

**YIELD AND QUALITY OF CAULIFLOWER PRODUCTION DEPENDING
ON THE SIZE OF CELL AND AGE OF SEEDLINGS UNDER THE
CONDITIONS OF UKRAINIAN FOREST- STEPPE**

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The results of research on the influence of the seedlings age and size of the cells on the yield and quality of cauliflower under the conditions of Ukrainian Forest-Steppe are shown.

Keywords: *cauliflower, cell, seedling age, crop capacity.*

Successful production starts from the production of quality planting material. Quality planting material is less damaged by pests, diseases and survives during the replanting in open ground. [1] The most popular among modern agricultural manufacturers are seedlings grown in cassettes [2, 3]. Practice shows that the cassette method of growing seedlings provides its high yield per unit of area of greenhouses [4, 5]. Seedlings are well kept in cassettes during transportation, it is easy to take them out from cassettes without any harm to the root system, providing dynamic growth of plants without loss of sprout during the sprouting period. One of the biggest advantages of cassette method – getting an early harvest [2, 3]. In the Netherlands, Finland, France, Japan, Germany and other countries, seedlings are mostly grown in plastic cassettes, pallets. Cassette method allows to influence efficiently and operatively on plant growth and development, to increase seedlings yield to 750 pcs. per 1 m² and to get more straighter plants with 100% survival, to reduce costs of seeds and substrate compared to method without cassettes in 2,5-3,0 times to reduce labor costs [6].

Research methodology. Research on the effect of cell size and age of seedlings on the growth, development and productivity of cauliflower plants under Forest-Steppe zone conditions was carried out in 2008-2010. Soil of researched field – gray forest soil, medium-loamy, is characterized by the following parameters: humus 2.4%, the reaction of soil solution (pH) 5.8, the amount of absorbed bases ekv./100 15.3 mg g soil, P₂O₅ – 21.2 mg/100 g of soil, K₂O – 9.2 mg/100 g of soil. Sprouts of cauliflower of variety Unibotra were grown in a greenhouse with seedlings diving into the cassette with cells size of 6x6, 4x4 and 2x2 cm. The diving of seedlings was carried out after appearance of the first true leaf. Seeds were sown in three periods 20.03, 1.04, 10.04, considering the time of planting – 15.05, plant should reach the age of 50, 40 and 30 days. Repetition of the experiment is fourfold with the accounting area of 20 m². Methodology provided phonological observations, biometric measurements and accounting. When the plants reached technical maturity the harvest accounting was conducted, were determined the qualitative characteristics of productive organs and some biochemical indices of heads [7]. Harvesting was carried out after forming of heads according to the existing standard – “Fresh Cauliflower, specifications ISO 3280-95” [8].

Results of the investigation. At the time of planting seedlings (15.05), depending on the age and size, cells had different biometric characteristics (Table 1). The highest were seedlings at planting term in variants with cells size of 6x6 cm, aged 50 and 40 days respectively 15.9 and 15.2 cm. In all other studied variants plants height was lower and amounted 9,8-14,6 cm.

1. Biometric characteristics of cauliflower seedling at planting period depending on its age and size of the cell (Average 2008-2010)

Variant		Height of the plants, cm	Thickness of the stem, mm	Amount of leaves, pcs	Area of the leaves, cm ²
Age of the seedling, days	Size of the cell, cm				
50	6x6 (control)	15,9	3,6	5,5	172,5
	4x4	14,6	3,3	4,9	162,6
	2x2	12,7	2,9	4,3	79,1
40	6x6	15,2	3,1	4,7	130,4
	4x4	13,2	3,0	4,2	83,1
	2x2	11,3	2,7	4,1	51,5
30	6x6	12,7	2,8	4,0	48,9
	4x4	10,4	2,2	3,3	41,9
	2x2	9,8	1,8	2,8	34,0

Thicker stems were noted in the variant of 50 days old seedlings with cells size 6x6 cm – 3.6 mm, and in other researched variants the thickness of the investigated stem was at the level of 1,8-3,3 mm which on 0,3-1,8 mm less. There is a regular decrease of the stem thickness with decreasing of seedling age and size of the cell. Analysis showed a strong direct connection between plant height and thickness of the stem of cauliflower seedlings ($r = 0,95$).

The phase of formation of 5-leaves entered 50 days old plants seedlings, but the level of entry into phase depended on the size of the cell. The most foliate in this period were plants of the control variant – 5.5 pc., and in other studied variants the number of leaves was much lower and amounted – 2,8-4,9 units., which is on 0,6-2,7 units less. It has also a strong direct connection between seedlings height and number of leaves per plant ($r = 0,95$).

