

INFLUENCE OF VEGETATION SPACE AND USAGE OF ARTICHOKE  
PLANT ON YIELD AND QUALITY OF ARTICHOKE SEED  
(*Cynara scolimus* L.)

**R. Jevdjović, Radojka Maletić and Jasmina Jevdjović \***

**Abstract:** Rapid development of plantation-commercial production of medicinal plants demands certain quantities of adequate quality seed. Preliminary results for yield and quality of artichoke seed obtained from one-year and two-year crop plants with two variants of vegetation space sizes are presented. The "Domestic large" variety was tested.

The highest yield of seed was achieved in two-year artichoke plants grown in the variant of 70x50 cm row spacing. The lowest yield was achieved in one-year crop, at seeding distance of 70x30 cm. The highest germination energy and total germination as well as the highest value of seed weight were established for the seed deriving from two-year artichoke plants (70x50 cm spacing), and the poorest germination energy and total germination as well as the lowest weight were obtained in the case of seed deriving from one-year artichoke planted at the spacing of 70x30 cm.

In both seeding variants of one-year crops (spacing: 70x50 cm and 70x30 cm), low yield of poor quality seed was obtained, so it should be used in leaf production instead of seed production. Two-year artichoke plants with of 70x30 cm spacing gave satisfactory yield of good quality seed.

**Key words:** artichoke, yield, seed quality, vegetation space.

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## Introduction

Artichoke (*Cynara scolimus L*) is perennial, herbaceous plant of the *Asteraceae* family. It was well known in ancient Greece and has been cultivated since 15<sup>th</sup> century. It has developed root system of great intake force. Leaves are large, low leaves can be 1 m long. Lamina is feathery, distinctly cut and hairy on the reverse. The stem is strong, upright and branchy at the top. At the top of the stem and side branches there are large clusters of flowers covered with juicy leaves used as vegetables. Artichoke - *Cynarae folium* leaf is used for medicinal purposes as a remedy against increased cholesterol and liver diseases. Recently, active substances have been extracted from the artichoke leaf and integrated into capsules and tablets. Well-known are also artichoke tinctures against cholesterol. Leaf contains bitter substances, phenol compounds, potassium and magnesium. Leaf is mostly used during the first year of growing (Jevdjović, Maletić, 1999), and in the second year artichoke is used for seed production. Artichoke seed is very large compared to seeds of other medicinal plants. It is situated in the fruit that is syncarpe nut, that is, it is a special form of achene. Mass of 1000 seed is 21-45 g. Seed loses germination ability very fast, and after two years it is not suitable for seeding any longer.

## Materials and Methods

Two-year investigation was carried out on swampy, marsh black soil in Pančevo owned by the Institute for Medicinal Plant Research. The objective of the research was to indicate the most favourable vegetation space and age of artichoke seed crops so that highest yield and best quality seed can be obtained.

During the first study year (1998), two parcels of artichoke crops were organized with seeding distance of 70x50 cm and 70x30 cm. Seeding was carried out on April 24<sup>th</sup> 1997 with 5 kg/ha of seeds. Seeding depth was 4 cm. Usual cultural measures were taken, and weeds were killed mechanically without herbicides. During vegetation period that year, mean daily temperature was 18.9°C, precipitation 288 mm (Dražić, Jevdjović, 1997). Seed was collected on September 10<sup>th</sup> 1998. Seed yield on the parcel with seeding distance of 70x50 cm was 839 kg/ha, and on the parcel with seeding distance of 70x30 cm 504 kg/ha. Seed was dried to 10% of humidity and processed to standard quality, and subsequently set for germination in ten repetitions -100 seeds for each distance variant. Previously seed weight was determined on a precise scale. Testing of the germination ability was carried out in Petri dishes on a filter paper and temperature of 20°C according to "Quality regulations of the agricultural plant seed" (1987) and to the international regulation of ISTA (Inter. Seed Testing Association).

During the second study year (1999) usual growing measures were taken, weeds were killed mechanically without herbicides. During vegetation period that year mean daily temperature was 19.05°C, precipitation 617 mm. Collection of seed from the two-year old crop was carried out on September 10<sup>th</sup> 1999. On the parcel with seeding distance of 70x50 cm seed yield was 2380 kg/ha, and on the parcel with seeding distance of 70x30 cm yield was 1725 kg/ha. Seed was dried to 10% of humidity and processed to standard quality, and subsequently set for germination in ten repetitions -100 seeds for each distance variant. Previously seed mass was determined on a precise scale. Testing of the germination ability was carried out in Petri dishes on a filter paper and temperature of 20°C.

The obtained experimental data were statistically analysed by applying the method of variance statistics: mean value ( $\bar{x}$ ) and variation coefficient ( $C_v$ ), Hadživuković, 1991. Statistical significance between calculated mean values of investigated factors was obtained by variance analysis model (Snedecor, Cochran, 1967) of the following mathematical form:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk} \quad (i=1,2,3,4; j=1,2,3; k=1,2,3,4).$$

All estimates of significance were based on F-test and LSD-test for the threshold of significance 5% and 1%. Relative degree of dependence of seed weight and germination parameters is expressed by simple correlation coefficient and t-tested at the level of significance 5% and 1%.

