CHARACTERS WITH MULTIPLE USAGES- PHENOTYPIC VARIABILITY ANALYSIS AT *Echinacea purpurea* (L.) Moench SPECIES

Mihai Radu POP*

*"Lucian Blaga" University of Sibiu, Faculty of Faculty of Agricultural Sciences, Food Industry and Environmental Protection, Sibiu, Romania
Corresponding author: Mihai Radu Pop, "Lucian Blaga" University of Sibiu, Faculty of Agricultural Sciences, Food Industry and Environmental Protection, 5-7 Ion Ratiu, 550371 Sibiu, Romania, phone: 0040269234111, fax: 0040269234111, e-mail: mihaipop76@yahoo.com

Abstract. Merging aesthetics with utility, some medicinal plants can benefit both of a high production and decoration potential. This calls for diversification of improvement directions of the species. Through this article we suggest one of these species, *Echinacea purpurea* (L.) Moench. This is considered to be important at this time, acquisition of new biological forms - varieties in this species, which show multiple attributes utility based on key biological characteristics, agronomic, physiological, biochemical and agrochemical (medicinal, decorative, culinary etc.). To achieve this goal, studies were undertaken, given in this article, which is the starting point for selecting characters representative for our targets.

The results presented in this study reveal a pronounced genetic polymorphism showing the selection operation can use the original material for a quantitative and qualitative differentiation of valuable genotypes that could be approved.

Keywords: *Echinacea purpurea,* variability coefficient, leaf, inflorescence, multiple usage

INTRODUCTION

The species *Echinacea purpurea* (L.) Moench is famous for its immune stimulatory effects [17, 19], for treating conditions such as dizziness, sore throat or teeth pain [11], candidiasis [7] etc. Moreover it is recognized for its antitumor [5], inflammatory [13] effects and because it improves resistance against viruses that cause influenza [18] and vesicular stomatitis virus [4].

Before modern antibiotics, the species was successfully used as anti-infective agent [8]. Lately, the literature has placed *Echinacea* species among the plants most widely used in the United States and Europe, being included in treatments for recurrent genital herpes [21], acute upper respiratory infections and tract [16].

It is a perennial herb, in the form of bush. Stems are branched and the leaves are at the basal ovate or ovate lanceolate (rarely lanceolate), with toothed edges, and embossed on the culinary ones.

The blossoming has conic receptacle, hemispheric or flat and contains ligulate dark pink or purple flowers on. Pollen is yellow and the fruit is an achenes.

The vegetal product contains, in varying degrees, depending on the species and organ: polysaccharides, volatile oil, fitosterine, starch, saponins, reducing sugars, pentozani, echinacea, echinolona, echinacina, echinacea B, minerals etc. [16].

Medicinal species of the *genus Echinacea* use as raw materials the roots (radix *Echinacea*) and the upper side (*Echinacea* herba).

Typically, *Echinacea purpurea* (L.) Moench is cropped for its upper side, and *Echinacea pallida* Nutt. for its roots. From the medical point of view at *Echinacea purpurea* (L.) Moench species we are highly interested in the production of "herba", because from this part of the plant are extracted active ingredients used in pharmaceutical industry. In terms of decorative qualities there are very important the leaves and flowers. These things have led to the analysis of both the characters, related to leaf and those related to inflorescence [20].

In order to provide quality raw material, in terms of economic efficiency for various commercial products, it is recommended to use for planting varieties that prove better crop characteristics, perfectly adapted to the climatic condition of the crop area. In this regard have been initiated a series of experiments that can be the basis of promoting an improvement program for this species. In this study it was considered appropriate to choose for measuring leaf and flower operations.

MATERIALS AND METHODS

In a strict breeding program, you first need to make the qualitative assessment and to describe the utility characteristics. In order to determine the multiple value of using species *Echinacea purpurea* (L.) Moench, it was considered the study of phenotypic variability at leaf-level and inflorescence.

Biological material was provided by National Institute of Research and Development for Potato and Sugar Beet - Laboratory of Medicinal Plants, Brasov, in the form of plants obtained the former year. They were transplanted in April in the greenhouse, in pots of 16 cm diameter filled with a mixture of peat with leaves and soil; they were thoroughly watered for 20 days. On 10^{th} of May, when plants were 15-18 cm and 5-6 leaves, random planting took place in five repetitions of 18 plants, each in small parcels 1.5 m x 1 m. Planting distances were 50 cm between rows and 30 cm between plants in the row, providing a density of about 65 thousand plants per hectare [10, 20].

Throughout all planting period, we carried out hoeing and weeding between rows, to keep the soil clean from weeds and loose soil. Also, until blooming there were carried out biological purification, thus removing the plants growing atypically, with weak development and the sick ones.

Plants subject of measuring operations, were grouped into ten classes, according to the recorded performances. Numbering was made as follows: G_1, G_2, G_3, G_4, G_5, G_6, G_7, G_8, G_9 and G_{10}.

Productivity and adaptability of the *Echinacea* species, in the current economic environment, is the main objective proposed by the breeder [12, 14].

Production capacity is a very complex biological feature of horticultural plants. The hereditary basis is the one which causes, to a great extent, the appearance of productivity elements, such as: number of leaves, leaf length and width, height and number of stems, inflorescence, flowering intensity, binding degree, number of seeds. For this, there were done measurements using as reference point the leaf (number, limb length, limb width) and the inflorescence (height and width), direct genetic parameters: mean, variance and standard deviation ($\bar{x}$, s^2, s) and derived genetic parameters: coefficient of variability (s%) [1] – shown in synthetic tables.

