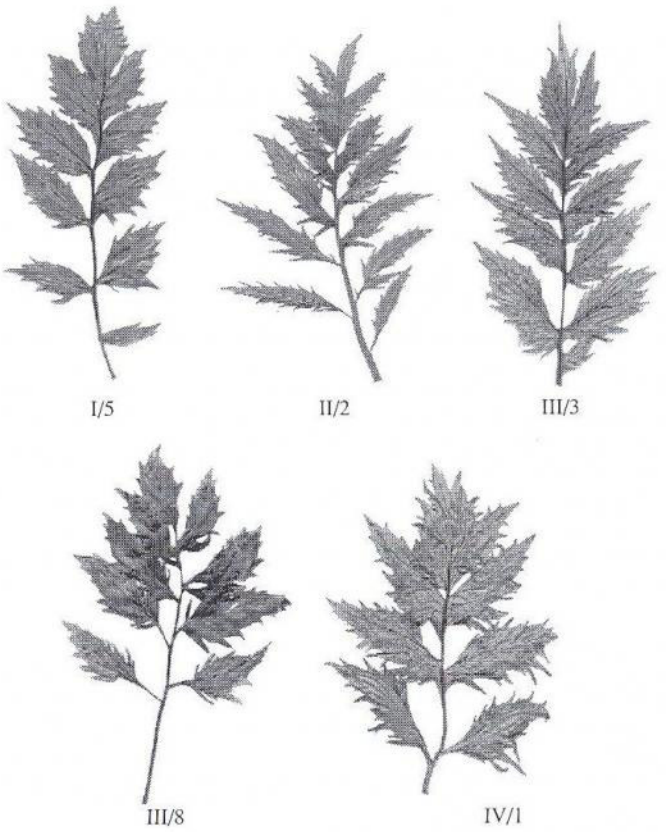

Figure 2 Typical leaf shapes of the studied *Valeriana officinalis* L. lines

Morphological characteristics

Leaf morphology

According to our results, the lines were not homogeneous. In the case of 'III/8', approximately 50% of the individuals were characterised by narrow leaflets meanwhile the other half had wide leaflets. The longest and widest leaves and leaflets were found in line 'IV/1'. The typical leaf shapes of the lines are shown in *Figure 2*.

Root morphology

Analysis of variance for different root parameters is summarized in *Table 2*. The typical root shapes can be seen in *Figure 3*. In line 'IV/1', roots consisted of many radicles that makes the harvesting process more difficult. From this aspect, 'III/8' seemed to be the best line since it did not have any root-hairs and the primary roots were thick.

Production-biological characteristics

The results of our study are shown in *Table 3*. Highest fresh (381.70 g) and dry (85.70 g) root mass was observed in 'IV/1'. The difference between this line and the others was significant. These results are mainly due to the different root shapes. As we mentioned before 'IV/1' had the most dense while 'III/8' was characterised by the most thin root. The lack of radicle resulted in significantly lower root-mass.

