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Biomorphological traits of *Callistephus chinensis* (L.) Nees cultivars under conditions of the Central Forest-Steppe zone of Ukraine

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Purpose. Determining prospects of introducing *Callistephus chinensis* cultivars of foreign breeding for further cultivation under conditions of the Central Forest-Steppe zone of Ukraine. **Methods.** Field, laboratory, analytical and statistical ones. **Results.** Ten *C. chinensis* cultivars of the German breeding were tested under conditions of the Central Forest-Steppe zone of Ukraine. Biomorphological traits of the varieties of five sort types were identified, and their comparative analysis was conducted. Seasonal dynamics of growth and development of cultivars in the growing area was studied. **Conclusions.** Cultivars with short and mean duration phases of development can be grown under conditions of the Central Forest-Steppe zone of Ukraine by direct sowing that does not affect their seed productivity and sowing quality of seeds. Seeds of late cultivars can reach complete maturity only in case of seedling use. *C. chinensis* cultivars of the German breeding have successfully passed the initial test for suitability to introduction into the studied area.

Keywords: *Callistephus chinensis*, cultivar, introduction, phenophases, decorative quality, seed productivity.

Introduction. Among the annual floriculture decorative cultigens one of the advanced places is taken by the annual aster (*Callistephus chinensis* (L.) Nees), that is rather popular both among specialists and amateurs in the sphere of floriculture. As the result of breeding work the *C. chinensis* assortment consists of more 4 thousand cultivars that are divided into 44 sort types by morphological features of inflorescence structure and ligulate flower shape. The scientific studies of these floriculture decorative cultigens in Ukraine are held in National botanic garden named after M. M. Hryshko that is a property of Ukrainian National Academy of Science. There is a collection of approximately 200 cultivars in the garden. Since 1967 the sorts studying and new cultivars working out has been done by Ukraine NAS Institute of horticulture. The cultivars are suitable for production growing, they have an advanced seed productivity and stability against the fusarium wilt. Their collection fund consists of 116 cultivars and 180 bred hybrids.

The spectrum of annual aster using in gardening is rather wide. It is used to decorate the rabattes, curbs, mixed borders, in module flower gardens constructing, making flower arrays or as a solitary plant. Asters can be decorative flowers for rooms, balconies, verandas. The main obstacle for the wide implementation of modern cultivars into the productive floriculture is almost complete absence of *C. chinensis* elite seedling in Ukraine. As the result, the native market has been overfilled with the seeds of foreign origin

(Germany, Czech, Poland, China). The quality of unzoned cultivars seeds and the decorativeness of the grown plant not always satisfy the consumer expectations.

The reaction of cultivars on the new edaphic and climatic conditions of the growing zone can be observed as the deviations of season growth and development rhythm and its sort characteristics by the main decorative features: plant height, inflorescence diameter, the degree of its doubling. The introduction cultivars more often used to be damaged by the fusarium wilt that significantly reduces their seed productivity.

As far as this matter is concerned, **the purpose of the study** is to determine the prospects of introducing *Callistephus chinensis* cultivars of foreign breeding for further cultivation in the conditions of Ukrainian midland Forest steppe. The studies were based on biological, morphological peculiarities and seed productivity of the plants. Such studies are significant for predicting the prospects of spreading the *C. chinensis* cultivars in the certain edaphic and climatic conditions.

Materials and methods of the study. Within 2011–2013 the investigation of 10 German breeding cultivars took place on the territory of Bila Tserkva NAS decorative seedling-plot. The initial seedling material has been got from the originator: German company of Christensen GmbH (the city of Erfurt, Germany). The investigated cultivars belong to the following five sort types: Princess ('Davina', 'Marcia', 'Sylvia', 'Helberg', 'Hilda'), Peon-like ('Roter Turm'), Pygmy Royal ('Erfurt Pygmy Violet',

‘Erfurt Pygmy Rose’), Artistic (‘Hollander’), La-Plata (‘Astoria Rose’). The seedling method of growing has been used. The agrotechnical measures of looking after the plants has been used according to the recommended sources [3, 4]. *C. chinensis* season sort development has been studied according to the methodological recommendations of I. M. Beidman [5] and the System of phenological observations in the botanic gardens of USSR [6]. To evaluate the seed productivity the system of I. V. Vaynagiy has been used [7]. The seeds sowing quality has been estimated according to the state standards of DST 12260-81 [8] and the International rules of seeds analysis [9]. The statistics process of experimental data has been done according to G. N. Zaytsev system [10].