One of the important indicators of the quality of seedlings is leaf area, bigger it was in variants of 50 days old plants seedlings with cells size of 6x6 cm – 172.5 cm² and with cells size of 4x4 cm – 162.6 cm², and in other studied variants the size of leaf area was significantly smaller and ranged within 34,0-130,4 cm². Analysis showed a strong direct connection between the number of leaves per plant and leaf area ($r = 0,90$). Analysis of biometric indicators of variants of the experiment helps us to suppose that between seedlings age, cell size, and biometric indices of cauliflower seedlings there is a strong direct connection.

The plants with higher indices of leaf area increase in the phase of technical maturity were observed in the variant with 50 days old seedlings and from cells of

4x4 cm – 27,8 thousand m²/ha and in variants with 40 days old seedlings from cells 6x6 cm – 33,8 thousand m² / ha and from cells 4x4 cm – 30.3 m²/ha thousand and 25.2 thousand in control m²/ha, which is on 2.6, 8.6 and 5.1 m²/ha thousand less (Table 2). This can be explained by the fact that in the variant of seedlings of 50 days and the size of cells 6x6 cm (control) were created better conditions for the formation of an earlier harvest.

**2. Biometric and physiological indicators of cauliflower in phase of technical maturity, depending on the seedlings age and size of the cell
(Average for 2008-2010)**

Variant		Height of the plants, cm	Rosette diameter, cm	Area of leaves, m ² /ha	Net productivity of photosynthesis, cm ² h/m ² per day
Age of the seedlings, days	Size of the cell, cm				
50	6×6 (C)	46,8	48,5	25,2	9,1
	4×4	51,5	53,6	27,8	9,6
	2×2	49,6	41,7	21,7	8,2
40	6×6	53,2	62,1	33,8	10,8
	4×4	52,6	57,2	30,3	10,3
	2×2	48,2	42,7	22,2	6,6
30	6×6	48,5	44,2	22,6	6,6
	4×4	48,1	39,2	20,3	6,3
	2×2	44,7	36,9	19,1	6,0

C – control

Analysis showed medium direct connection between the index of leaf area during the period of intensive growth of plants and in the phase of technical maturity ($r = 0,64$). In other variants the leaf area indices were lower and correlated with seedling age and size of cells during its cultivation. In the phase of technical maturity by plant height differed variants of age of 50 days old seedlings from cells 4x4 cm – 51.5 cm, and plants with 40 days old seedlings from cells 6x6 cm – 53.2 cm and 4x4 cells cm – 52.6 cm and in control – 46.8 cm, which on 4.7, 6.4 and 5.8 cm less. Analysis showed a strong direct connection between height and leaf area of Cauliflower plants ($r = 0,86$). With a rosette diameter differed plants in variants with 50 days old seedlings from cells 4x4 cm – 53.6 cm, and 40 days from 6x6 cells cm – 62.1 cm and 4x4 cells cm – 57.2 cm and in control – 48 5 cm, which on 5.1, 13.6 and 8.7 cm less. Analysis showed a strong direct correlation between plant height and rosette diameter ($r = 0,86$), but also found a strong direct correlation between the rosette diameter and leaf area of Cauliflower plants ($r = 0,99$).

It was found that in the average for the period of research, with higher indices of accruing dry weight g/m² per day were observed plants in the variant of seedlings aged 50 days from cells 4x4 cm – 9.6 g/ m² per day, and in variants of seedlings age – 40 days from cells 6x6 cm – 10.8 g/ m² per day and cells size 4x4 cm – 10.3 g/ m² per

day, and in the control of 9.1 g/ m² per day, which is on 0.5, 1.7 and 1, 2 g/ m² per day less. Analysis showed a strong direct connection between the net productivity of photosynthesis index and leaf area of Cauliflower plants ($r = 0,93$). The highest yield in average over three years was obtained in the variant of seedlings aged 50 days from the cells of 4x4 cm – 24.8 t / ha, and 40 days old seedlings from cells 4x4 cm – 26.4 t / ha and cells 6x6 cm – 27.9 t / ha and 23.3 in the control t / ha, which is on 1.5, 3.1 and 4.6 t / ha less (Table 3).

3. Crop capacity and harvest quality indicators of cauliflower depending on the seedlings age and size of the cell (average for 2008-2010)

Variant		Average for 2008-2010		Harvest t / ha				±, before control
Age of the seedlings, days	Size of the cell, cm			2008	2009	2010	average	
		Diameter of the head, cm.	Weight of the head, g.					
50	6×6 (C)	13,2	489	15,9	20,3	33,6	23,3	–
	4×4	13,5	522	16,0	22,0	36,5	24,8	+1,5
	2×2	12,7	429	13,1	16,7	31,5	20,4	-2,9
40	6×6	14,3	586	18,0	25,3	40,4	27,9	+4,6
	4×4	13,8	555	17,5	23,3	38,5	26,4	+3,1
	2×2	12,8	438	13,8	15,5	33,3	20,9	-2,4
30	6×6	13,2	472	15,5	19,6	32,3	22,5	-0,8
	4×4	13,0	451	14,3	18,8	31,4	21,5	-1,8
	2×2	12,3	411	13,0	17,3	28,4	19,6	-3,7
<i>HIP₀₅</i>	<i>A</i>	–	–	0,4	0,6	1,4	–	–
	<i>B</i>	–	–	0,4	0,6	1,4	–	–
	<i>AB</i>	–	–	0,7	1,0	2,4	–	–

C – control

Essentiality of this difference confirmed by the results of variance analysis except of 2008 in the variant with seedlings age of 50 days and cells of 6x6 cm. Analysis showed a strong direct connection between leaf area and crop capacity of cauliflower ($r = 0,98$). Also it was found a strong direct connection between the net productivity of photosynthesis and crop capacity ($r = 0,89$). Analysis showed a strong direct connection between the level of crop capacity and head diameter ($r = 0,98$).