## Results and Discussion

Two-year research showed that morphological properties included in the investigation of artichoke plant (plant height, number of trees, number of flower clusters per tree and total number of flower clusters per plant) as well as seed yield were considerably low in both seeding distances, in the year of planting (1998). The plant was, on average, 30 cm smaller in both seeding distances 70x30 cm and 70x50 cm compared to the same plants the following year (two-year plants), table 1.

Values for other morphological properties (number of stems and flower clusters per stem and plant) in 1998 were considerably lower. In the first study year both seeding distances gave one tree each and approximately equal number of flower clusters per tree and plant (6-7). Next year the number of trees increased (3-5) as well as the total number of flower clusters per plant (25). This was expressed through high degree of relative variation ( $50\% < C_v < 67\%$ ) compared to the results from the previous year.

In one-year crops, the investigated artichoke properties expressed almost no difference (statistically insignificant) in regard to seeding distance, whereas in two-year crops this difference was highly significant ( $LSD_{uz} > LSD_{0.01}$ ), being in

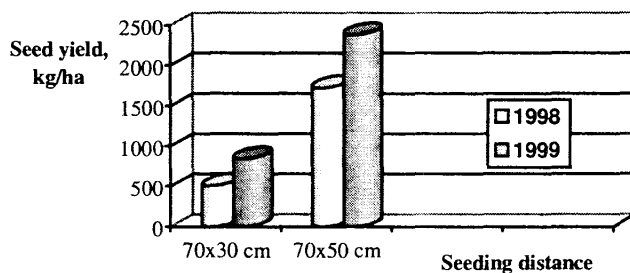
favor of the seeding distance of 70x50 cm, table 1. On average, two-year crop plants were 20 cm higher in the distance of 70x50 cm, two more trees, as well as 10 flower clusters more per plant compared to plants seeded at the distance of 70x30 cm.

T a b . 1. - Statistical indices of artichoke plant properties

Artichoke plant properties	Year				Statistical indices		LSD <sub>0.01</sub>	
	1998		1999		$\bar{X}$	C <sub>v</sub> (%)	Factors	Interac- tion
	Seeding distance							
	70x30	70x50	70x30	70x50				
Plant height	104.8	106.0	134.7	156.0	100.375	57.23	12.157**	17.193**
Number of trees	1	1	3.2	5.1	2.575	66.50	0.865**	1.224*
Total flower clusters per plant	6.4	7.6	14.9	25.1	13.50	55.15	5.521**	7.808*
Seed yield kg/ha	504	839	1725	2380	1362	54.18	330**	427*

The highest seed yield was achieved in the second study year (1999), i.e. in two-year artichoke plants with seeding distance of 70x50 cm (table 1). The yield produced (2380 kg/ha) was by 38% higher compared to the yield produced with seeding distance of 70x30 cm in the same year, and considerably higher compared to the yield of one-year crop plants and in relation to the seeding distance variants 70x50 cm and 70x30 cm, 2.8 and 4.5 times higher, respectively.

The second study year had more favourable climatic conditions, higher daily temperatures and higher precipitation amounts compared to the previous year, 1998, which affected positively the total seed yield (Graph 1).



Graph. 1. - Total yield of artichoke seed, kg/ha

The results of investigation indicated that obtained differences in average values of seed yield between years or seeding distances were significant (LSD<sub>uz</sub> > p<sub>0.01</sub>), tab.1.

T a b . 2. - Mean values and germination dispersion indices of *Cynara scolimus* seed

Year	Statistical indices	Weight of 100 seeds		Germination energy Seeding distance (cm)		Total germination	
		70x30	70x50	70x30	70x50	70x30	70x50
1998	$\bar{x}$	2.24	2.32	66.9	71,7	76,6	82,7
	$x_{MIN}$	2.11	2.28	64.0	69,0	74,0	80,0
	$x_{MAX}$	2.31	2.36	70.0	74,0	81,0	85,0
	$C_v$ (%)	2.51	1.17	2.87	2,34	2,62	1,80
1999	$\bar{x}$	2.43	2.67	79.5	85,3	87,6	94,1
	$x_{MIN}$	2.39	2.49	74.0	82,0	84,0	91,0
	$x_{MAX}$	2.50	2.98	83.0	89,0	92,0	98,0
	$C_v$ (%)	1.44	6.08	3.52	2,57	2,56	2,44
LSD <sub>0.01</sub>	factors	0.0763**		1.882**		1.751**	
	interaction	0.108**		2.662 <sup>NZ</sup>		2.476 <sup>NZ</sup>	

The obtained results for average weight indicated that the seed deriving from one-year artichoke plants had lower weight in both seeding variants (70x50 cm and 70x30 cm) compared to seed weight of two-year crop plants. This difference was statistically highly significant ( $LSD_{uz} > p_{0.01}$ ), table 2. The highest value of seed weight was obtained from two-year artichoke plants with seeding distance of 70x50 cm (weight of 100 seeds 2.67 g). It was by 15% higher than the weight in the previous study year with the same seeding distance, or by 10% compared to denser seeding (70x30 cm) in 1999 and by 20% in regard to the seed weight in 1998. The seed weight indicated the compactness of samples according to harvest years ( $1\% < C_v < 6\%$ ).