Results of the study. One of the plants introduction success indicators is season development dynamics. according to phenological observations, the early shoots appeared in the 7–10th day (tab. 1). In the conditions of the research zone the budding phase has come in the second decade of July (‘Roter Turm’, ‘Astoria Rose’, ‘Erfurt Pygmy Rose’, ‘Erfurt Pygmy Violet’, ‘Hollander’), the Princess sort type cultivars have their budding phase in the third decade of July. The blossom has be-

gun correspondingly in the second decade of August. The longest blossom period was inherent to ‘Davina’ and ‘Marcia’ cultivars. Their term was 42–47 days. Such long and plentiful blossom, which maximum phase is in the late terms, emphasizes *C. chinensis* among the most introduced in Ukraine floriculture decorative cultigens and gives the opportunity to distinguish them as specially valuable plants for the late summer and autumn periods assortment enrichment. This peculiarity can be used in the non-stop blossom flower gardens planning.

During the process of studies it is established that the period between the blossom phases of ‘Astoria Rose’, ‘Hollander’, ‘Roter Turm’, ‘Erfurt Pygmy Violet’, ‘Erfurt Pygmy Rose’ took place for 124–136 days. These are the cultivars of short and middle term development phases that can be grown in the conditions of Ukrainian midland Forest steppe with a no-seedling method that doesn’t influence their seed productivity and seeds sowing quality. The length of “shoot–blossom” period of Princess sort type is 146–150 days. These cultivars can have their complete blossom under conditions of seedling cultigens only.

The studying of morphological features of the plants shows the height and shape of a

Table 1

C. chinensis cultivars phenological observations data (2011–2013)

Cultivar	Sowing data	Shoots appearance	Seedling mass implant	Budding		Blossom				Complete ripening		Length of phases, days		
				Beginning	End	Beginning	Mass blossom	End	Complete loss of decorativity	Beginning	End	Budding	Blossom	Complete ripening
‘Davina’	26.03 ±2,8	03.04 ±2,3	22.05 ±3,4	26.07 ±3,1	11.08 ±3,9	12.08 ±3,2	27.08 ±3,0	24.09 ±4,6	27.09 ±2,2	28.09 ±3,1	30.10 ±3,2	17 ±2,8	44 ±2,4	33 ±1,6
‘Marcia’	»	03.04 ±2,4	30.05 ±3,2	27.07 ±3,7	12.08 ±3,7	13.08 ±3,0	30.08 ±3,3	26.09 ±4,2	29.09 ±2,6	30.09 ±3,0	31.10 ±3,6	17 ±2,4	45 ±2,6	32 ±1,8
‘Sylvia’	»	05.04 ±2,1	25.05 ±2,8	29.07 ±3,0	15.08 ±3,0	16.08 ±3,1	29.08 ±4,1	22.09 ±4,8	26.09 ±2,4	27.09 ±3,8	29.10 ±2,8	18 ±2,2	38 ±2,0	33 ±2,0
‘Helberg’	»	05.04 ±2,8	23.05 ±2,7	26.07 ±3,6	12.08 ±3,1	13.08 ±3,3	27.08 ±4,0	20.09 ±4,0	25.09 ±2,8	26.09 ±4,0	28.10 ±3,2	17 ±2,0	39 ±2,2	32 ±2,0
‘Hilda’	»	04.04 ±2,7	28.05 ±3,0	28.07 ±3,2	14.08 ±3,0	15.08 ±3,4	30.08 ±3,5	22.09 ±3,1	24.09 ±3,0	25.09 ±3,5	26.10 ±3,0	18 ±1,9	39 ±1,4	32 ±1,8
‘Roter Turm’	31.03 ±2,4	08.04 ±2,3	17.05 ±2,1	12.07 ±3,4	30.07 ±3,2	31.07 ±2,5	22.08 ±3,1	10.09 ±3,3	16.09 ±2,2	17.09 ±3,2	18.10 ±3,7	16 ±2,5	41 ±1,6	32 ±1,5
‘Erfurt Pygmy Violet’	»	07.04 ±2,5	18.05 ±2,4	11.07 ±3,2	22.07 ±3,6	23.07 ±2,8	12.08 ±3,0	01.09 ±3,0	07.09 ±2,0	08.09 ±3,1	09.10 ±3,2	13 ±1,8	40 ±1,4	31 ±1,2
‘Erfurt Pygmy Rose’	»	07.04 ±2,5	18.05 ±2,4	11.07 ±3,2	22.07 ±3,6	23.07 ±2,8	12.08 ±3,0	01.09 ±3,0	07.09 ±2,0	08.09 ±3,1	09.10 ±3,2	13 ±1,8	40 ±1,4	31 ±1,4
‘Hollander’	»	08.04 ±2,4	15.05 ±2,5	15.07 ±3,8	29.07 ±3,1	31.07 ±2,3	24.08 ±2,7	08.09 ±3,4	20.09 ±2,2	21.09 ±3,0	21.10 ±3,5	15 ±1,5	40 ±1,3	32 ±1,4
‘Astoria Rose’	»	08.04 ±2,2	16.05 ±2,6	12.07 ±3,1	24.07 ±3,0	25.07 ±3,0	12.08 ±3,0	02.09 ±3,3	10.09 ±2,3	11.09 ±3,2	10.10 ±3,1	13 ±2,0	39 ±1,8	30 ±1,1