With larger diameter of heads were observed plants in variants with 40 days old seedlings from cells 4x4 cm – 15.3 cm and 6x6 cm cells – 15.9 cm and in control – 13.2 cm, which on 15.9 and 20.5% less. With higher average weight of heads were observed plants in variants of 50 days old seedlings from cells 4x4 cm – 522 g and in variants of 40 days old seedlings from cells 4x4 cm – 555 g and cells 6x6 cm – 586 g and in control – 489 g, which on 6.7, 13.5 and 19.8% less.

According to the standard requirements, collected products are divided into first and second variety (Table 4). The largest share of first variety was marked in variant of 50 days old seedlings from cells 4x4 cm – 23.9 t / ha or 94.8%, and in variants of 40 days old seedlings from cells 4x4 cm – 25.5 t / ha or 95.2% and cells 6x6 cm – 27.0 t / ha or 95.5%, and 22.1 in the control t / ha or 93.6%. Analysis showed a strong direct connection between the proportion of first variety in general yield and net productivity of photosynthesis ($r = 0,90$), between share of first variety and diameter of cauliflower head ($r = 0,90$).

4. Structure of cauliflower harvest depending on the seedlings age and size of the cell (average for 2008 – 2010)

Variant		First variety		Second variety	
Age of the seedlings, days	Size of the cell, cm	t/ha	%	t/ha	%
50	6×6 (C)	22,1	93,6	1,2	6,4
	4×4	23,9	94,8	0,9	5,2
	2×2	18,8	90,4	1,6	9,6
40	6×6	27,0	95,5	0,9	4,5
	4×4	25,5	95,2	0,9	4,8
	2×2	19,8	93,4	1,1	6,6
30	6×6	20,7	90,7	1,8	9,3
	4×4	19,7	90,3	1,8	9,7
	2×2	17,5	88,2	2,1	11,8

Conclusion. Seedling age and size of cells have a significant influence on biometric and physiological indices of cauliflower plants. The highest crop capacity in average over three years was obtained in variants of 50 days old seedlings from cells 4x4 cm – 24.8 t/ha, 40 days from the cells of 4x4 cm – 26.4 t/ha and 6x6 cm – 27.9 t / ha, and in the control of 23.3 t/ha. With higher average weight of heads were observed plants of variants of 50 days old seedlings from cells 4x4 cm – 522 g and variants of 40 days old seedlings from cells 4x4 cm – 555 g and cells 6x6 cm – 586 g and in control – 489 g. The largest share of the first variety was observed in the variant of 50 days old seedlings from cells 4x4 cm – 23.9 t / ha or 94.8%, and in variants of 40 days old seedlings from cells 4x4 cm – 25.5 t / ha or 95.2% and cells 6x6 cm – 27.0 t / ha or 95.5%, and 22.1 and in the control 22,1 t / ha or 93.6%.

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Урожайность и качество продукции капусты цветной в зависимости от размера ячейки и возраста рассады в условиях Лесостепи Украины

В условиях Лесостепи Украины проведены исследования по изучению влияния размера ячейки и возраста рассады на рост, развитие и урожайность растений капусты цветной. Установлено, что наибольшую урожайность в среднем за три года исследований получена у вариантах с возрастом рассады 50 суток с ячейками 4×4 см — 24,8 т/га, 40 суток с ячейками 4×4 см — 26,4 т/га и 6×6 см — 27,9 т/га, а в контроле — 23,3 т/га.

Ключевые слова: капуста цветная, ячейки кассет, возраст рассады, урожайность.

Cherednichenko V.M.

Yield and quality of cauliflower production depending on the size of cell and age of seedlings under the conditions of Ukrainian Forest-Steppe

Under the conditions of Ukrainian Forest-Steppe was conducted the research on the effects of cell size and age of seedlings on growth, development and yield of cauliflower plants. Found that the highest yield in the average of three years of research was received in the variants with the age of seedlings – 50 days with cells of 4x4 cm – 24.8 t / ha, 40 days with cells of 4x4 cm – 26.4 t / ha and 6x6 cm – 27 9 t / ha, and in control – 23.3 t / ha.

Key words: cauliflower, cell cartridges, age of seedlings, productivity.