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CORRELATIONS BETWEEN THE VEGETATIVE AND DECORATIVE INDICATORS IN *CALLISTEPHUS CHINENSIS L.* BY TYPE OF CULTIVATION

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Abstract

Callistephus chinensis is widely used variety of species for the production of cut flowers and shaping of colorful annual groups in landscaping. The control of plant height, size and number of clusters are the basis of a large number of studies. The objective of this article is to trace the correlation changes of these and other groups of vegetative and decorative indicators according to the way of plant cultivation. The analysis of the correlations shows that they have highly interrelated variable values . With their help we can predict the changes in the key indications depending on the change of the correlative related indicators.

Key words*: Callistephus chinensis, China asters, correlation analysis, farming.*

INTRODUCTION

The rich colour range, interesting configuration of clusters and varying amount of flowering stems determine the annual asters *Callistephus chinensis* an attractive species both for the production of cut flowers and for landscaping. The establishment of an optimal way of growing is basic prerequisite for manifestation of the morphological and productive capacities of the plants. In our country there are no systematic studies in this direction. The recommendations of our authors (Vitanova et al., 2011; Nikolova, 1999) are based on own research, practical and foreign experience. According to them the seedlings way is most common in the practice. In her study Varbanova (1994, 1995) defines the direct way of growing as better to the growing of asters through seedlings, because plants are characterized by a prolonged period of flowering and the best quality of the cut flowers. Results obtained by Wegfrass (1982) show that with direct sowing a larger number of cut flowers of asters is obtained and it prevents the occurrence of fungal diseases. In our other studies (2011) plants grown by direct sowing are characterized by more compact dimensions of the bush, a smaller diameter of inflorescences and lower productivity expressed by the number of standard inflorescences in comparison to the plants grown through seedlings. The study of the correlation between the main vegetative and decorative signs of China aster enables an adequate planning of the technology for growing plants and in particular, their method of cultivation.

The objective of the study is to establish the existence of correlations between basic morphological characteristics in annual asters.

MATERIALS AND METHODS

During the period of investigation (from 2010 to 2012 year) in the Institute for Plant Genetic Resources (IPGR) - Sadovo, two varieties of asters (Princess sylvis and Harzyrus) were tested. Plants are grown by pre-production of seedlings in unheated greenhouses and direct sowing of seeds in the adopted country for technology (Nikolova, 1999). Plants are grown by pre-production of seedlings in unheated greenhouses and by direct sowing of seeds according to the technology adopted by the country (Nikolova, 1999). The experience is set in the block method in 4 repetitions with size of the test plot 3.5 m^2. The reported parameters are for plant height, length of 1st order branches, number of leaves, volume of the root system, etc. The data are processed through a correlation analysis, as its reliability is assessed

by criteria t on the table of Student (Zapryanov and Dimova, 1995).

RESULTS AND DISCUSSIONS

Tables 1, 2 show all the possible correlation coefficients between the parameters plant height, length of 1st order branches, number of leaves, volume of the root system, the diameter of the inflorescence and number of 1st order clusters of the variety Princess sylvis. No significant differences can be observed in the values of the correlation coefficients according to the method of growing plants. Regardless of the growing the height of the plants is highly correlated (0.84^{+++}; 0.839^{+++}) in relation to the length of the 1st order branches, as a result of which it can be assumed that the higher plants respectively form longer flowerings.

Table 1. Correlation coefficients of the variety Princess sylvis in seedling growing of plants GD (95% - 2.447; 99% - 3.707 and 99.9% - 5.959).

Parameters	Plant height	Length of 1st order branches	Number of leaves	Volume of the root system	Diameter of the inflorescence	Number of 1st order clusters
Plant height	-	0.84^{+++}	0.842^{+++}	0.718^{+}	0.892^{+++}	0.628^{+}
Length of 1st order branches		-	0.881^{+++}	0.441^{ns}	0.724^{++}	0.533^{ns}
Number of leaves			-	0.527^{ns}	0.676^{+}	0.829^{+++}
Volume of the root system				-	0.515^{ns}	0.629^{+}
Diameter of the inflorescence					-	0.44^{ns}
Number of 1st order clusters						-

Table 2. Correlation coefficients of the variety Princess sylvis in direct sowing cultivation GD (95% - 2.447; 99% - 3.707 and 99.9% - 5.959).

Parameters	Plant height	Length of 1st order branches	Number of leaves	Volume of the root system	Diameter of the inflorescence	Number of 1st order clusters
Plant height	-	0.839^{+++}	0.84^{+++}	0.85^{+++}	0.925^{+++}	0.876^{+++}
Length of 1st order branches		-	0.844^{+++}	0.778^{++}	0.971^{+++}	0.94^{+++}
Number of leaves			-	0.745^{++}	0.918^{+++}	0.89^{+++}
Volume of the root system				-	0.856^{+++}	0.759^{++}
Diameter of the inflorescence					-	0.969^{+++}
Number of 1st order clusters						-

A very strong positive relationship is detected with provability GD-0.01% between plant height and number of leaves per plant, with correlation coefficients 0842^{+++} in seedling growing of plants and 0.84^{+++} in direct sowing cultivation. Analogous proportion dependence and high correlation is revealed between plant height and diameter of clusters. This shows that higher plants form larger clusters. Plant height is also positively correlated with the number of 1st order clusters and the volume of the root system, as the obtained coefficients in direct sowing cultivation has the highest level of provability (GD - 0.01%, respectively 0.876^{+++} and 0.85^{+++}), while in seedling cultivation the provability is at GD - 5%.

