Influence of Culture Methods on Cauliflower Yield and Economic Efficiency

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Abstract

Cauliflower is grown for its hypertrophied inflorescences that are used in the preparation of various fresh cooked dishes as well as in pickling or canning industry. The inflorescences are rich in water (90%). The energy value of cauliflower inflorescences is low (118.5 kJ / 100) due to low content of energetic substances. Cauliflower culture is practiced in the field and in protected areas. Climatic conditions are favorable for growing cauliflower in Transylvania. Cultures are mainly started with seedlings leading to additional costs for their production. The experience was carried out in 2011-2012 in the Reghin area, Mures County. Experimental factors were planting date and culture method. Experimental culture was established at different dates (April, May, June) by two methods (by planting seedlings and direct seeding). The aim of the experiment was to demonstrate the feasibility of growing cauliflower crops by direct seeding, in Reghin area, and if the obtained results, are comparable to those achieved by seedling cultures. In the experiment it was found that direct sowing method can be best practiced if the culture is established in June.

Keywords: *direct sowing, inflorescences, planting date, planting seedlings*

INTRODUCTION

Cauliflower can be used, fresh boiled, cooked, canned, pickled or marinated. Cruciferous vegetables contain isothiocyanates that have anticancer effect by inhibiting the formation of tumors (Gherghi *et al.*, 2002). Some authors noted that the consumption of cruciferous vegetables can reduce the risk of cancer. Among the cancers which can be prevented by consumption of cauliflower are breast, colon, ovarian, prostate, lung cancer (Mohanty and Srivastava, 2002) and especially the gastrointestinal form (Prohens and Nuez, 2008). One kg of cauliflower has 157 calories, 12.2 g protein, 1.0 g fat, 25.5 g carbohydrate, 112 mg Ca, 367 mg P, 5.5 mg Fe, 500 IU vitamin A, 0.5 mg vitamin B2 0.55 mg vitamin B6, 352 mg vitamin C (Berar *et al.*, 2012). Cauliflower inflorescences accumulate a small amount of nitrate below 100 ppm, but fertilization with 80-120 kg N/ha increased the nitrate content of cauliflower by 33% (Feller and Fink, 2005, quoted by Apahidean, 2011).

Cauliflower consumption also prevents formation of atherosclerotic plaques and sclerosis of the arteries. It is recommended to use for this purpose boiled cauliflower or fresh in the form of salad, 300 g daily for at least three days/week (Ilie, 2011).

Cauliflower is grown worldwide, except in wet tropical areas, and is ranked 13th in the world because of the cultivated surfaces it holds. World production of cauliflower and broccoli, in 2011 totaled 18.7 million tons. China is the largest country producing cauliflower and broccoli in the world, with 8.5 million tons. India is second with 6.5 million tons, production of the two countries, representing 80% of global production. (FAOSTAT, 2012).

Cultures can be started with seedlings (Ciofu *et al.*, 2003 quoted by Indrea *et al.*, 2013). Crop by direct seeding method is practiced to obtain mini (baby) cauliflower (Selvakumar *et al.*, 2007).

MATERIALS AND METHODS

Avalanche Hybrid was used in the experience. Hybrid Avalanche is for spring-autumn crop, reaching harvest maturity in 60-65 days after planting. Inflorescences are white, round shaped and weight 1.0-1.5 kg in average. Plants are vigorous and leaves of the rosette are standing tall and cover well the inflorescence. It is recommended for fresh use or industrialization.

Experimental factors were culture method (by planting seedlings and direct sowing) and establishing planting date (April, May and June). The combination of experimental factors resulted in six experimental variants, which were located in three repetitions. Plant density cultures, performed both by direct sowing in the field and those established by seedling, was 40000 plants per hectare.

The experimental variants are:

V1-culture established by direct sowing in April;
V2-culture established by planting seedlings, in April;
V3-culture established by direct sowing in May;
V4-culture established by planting seedlings in May;
V5-culture established by direct sowing in June;
V6-culture established by planting seedlings in June.

During the growing season, the specific cauliflower crops technology in open field was applied and observations set in the experimental protocol, were made. The experiment was conducted in Reghin area, Mureş County: the area is favorable for the cultivation of vegetable species with lower requirements to temperature. Mureş County is located between 46°09' and 47°00' parallels, north latitude and 23°55' and 25°14 ' meridians, west longitude, has a harmonious landscape. Average annual temperatures are between 8-10.1°C in plateau and hilly areas, generally the summer months are cool. During the growing season (April-October 2012) monthly average temperature was between 15.3-17.3°C. Rainfall distribution was uneven across Mureş County, with average values of 550 mm/year in the plain part of the county, gradually increasing towards the mountains to values of 1000-1200 mm/year. Rainfall is lower in the cold season and abundant in spring and summer. Average monthly rainfall during the growing season ranged from 16.6 to 21.3 mm. To calculate the economic efficiency were taken into account the total cost of each option and for calculating income an average price of recovery was used.

RESULTS

At the crops established by direct seeding, the average weight of cauliflower inflorescences at harvest, ranged between 0.87 kg and 1.24 kg (Fig. 1). Also at the crops started by direct sowing in the field average inflorescences weight were between 1.13 kg at planting date 2 (May) and 1.24 kg at planting date 3 (June). The average weight of inflorescences is similar to that mentioned by Chaux and Foury (1994) which state that inflorescences from late crops weigh between 800 and 1500 g and their diameter is more than 16 cm.

Average weight of inflorescences at the crops started with seedlings (0.87 to 1.22 kg) was higher for crops established in the first planting period (April) and lower in the second and third planting period (May and June) compared to cultures started by direct sowing in the field.

