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 XYI - XYII 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
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 1 x 1 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 12th day after sowing, and mass shoots appeared on December 4 and on the 20th day, respectively. In the GreenGlobe cultivar, single shoots appeared on the 15th and mass shoots on the 22nd day from sowing (Table 1).

### Table 1

| Developmental phases | Cultivars | Krasavets | GreenGlobe |
|----------------------|-----------|-----------|------------|
|                      | I-year of life |          |            |
| Shoots               | 10%       | 27.11.2017| 30.11.2017 |
|                      | 75%       | 04.12.2017| 06.12.2017 |
| Repeness             | 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 |
|                      | II-year of life |        |            |
| 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     | Before the beginning of ripeness | Before mass ripeness | Before the beginning of flowering | Before mass flowering | Before full ripeness |
|---------------|---------------------------------|----------------------|----------------------------------|----------------------|---------------------|
| I-year of life|                                 |                      |                                  |                      |                     |
| Krasavets     | 190                             | 195                  | 200                              | 206                  | 231                 |
| GreenGlobe    | 197                             | 205                  | 207                              | 212                  | 237                 |
| II - year of life (from the beginning of regrowth) |                       |                      |                                  |                      |                     |
| 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 |
|------------------------------------|---------------------------------|----------------------------------------|-----------------------|-----------------------|
| 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 morpho-biological 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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