



# MORPHO-BIOLOGICAL FEATURES AND PRODUCTIVITY OF THE ARTICHOKE IN THE CONDITIONS OF THE SOUTH OF UZBEKISTAN

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## ABSTRACT

The article is dedicated to the results of research on the introduction of artichoke in the conditions of Uzbekistan. It was revealed that artichoke plants grow and develop well, form mature seeds during the growing season. The manifestation of morphobiological and farm-valuable traits largely depends on the age of the plants. A significant reduction in the growth period, an increase in plant height and number of stems, an increase in average weight and number of inflorescences and, ultimately, the yield occur in the second year of plant life. It was also determined that the potential productivity of artichoke plants in the condition of Uzbekistan is very high. The yield of the cultivar Krasavets is 55.5 t/ha in the second year of life, for the Green Globe cultivar – 39.2 t/ha. This is significantly higher worldwide.

During the research, some issues of artichoke seed production in the dry subtropics of Uzbekistan were also studied. The studies were carried out on the cultivar Krasavets. When identifying the most effective method of forming a seed cluster, we compared the cultivation of seed plants without formation and 4 methods of formation: 1 stem per plant and three inflorescences per stem, 2 stems per plant and three inflorescences each, 3 stems per plant and three inflorescences each, 4 stems per plant and three inflorescences each. The highest seed productivity was noted in the variant without the formation of a seed plant: 734.2 g/plant or 15789 seeds/plant. However, in terms of such indicators as the mass and number of seeds from one inflorescence, the mass of 1000 seeds of a plant without formation is significantly inferior to other options. Based on the results of experience, the variants 3, 4, 5 can be considered appropriate to use in artichoke seed production.

**KEYWORDS:** artichoke, phenology, inflorescence, productivity, mass and number of inflorescences, interphase periods, growing season, plant height, seed production.

## INTRODUCTION

Artichoke (*Cynara cardunculus* L. subsp. *scolymus* (L.) Hayek.) is native to Mediterranean, where its wild population is still occupy vast area. Since the XVI - XVII centuries, the artichoke has been cultivated in all Mediterranean countries [1, 2].

Artichoke is a plant of the Asteraceae family, widespread in almost all Mediterranean countries, as

well as in France, Spain, the USA, Canada, Argentina and so on. It is cultivated in the southern regions of Russia - in the Krasnodar territory and in the North Caucasus [2].

According to the data of FAO, in 2013 the artichoke sown area in the world amounted to 0.131 million hectares, the average yield was 13.72 t/ha, and the volume of gross production reached 1.793 million



tons. Large artichoke producers are Italy – 0.548 million tons, Egypt – 0.391 million tons, Spain – 0.200 million tons, Peru – 0.113 million tons, Argentina – 0.106 million tons [3].

The highest yield was recorded in Argentina (24.93 t/ha), Egypt (24.10 t/ha), Cyprus (20.60 t/ha), Kazakhstan (20.0 t/ha), Peru (19.30 t/ha). California is the main artichoke producer in the United States.

In European countries, a lot of attention is paid to breeding, seed production, genetics, the development of advanced technologies for growing artichoke. In 2008, a project was launched called "European genetic resources of *Cynara* ssp." [4]. The project coordinated by the University of Tuscia (Italy) has 7 partners - three Italian (Tuscia University, CNP, ENEA), two French (BBV, GEVES) and two Spanish (Cartagena University, ITGA). The project conducts research in five areas:

1. collection of germplasm and rationalization of collection;
2. preservation of plants and DNA and their reproduction;
3. evaluation and characterization of germplasm;
4. an interactive web catalog of documentation;
5. Cynares network implementation and actions.

Only in the first area under the leadership of Dc. Macua (ITGA), 196 lines of artichoke, 34 samples of cardoon and 55 samples of wild cardoon were collected.

Much of the research on artichoke, cardoon and their wild relatives is carried out in accordance with this project.