RESULTS

Technical literature recommends, through describing the working methods for genotypes selection, in order to capitalize on available hereditary potential, and amelioration techniques, a strict evaluation of phenotypic variability [14]. Variability of biological material gives us information on opportunities in the ongoing operation of amelioration, in order to obtain new varieties, differentiated in terms of somatic heterosis, reproductive and suitability for different operating modes (medicinal, decorative, culinary etc.) [12, 15]. Data obtained from measurements, suggest the degree of heterogeneity of the analyzed material. This data has been summarized in Table 1. Analysis of this table reveals the performance classes of individuals who have registered the highest values for each parameter measured.

Thus the largest number of leaves was recorded at 72-leaf class G_1, well above the lowest grade highlighted, G_7 with 25 leaves. For foliar leaf length, the lowest value was 13.47 cm obtained at G_8 class, much different from the highest grade of 19.3 cm in G_1. For leaf width, G_8 recorded the best performance, with the lowest value of 20.30 mm, much different than the G_1 with a maximum of 57 mm. A greater number of leaves per plant and also, the largest width of leaves, are important characteristics of foliar mass.

For highest inflorescence height, the greatest value was 31 mm, registered in class G_1, well above the lowest grade recorded 16 mm G_8. When measuring the width of inflorescence, G_4 class had the lowest level of 19 mm and, in the opposite side, G_7 class had the highest level of 28 mm.

Table 1. Values of the main morphological characteristics recorded at plants of *Echinacea purpurea*(L) Moench

No.	*Echinacea purpurea*(L) Moench	Leaf			Inflorescence	
		Number	Foliar leaf length (cm)	Foliar leaf width (mm)	Height (cm)	Width (cm)
1	G_1	72	19.3	57	31	27
2	G_2	54	17.95	36.30	28	25
3	G_3	61	18.40	63.80	23	21
4	G_4	29	14.33	23.40	21	19
5	G_5	69	17.22	34.60	29	26
6	G_6	28	14.11	26.90	25	21
7	G_7	25	17.25	33.50	31	28
8	G_8	39	13.47	20.30	16	22
9	G_9	47	15.93	41.10	19	23
10	G_{10}	41	15.80	27.2	17	22

The variation coefficient was calculated and recorded in Table 2. Interpretation was done according to instructions given by the literature, considering that the frequency distributions that have a coefficient of variation less than 10% shows a small variation, medium variation is for those who have a coefficient of 10-20% and the ones with a figure of over 20% have a large variation [2].

In Table 2 we can see that the number of leaves recorded a large amount of variability, of 36.7%. Somatic heterosis, expressed through the length of middle leaf, has a variance of 12.02%. High values were recorded medium at foliage leaf, of 38.97% and inflorescence height of 23.57%. Inflorescence width recorded a mid-value of 12.61%.

Table 2. Direct genetic parameters (mean. variance and standard deviation) and derived genetic parameters (coefficient of variability) calculated for productivity elements variance at *Echinacea purpurea* (L.) Moench groups.

Type		Variance S^2	Mean ± Standard Deviation	Variability Coefficient s%	Significance
Leaf	Number	291.17	46.51± 7.06	36.70	large variation
	Foliar leaf length (cm)	3.88	16.4±1.97	12.02	medium variation
	Foliar leaf width (mm)	201.33	36.4±14.19	38.97	large variation
Inflo-res-cence	Height (mm)	32.00	24.0±5.66	23.57	large variation
	Width (mm)	8.71	23.4±2.95	12.61	medium variation

DISCUSSIONS

In this program, the interest is focused on organ depicting characters with values of multiple usages. In an overall analysis we can say that there were recorded big and medium values at all the characters subject for measuring operation, both those related to leaf and those related to inflorescence.

In regards the number of leaves per plant at *Echinacea purpurea* (L.) Moench species, previous reports made by Banga and Ardelean (2008), show that best performances are obtained at the ones originate

from United States [3]. A large number of leaves does not mean a high production of herba, but instead may be interesting to enhance the decorative effects which reported by Miller in 2004 [9]. Thus, the nominal value reported is slightly above the one described in this article [3]. However the high value of coefficient of variability in the number of leaves suggests the premises of some successful selection work to improve this character.

Concerning the measurements regarding leaf size, good performance of the coefficient of variability was obtained in leaf width. In this case, the values here are close to those reported by Muntean (2007) [10]. The coefficient of variation has a value (38.97) that can be improved, giving a chance for breeding works.

Flowering width values ranging between 19 and 28 cm are encouraging as higher values of up to 18 cm, reported by Hetman in 1996 after studies in Poland [6]. Vârban (2001) [20] shows that at a corresponding density development, inflorescence will have a good evolution, being able to record performance in terms of height. Inflorescence height values obtained from analysis emphasizes the decorative value of G_1 and G_7 genotypes and 31 cm or G_5 and G_2 with 29 and 28 cm. We recommend them to be used successfully in the arrangement of green spaces in combination with other perennial species with similar sizes *Gaillardia picta*, *Dianthus chinensis*, *Aquilegia vulgaris*, *Lavandula angustifolia*, *Aster amellus*.

In the present experiment, high coefficient of variability calculated for inflorescence height, suggests the possibility of obtaining genotypes with large decorative valences, but also with good performances in their work of seed production.

By viewing all the data obtained, it shows that the biological starting material, the 10 classes have been grouped plants of *Echinacea purpurea* (L.) Moench, is characterized by an increased genetic polymorphism. General analysis of the data presented in this study highlight that variability can be correlated with a high selection pressure for improvement in future works of this species. Using the selection of original material will provide the future possibility of phenotypic and genetic differentiation, in terms of quantity and quality of valuable genotypes suggests that we can later be tested in ISTIS network.

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