Well to very well proven is the correlation between the length of the 1st order branches, the number of leaves per plant and the diameter of clusters, which is completely logical and

determines the quality of the cut flowers. In plants grown through direct sowing the length of the 1st order branches is from moderate to high correlation with the volume of the root system (0.778^{++}) and with the number of 1st order clusters formed (0.94^{+++}) while the plants grown through seedlings in these indicators the correlation is moderate and unproven.

Unproven and moderate is the relationship between the number of leaves and the volume of the root system. It is found that through seedling plants cultivation the formed foliage is slightly influenced by the volume of the root system (0.527ns), while plants grown by direct sowing form more foliage in greater volume of the root system as the correlation coefficient for this type of growing has high values - 0745^{++} and provability at P1%. The larger amount of leaves has a proven high dependability and a larger number of inflorescences of 1st order plants, regardless of the type of growing.

For the first time in asters, this study observes the impact of the lower volume of the root system on the formation of a smaller number of clusters in a direct way of cultivation. In confirmation, highly positive is the relationship -0.759^{++} between the two indicators, proven with a high level of GD - 0.1%. A strong correlation is observed in the direct sowing and between the volume of the root system and the diameter of the clusters (0856^{+++}), and between the diameter and number of 1st order inflorescences of (0969^{+++}).

In seedling plant cultivation there is a moderate to significant correlation between the volume of the root system, the diameter of the clusters and the number of 1st order inflorescences, but it is unproven to poorly proven at P5%.

Similar in magnitude are also the calculated correlation coefficients between the said signs and in the variety Harzyrus (Table 3, 4).

Table 3. Correlation coefficients of the variety Harzyrus in seedling growing of plants
GD (95% - 2.447; 99% - 3.707 and 99.9% - 5.959)

Parameters	Plant height	Length of 1st order branches	Number of leaves	Volume of the root system	Diameter of the inflorescence	Number of 1st order clusters
Plant height	-	0.654^{+}	0.966^{+++}	0.632^{+}	0.982^{+++}	0.99^{+++}
Length of 1st order branches		-	0.76^{++}	0.269^{ns}	0.618^{+}	0.605^{ns}
Number of leaves			-	0.645^{+}	0.974^{+++}	0.967^{+++}
Volume of the root system				-	0.668^{+}	0.63^{+}
Diameter of the inflorescence					-	0.995^{+++}
Number of 1st order clusters						-

Table 4. Correlation coefficients of the variety Harzyrus in direct sowing cultivation
GD (95% - 2.447; 99% - 3.707 and 99.9% - 5.959)

Parameters	Plant height	Length of 1st order branches	Number of leaves	Volume of the root system	Diameter of the inflorescence	Number of 1st order clusters
Plant height	-	0.967^{+++}	0.937^{+++}	0.599^{us}	0.98^{+++}	0.983^{+++}
Length of 1st order branches		-	0.851^{+++}	0.537^{ns}	0.914^{+++}	0.98^{+++}
Number of leaves			-	0.808^{++}	0.965^{+++}	0.888^{+++}
Volume of the root system				-	0.646^{+}	0.53^{ns}
Diameter of the inflorescence					-	0.932^{+++}
Number of 1st order clusters						-

In seedling plant cultivation the plant height correlates strongly with the number of leaves, inflorescence diameter and number of 1st order inflorescences. The larger number of leaves is in a strong positive correlation with the diameter and number of 1st order inflorescences, as it provides greater feeding (photosynthesizing) surface. Characteristic of the variety are the large flowers and large number of 1st order inflorescences, which is also reflected in the established strong positive correlation coefficient of the relationship between them. The height of the plants grown in a direct way has a strongly expressed proven correlation with the length of the 1st order branches (0.967^{+++}), number of leaves (0.937^{+++}), diameter of clusters (0.98^{+++}) and number of 1st order clusters (0983^{+++}), and moderately expressed with the volume of the root system (0.599ns).

Longer 1st order flowerings determined a large number of leaves, a larger number of 1st order clusters, and clusters with a greater diameter and vice versa. Such relation is established by the coefficients in the studied indicators. Low proven is the influence of the length of flowering on the volume of the root system. It is rather highly determinative of the number of leaves and diameter of clusters. In the seedling cultivation as well as in the direct sowing, the greater mass of the leaves is in a very high correlation with the diameter of the inflorescence (0.965^{+++}), and the number of 1st order clusters (0.888^{+++}). The change of the indicator diameter of the cluster will lead to a change in the number of 1st order clusters, because between them there is very high correlation dependence, proven at the highest level of GD - 0.01%, with a coefficient of 0995^{+++}.

CONCLUSIONS

Plant height is highly correlated to the length of the 1st order branches, the diameter of the clusters and the number of 1st order inflorescences of a plant, as a result of which it can be assumed that the higher plants respectively form a greater number of longer flowerings with larger clusters.

The larger amount of leaves has proven to be in high correlation with the larger number of 1st order clusters of plants, regardless of the type of cultivation.

The smaller volume of the root system affects the formation of a fewer clusters in a direct way of cultivation.

Similar in magnitude are also the calculated correlation coefficients between these indications of plants of the variety Harzyrus.

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