To coordinate the work of scientists, artichoke producers and to solve the problem of this culture, the symposia are held in different countries of the world every 3 years.

The Seventh International Symposium on artichoke, cardoon and their wild congeners was held from 16 to 19 June in 2009 in the small town of Plouenan, near Saint-Pol-de-Leon, Brittany, France.

The choice of the venue for the symposium is not accidental, since 1890 Saint-Pol-de-Leon has been the largest center for the production of artichoke (70%) and cauliflower (90%) in France [5].

The IX-Symposium was held in 2015 in Argentina, the X-in 2019 in Spain. From the analysis of the works presented at these symposia, it follows that the selection work is most intensively carried out with an artichoke of the Romanesco type. The joint work of scientists from Italy, Spain and the USA made it possible to obtain promising F<sub>1</sub> hybrids on the basis of male sterility, the maintenance of which does not require biotechnological methods.

The artichoke is a dietary vegetable. It contains protein, carbohydrates, vitamins A, B, P, cynarin, inulin, fiber and other elements necessary for the human body. The use of artichoke in cooking is very varied: it is served both as a main dish and as a side dish. Pizza and salads are made from it, added to pies and bread. Some restaurants make desserts from it [6].

As a vegetable, ornamental, fodder, melliferous and medicinal plant, the artichoke is of great interest as a potential introducer in the conditions of Uzbekistan.

Previously, studies were carried out on two cultivars of artichoke in the conditions of southern Uzbekistan [7]. To the mind of the authors, the varietal characteristics of the reaction of the artichoke to the conditions of introduction were not revealed. All plants after sowing grew rapidly, developed normally and gave full seeds in the first year of life. However, further research with this culture was discontinued.

## MATERIALS AND METHODS

In 2018-2019 at the Surkhandarya scientific experimental station of the Research Institute of vegetable, melon and potato growing, the studies were carried out on the introduction of the artichoke.

The objects of research were the cultivars Krasavets (Russia) (Spinosi group) and GreenGlobe (Spain) (Romanesco group). The Romanesco group includes cultivars with spherical or close to spherical inflorescences, without sharp protrusions on the bracts and leaves. The Spinosi group includes varieties that have long, sharp projections on the bracts and leaves.

The seeds were sown on November 15, 2017 and 2018 in unheated film greenhouses. Seedlings were transplanted in the phase of 5-6 true leaves in the first decade of February. Planting scheme was 1x1 m size.

During the growing season, phenological observations, morphological description of plants, and yield accounting were carried out according to the method [8, 9].

## RESULTS AND DISCUSSION

Introductions have played an outstanding role in the history of world agriculture. Suffice it to say that countries such as the USA, Canada, Australia built their agriculture almost entirely on the introduction of foreign plants and animals [10, 11, 12].

The introduction in Uzbekistan is associated with the appearance of tomato, sweet pepper, potato and a number of other important agricultural crops, without which it is difficult to imagine our life now.

A promising direction is the introduction of new valuable species of vegetable plants, widely cultivated in various countries of the world, but little-known and therefore less widespread in Uzbekistan. These crops include the artichoke, known for its nutritional and healing properties.

The problems of plant introduction, solution of the problems of growth and successful development of plants in various soil and climatic conditions are extremely relevant issue today [13].

This article presents some of the results of research on the introduction of artichoke in the dry subtropics of Uzbekistan.

When sowing artichoke seeds in unheated film greenhouses on November 15, 2017 and 2018, single shoots of the cultivar Krasavets appeared on November



27, i.e. on the 12<sup>th</sup> day after sowing, and mass shoots appeared on December 4 and on the 20<sup>th</sup> day, respectively. In the GreenGlobe cultivar, single shoots

appeared on the 15<sup>th</sup> and mass shoots on the 22<sup>nd</sup> day from sowing (Table 1).