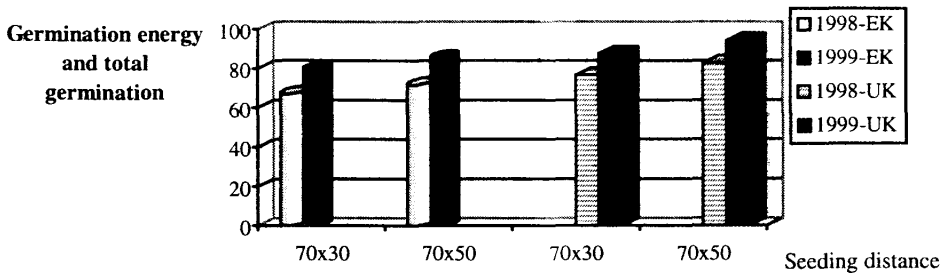
Average germination values of artichoke seed, in both years and both variants, expressed stability, compactness ( $C_v \approx 2\%$ ), table 2. Seed of two-year artichoke plants had statistically more significant germination energy with both seeding distance variants compared to seed of one-year crop plants (table 2). Dispersed seeding is adequate for developing higher germination energy, therefore the seed obtained from plants seeded at the distance of 70x50 cm had by 7% higher germination energy content (graph 2) in both study years.

The lowest germination energy was obtained from one-year artichoke plants in a denser seeding form (70x30 cm).

Interaction showed no significance, therefore regarding this property of artichoke plant, the analysed factors have an independent effect.

Average value of total germination ability of artichoke seed had dispersion similar to a previous trait (germination energy). Namely, this indicator showed compact values of samples ( $C_v < 2.5\%$ ), table 2. However, total germination was by 14% higher in seed from two-year crop plants in comparison to seed from one-year crop plants with identical seeding density. Also, total germination depended on seeding density, therefore dispersed seeding (70x50 cm) had by 8% higher

total germination percentage than denser seeding distance (70x30 cm) in both study years. Seed from two-year artichoke plants growing at the distance of 70x50 cm possessed better total germination (94.1%), and seed from one-year crop plants at the distance of 70x30 cm had the lowest total germination (76.6%) or 23% less compared to the best total germination.



Graph. 2. - Germination energy and total germination of artichoke seed

Fischer's test of variance analysis showed that the obtained differences in total germination between years and seeding density were highly significant ( $F_{uz} > F_{0.01}$ ). The evaluation of significance was determined for all variants of investigated factors (year and seeding distance),  $LSD_{uz} > LSD_{0.01}$ . Interaction of factors showed no significance.

Correlation analysis showed that there was positive, strong and statistically significant dependence between seed weight and germination indices (germination energy and total germination). The germination energy increased ( $r = 0,84^{**}$ ) with the increase of seed weight as well as total germination ( $r = 0,92^{**}$ ). A positive and highly significant dependence existed between germination indices (germination energy and total germination),  $r = 0.94^{**}$ .

## Conclusion

Based on the results of the investigation, the following can be concluded:

- Greater seeding distance resulted in higher values of seed weight;
- Seed with greatest weight had highest germination energy and total germination;
- One-year artichoke crops are to be used for leaves production;
- In the case of seed production it is necessary to use two-year artichoke crops, seeding distance of 70x50 cm, because highest yield and best quality seed are produced;
- Small precipitation and lower average daily temperature have negative effect on seed quality and artichoke plant growing.

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## PRINOS I KVALITET SEMENA ARTIČOKE U ZAVISNOSTI OD VELIČINE VEGETACIONOG PROSTORA I STAROSTI ZASADA

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### Rezime

Nagli razvoj plantažne proizvodnje lekovitog bilja zahteva određene količine sortnog semena odgovarajućeg kvaliteta.

Dati su preliminarni rezultati prinosa i kvaliteta semena artičoke dobijenog iz jednogodišnjih i dvogodišnjih zasada sa dve veličine vegetacionog prostora. Testirana je sorta "Domaća krupna".

Najveći prinos semena postignut je u dvogodišnjem zasadu semenskog useva artičoke gajene u varijanti na rastojanju 70x50 cm. Najmanji prinos bio je u jednogodišnjem zasadu sa rastojanjem 70x30 cm. Najbolju energiju klijanja i ukupno klijanje, kao i najveću masu imalo je seme iz dvogodišnjeg zasada sa rastojanjem 70x50 cm, a najslabiju energiju klijanja i ukupnu klijavost kao i najmanju masu imalo je seme iz jednogodišnjeg zasada sa rastojanjem 70x30cm.

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Obe varijante setve jednogodišnjeg zasada (rastojanje 70x50 cm i 70x30 cm) dobijen je mali prinos semena slabog kvaliteta pa bi ih trebalo koristiti za proizvodnju lišća a nikako za proizvodnju semena. Dvogodišnji zasad sa rastojanjem 70x30 cm dao je zadovoljavajući prinos semena dobrog kvaliteta.

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