bush, colour and doubling degree of the investigated sorts were in frame of sort characteristics (tab. 2). Column-like bush shape and firm shoots were inherent to 'Roter Turm', 'Hollander', 'Astoria Rose'. The average inflorescence

diameter was between 4.3 cm ('Helberg') and 12.5 cm ('Hollander'). The inflorescence diameter of 'Davina', 'Marcia' and 'Sylvia' cultivars was significantly reduced up to 1.5–2.0 cm comparing with their sort characteristics.

Table 2

***C. chinensis* cultivars characteristics according to morphological features (2011–2013)**

Cultivar	Bush height, cm	Bush shape	Inflorescence colour	Inflorescence diameter, cm	Inflorescence doubling	Quantity of simultaneously blossoming inflorescences, units	Plants standardity, %
'Davina'	55,5–58,5	wide	salmon	8,5–8,8	densely double	8–10	92
'Marcia'	52,3–54,2	wide	red	7,2–7,4	densely double	8–12	90
'Sylvia'	59,0–60,1	wide	red	7,1–7,3	densely double	7–10	91
'Helberg'	49,4–52,2	column-like	light-yellow	4,3–4,8	densely double	8–18	90
'Hilda'	47,4–48,2	column-like	light-yellow	7,5–7,8	densely double	10–16	93
'Roter Turm'	55,6–56,4	column-like	dark-red	6,6–6,8	densely double	3–5	89
'Erfurt Pygmy Violet'	31,6–32,5	wide	pink	6,0–6,3	double	6–8	91
'Erfurt PygmyRose'	31,4–32,4	wide	violet	6,1–6,5	double	6–8	91
'Hollander'	52,1–54,2	wide	pink	12,2–12,5	double	4–6	92
'Astoria Rose'	60,5–62,3	column-like	pink	6,8–7,0	half double	6–8	95

All investigated cultivars had a high percent of typical plants: 89–95% that witnesses about high seeds quality that has been got from the originator, and about the stability of cultivars.

The seed productivity is one of the most important agricultural indices that shows the degree of cultivar adaptivity in certain living conditions and their stability against the external factors. The received data analysis (Tab. 3) gives the opportunity to say about the significant difference between the received indices of the different sort types cultivars. It is distinguished that the highest indices of seed productivity are inherent to Princess sort type cultivars. In the process of seeds quality indices distinguishing it turned that the high (more than 80%) laboratory similarity was inherent to the following cultivars: 'Davina',

'Marcia', 'Sylvia', 'Hilda' (Princess sort type); 'Roter Turm' (Peon-like sort type). The seeds of Astoria Rose plants are characterized by the lowest sowing quality.