**Table 1**  
**Dates of phenological phases of the development of artichoke depending on the age of the plant, in 2017-2019**

Developmental phases	Cultivars		
	Krasavets	GreenGlobe	
<b>I-year of life</b>			
Shoots	10%	27.11.2017	30.11.2017
	75%	04.12.2017	06.12.2017
Repiness	10%	10.06.2018	20.06.2018
	75%	15.06.2018	28.06.2018
Flowering	10%	20.06.2018	30.06.2018
	75%	26.06.2018	05.07.2018
Full ripeness	10%	21.07.2018	30.07.2018
	75%	28.07.2018	10.08.2018
<b>II-year of life</b>			
Regrowth		25.01.2019	25.01.2019
Ripeness	10%	30.04.2019	05.05.2019
	75%	06.05.2019	10.05.2019
Flowering	10%	10.05.2019	15.05.2019
	75%	18.05.2019	22.05.2019
Full ripeness	10%	16.06.2019	20.06.2019

Depending on the age of the plants, the dates of onset and the duration of the subsequent interphase periods of the artichoke differ significantly.

In the first year of life, the beginning of the ripeness of the inflorescences (flower head) of the Krasavets variety occurs on June 10, full ripeness on June 15. In the second year of life, the onset of these phases of development occurs on April 30 and May 6, respectively. In the GreenGlobe variety, the beginning of ripeness of inflorescences in the first year of life begins on June 20, mass ripening on June 28.

Mass flowering of Krasavets cultivar of artichoke plant in the first year of life occurs on June 26, and in the second year - on May 18. In the second year of life, the onset of this phase occurs 38 days earlier than in the first year. Mass flowering of GreenGlobe cultivar of artichoke plants occurs on July 5 in the first year of life, while in the second year - on May 22. In the second year of life, the onset of this phase occurs 43 days earlier than in the first year.

When comparing the duration of the interphase periods of plants in the first and in the second year of life, it was found that in the second year of life it is significantly reduced.

In the first year of life, the period from mass shoots to the beginning of ripeness in the studied varieties made 190-197 days (Table 2). In the second year of life, the duration of this period constituted 96-101 days and decreased by 94-96 days compared to the first year of life.

This feature can be used to ensure an even supply of the artichoke crop to retail chains. First, the harvest comes from the second year crop, and then from the first years.

The period from mass shoots to the beginning of full ripeness (i.e., to seed ripening), depending on the variety, makes 231-237 days in the first year of life, while in the second year, it is 143-147 days. In the second year of life, this period is reduced by 88-90 days.

Depending on the age of artichoke plants, the morpho-biological characteristics also differ significantly (Table 3). So, in the first year of life, the height of plants of the Krasavets variety was 110 cm, and in the second year – 216 cm. The same phenomenon was observed in the GreenGlobe cultivar.

If the plants of the Krasavets variety in the first year of life form 1-2 branches, then in the second year they are 2-4 pieces. At the same time, GreenGlobe plants do not form branches regardless of age.



**Table 2**  
Duration of phonological phase of the development of artichoke in the conditions of the south of Uzbekistan, in 2017-2019

Cultivars	From mass shoots, days				
	Before the beginning of ripeness	Before mass ripeness	Before the beginning of flowering	Before mass flowering	Before full ripeness
<b>I-year of life</b>					
Krasavets	190	195	200	206	231
GreenGlobe	197	205	207	212	237
<b>II - year of life (from the beginning of regrowth)</b>					
Krasavets	96	102	106	114	143
GreenGlobe	101	107	111	118	147

The most significant differences were, in our opinion, in the number of inflorescences (flower heads). Thus, the plants of the Krasavets variety in the first year of life form from 10 to 28 inflorescences, and in the second year - from 36 to 67. The number of inflorescences of plants of the GreenGlobe variety is significantly less than in the Krasavets variety. In the GreenGlobe variety, the plants formed 9-20 inflorescences in the first year of life, while in the second year of life, they were 11-24.