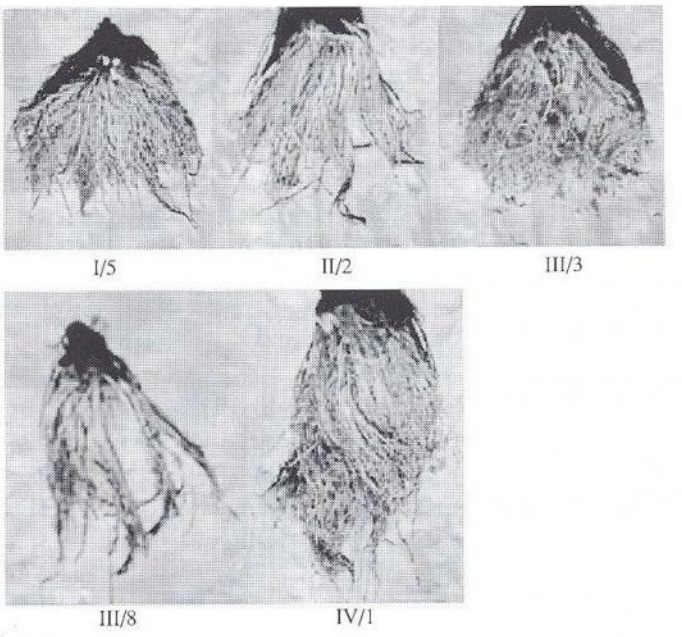

Figure 3 Typical root shapes of the studied *Valeriana officinalis* L. lines

Amount of active components

The results of active components' analyses are demontsrated in *Figure 4*. The highest essential oil content was measured in 'IV/1' (0.60 ml/100 g). But the differences were not significant except for 'III/8' (0.32 ml/100 g), which line failed to meet the minimum requirement (0.40 ml/100 g) of *Ph.Hg.VII*. According to *Bos* et al. (1984) the essential oil content of *Valeriana officinalis* L. can vary between 0.40–2.00%. Taking this into consideration, we came to the conclusion that the studied lines were not rich in essential oil. This result is in agreement with the statement of *Lenchés & Petheő* (2000) that Hungarian valerian populations have low essential oil content.

Line 'I/5' attained the highest valeric-acid content (0.21%), 'IV/1' produced significantly lower results (0.13%). In 2000, *Gao & Björk* made a comparison between 117 valerian populations. The measured amount of valeric acid was 0.15–11.65%. *Noller* (1989), in his Ph.D thesis of *Valeriana officinalis* L., obtained 0.02–2.60% valeric acid

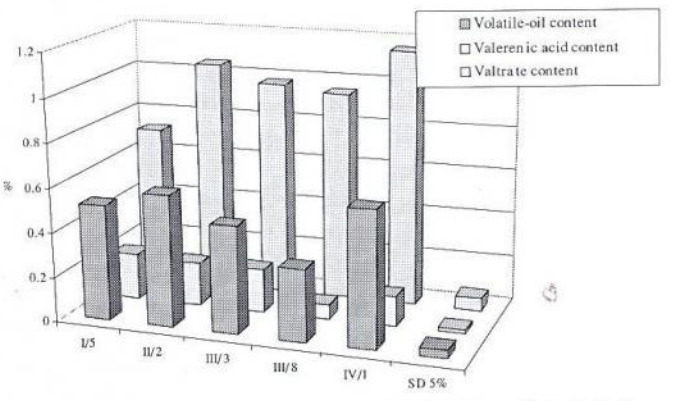

Figure 4 Chemical composition of the studied *Valeriana officinalis* L. lines

content. So we can state that our results compared with those of others were relatively low.

Line 'IV/1' was characterised by the highest valtrate level (1.15%). In another experiment carried out by *Gao & Björk* (2000) the results were between 1.81–0.03%. According to *Lenchés & Petheő* (2000), the valepotriate content of *Valeriana officinalis* L. usually ranged from 0.50% to 1.50%. Based on the results mentioned before, the valtrate content, which is only a part of total valepotriate amount, was relatively high.

Opinions about pharmaceutical advantages and disadvantages of valepotriates have some contradictions. In the 1980s researchers succeded in proving cytotoxic activity of this chemical group. The experiments were carried out *in vitro* on isolated liver cell tumours of rats. 33 mg valtrate per ml led to total cell mortality (*Bounthanh* et al., 1981). However, in another study (*Tortarolo* et al., 1982) no evidence was found for their *in vivo* toxicity. With regard to the possible harmful effect caused by valepotriates, line 'I/5' is recommended for breeding because of its advantageous valtrate/valeric acid ratio.

On the other hand, valtrates have become one of the most important anti-HIV compounds (*Murakami* et al., 2002). If their role in pharmacy will be more emphasized again, line 'IV/1' can be the basic material of future breeding work owing to its high valtrate content.

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