Thus, as the received data shows, *C. chinensis* cultivars of German breeding had a high genetically determined potential of seed productivity that can be realized satisfactory in our conditions that gives the opportunity to belong it to the high productivity and suitable for growing in production quantity.

Conclusions. The investigated *C. chinensis* cultivars of German breeding in conditions of Ukrainian midland Forest steppe have saved their sort characteristics. The data about the peculiarities of phenological phases and high reproduction ability of cultivars witness about the success of their cultivating. The high indices of seed productivity and blossom in the late summer and autumn months give the ground to consider the Princess sort type cultivars as highly perspective for the practical use in the research zone.

Table 3

***C. chinensis* seed productivity and sowing quality (2011–2013)**

Cultivar	Seed weight out of one plant, g	Weight of 1000 seed pieces, g	Laboratory similarity of seeds, %
'Davina'	2,34±0,09	1,84±0,14	88,2±1,8
'Marcia'	2,25±0,07	1,77±0,12	84,0±1,2
'Sylvia'	2,36±0,05	1,83±0,09	87,8±1,1
'Helberg'	2,36±0,11	1,91±0,21	79,6±1,4
'Hilda'	3,01±0,06	2,12±0,18	86,2±2,0
'Roter Turm'	1,89±0,07	1,70±0,12	86,4±1,6
'Erfurt Pygmy Violet'	1,82±0,12	1,03±0,08	78,5±1,2
'Erfurt PygmyRose'	1,85±0,13	1,04±0,11	79,0±2,1
'Hollander'	1,71±0,05	0,93±0,10	78,2±1,3
'Astoria Rose'	1,15±0,07	0,87±0,09	75,5±1,8

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С. М. Левандовська. Біоморфологічні особливості культиварів *Callistephus chinensis* (L.) Nees в умовах центрального Лісостепу України // Сортовивчення та охорона прав на сорти рослин. – 2015. – № 3–4 (28–29). – С. 29–32.

Мета. Визначення перспективності інтродукції культиварів *Callistephus chinensis* зарубіжної селекції для подальшого культивування в умовах центрального Лісостепу України. **Методи.** Польовий, лабораторний, аналітичний та статистичний. **Результати.** Проведено сортовипробування десять культиварів *S. chinensis* німецької селекції в умовах центрального Лісостепу України. Встановлено біоморфологічні особливості сортів п'яти сортотипів, проведено їх порівняльний аналіз. Вивчено сезонну динаміку росту та розвитку культиварів у досліджуваній зоні вирощування. **Вис-**

новки. Культивари з коротко- й середньотривалими фазами розвитку в умовах центрального Лісостепу України можна вирощувати безрозсадним способом, що не впливає на їхню насінневу продуктивність та посівні якості насіння. Повне досягання насіння у пізніх сортів можливе лише за умов розсадної культури. Культивари *S. chinensis* німецької селекції успішно пройшли первинне інтродукційне випробування в досліджуваній зоні.

Ключові слова: *Callistephus chinensis*, культивар, інтродукція, фенофази, декоративність, насіннева продуктивність.

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Цель. Определение перспективности интродукции культиваров *Callistephus chinensis* зарубежной селекции для дальнейшего культивирования в условиях центральной Лесостепи Украины. **Методы.** Полевой, лабораторный, аналитический и статистический. **Результаты.** Проведено сортоиспытание десять культиваров *S. chinensis* немецкой селекции в условиях центральной Лесостепи Украины. Установлены биоморфологические особенности сортов пяти сортотипов, проведен их сравнительный анализ. Изучена сезонная динамика роста и развития культиваров в исследуемой зоне выращивания. **Выводы.** Культивары с мало- и

среднепродолжительными фазами развития в условиях центральной Лесостепи Украины можно выращивать безрассадным способом, что не влияет на их семенную продуктивность и посевные качества семян. Полное созревание семян у поздних сортов возможно лишь при условии рассадной культуры. Культивары *S. chinensis* немецкой селекции успешно прошли первичное интродукционное испытание в исследуемой зоне.

Ключевые слова: *Callistephus chinensis*, культивар, интродукция, фенофазы, декоративность, семенная продуктивность.

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