The most important indicator that ultimately determines the yield is the average weight of the inflorescences. Thus, in the cultivar Krasavets in the first year of life, the average weight of inflorescences in the ripeness phase was 98 g, and in the second year, 121 g. In the GreenGlobe cultivar, these indicators were, respectively: 202 g and 215 g. In the second year of life, the plants formed larger inflorescences.

Depending on the age of the plants, the yield of the artichoke was different. Thus, in the first year of life the

productivity of the plants of Krasavets cultivar was 1.96 kg, which in terms of an ideal hectare was 19.6 t/ha. The same indicators in the second year of life were respectively: 5.55 kg/plant and 55.5 t/ha. The productivity of GreenGlobe variety in the first year of life was 2.97 kg, which was 29.7 t/ha per ideal hectare. In the second year of life, the indicators were 3.92 kg/plant and 39.2 t/ha respectively.

In the process of research, some issues of artichoke seed production in the dry subtropics of Uzbekistan were also studied (Table 4). When identifying the most effective method for the formation of a seed plant, we compared the cultivation of seed plants without formation and 4 methods of formation: 1 stem on a plant and 3 inflorescences on a stem, 2 stems on a plant and three inflorescences on each, 3 stems on a plant and three inflorescences on each, 4 stems per plant and 3 inflorescences on each.

**Table 3**  
Morpho-biological traits of artichoke depending on the age of plant, in 2018-2019

Traits	Cultivars			
	Krasavets		GreenGlobe	
	I-year of life	II-year of life	I-year of life	II-year of life
Plant height, cm	110	216	93	155
Numbr of branches, pcs	1-2	2-4	1	1
Number of inflorescences (flower heads), pcs	10-28	36-67	9-20	11-24
Mass of inflorescences (flower heads) in ripeness phase, g	98	121	202	215
Plant productivity, kg/plant.	1.96	5.55	2.97	3.92



**Table 4**  
**Productivity and quality of artichoke seeds with different methods**  
**of formation of seed plant, in 2018-2019**

Methods of formation of seed plant	Seed productivity of a plant, g	Mass of seeds from one inflorescence, g	Mass of 1000 seeds, g	Number of seeds, pcs	
				From one plant	from one inflorescence
Control – without formation	734.2	15.0	46.5	15789.0	322.2
1 stem on a plant and 3 inflorescences on a stem	102.7	34.2	54.6	1881.0	627.0
2 stems on a plant and 3 inflorescences on each	179.7	30.0	54.8	3279.0	546.5
3 stems on a plant and 3 inflorescences on each	246.5	27.4	67.6	3648.0	405.3
4 stems on a plant and 3 inflorescences on each	270.1	22.5	47.1	5735.0	477.9

The highest seed productivity was noted in the variant without the formation of a seed plant: 734.2 g/plant or 15789 seeds/plant. Comparatively higher seed productivity was noted in the variants 3, 4 and 5 of the experiment. Seed productivity of plants in these variants was 179.7, 246.5, 270.1 g, respectively. This is 24.5-36.8% compared to the control. However, in terms of such indicators as the mass and number of seeds from one inflorescence, the mass of 1000 seeds of a plant without formation is significantly inferior to other variants. Based on the results of experience, the variants 3, 4, 5 can be considered appropriate to use in artichoke seed production.

Research has shown that in the conditions of southern Uzbekistan there is potential for the cultivation of artichoke seeds with high sowing quality.

## CONCLUSION

Thus, for the first time in Uzbekistan, the morphobiological and farm- valuable traits of the artichoke have been studied. The research results showed that the artichoke is a valuable food product for the conditions of Uzbekistan and its introduction allows us to expand the range of cultivated vegetable crops.

Phenological observations made it possible to determine the specific and varietal reactions to the onset and duration of phenological phases, the rhythm of development of artichoke plants at different sowing dates.

In the conditions of the southern Uzbekistan, there is potential for the cultivation of high-quality artichoke seeds.

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