The highest average weight of cauliflower inflorescences was obtained in the third period of planting (June), by direct seeding in the field and is very close to the weight of the inflorescences obtained at the seedling culture, the first culture period.

Average yield achieved at variants grown by direct seeding ensured a production increase of 16.8% compared to the variants started with seedlings, production difference being significant (Tab. 1).

From the analysis of the combined influence of the method of cultivation and crop establishment period, production notes differences between experimental variants (Tab. 2). Thus it can be concluded that the seedling culture method provided a higher production when crop establishment was made in April. Crop by direct seeding method resulted in production increases of 30-32% when cultures were set up in May and June. Compared to the culture started with seedlings, differences in production are distinctly significant (over 10 t/ha).

With regard to the combined influence of sowing method and planting period, production ranged from 34.62 t/ha when the culture was started with seedlings in planting period 2 (May) and 49.44 t/ha recorded in planting period 3

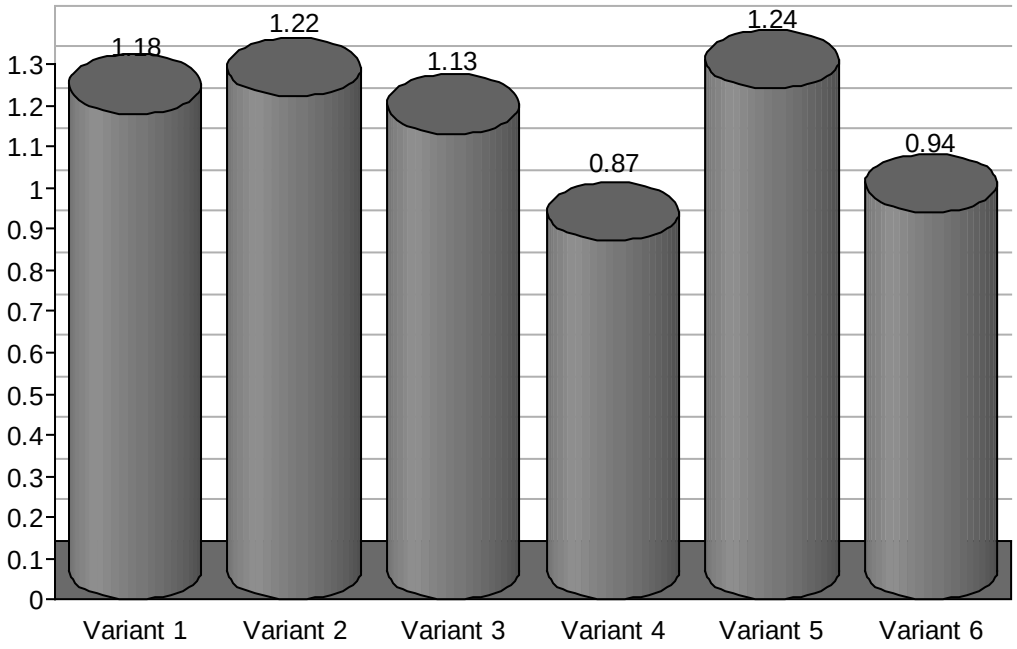

Fig. 1. Average weight of cauliflower inflorescences at harvest (kg)

Tab. 1. Influence of the method of establishing the culture of cauliflower on production

Variant	Production (t/ha)	Production (%)	The difference compared to control (t/ha)	Significance
Culture started with seedlings	40.38	100.0	0.00	-
Direct seeding culture	47.18	116.8	6.79	*
DL (p 5%)	4.16			
DL (p 1%)	6.30			
DL (p 0.1 %)	10.11			

Tab. 2. Combined influence of the method and starting period of cauliflower culture on production

Variant		Production		The difference compared to control (t/ha)	Significance
Method	Planting period	(t/ha)	(%)		
Culture started with seedlings	April	48.94	100	0	-
Direct seeding culture	April	47.05	96	-1.89	-
Culture started with seedlings	May	34.62	100	0	-
Direct seeding culture	May	45.05	130	10.44	**
Culture started with seedlings	June	37.58	100	0	-
Direct seeding culture	June	49.44	132	11.86	**
DL (p 5%)	7.00				
DL (p 1%)	9.92				
DL (p 0.1 %)	15.73				

Tab. 3. The combined influence of age and method of establishing a culture of cauliflower on production

Variant		Production		The difference compared to the control (t/ha)	Significance
Planting period	Method	(t/ha)	(%)		
April	Direct seeding culture	45.05	100	0	-
May	Direct seeding culture	47.05	104	2.00	-
June	Direct seeding culture	49.44	110	4.39	*
April	Culture started with seedlings	34.62	100	0	-
May	Culture started with seedlings	48.94	141	14.32	**
June	Culture started with seedlings	37.58	109	2.97	-
DL (p 5%)		6.41			
DL (p 1%)		10.19			
DL (p 0.1 %)		16.41			

Tab. 4. Economic efficiency in experimental culture

Economic indicators	Variant					
	V1*	V2	V3	V4	V5	V6
Total production (kg/ha)	47050	48940	45050	34620	49440	37580
Direct expenditure (EUR/ha)	7051	17382	6999.5	17013.6	7111.8	17365.4
Indirect Expenses (EUR/ha)	2030.7	5006.1	2015.9	4900	2048.2	5001.2
Total expenditure (EUR/ha)	9081.8	22388.8	9015.5	21913.6	9160	22366.6
Total cost (EUR/kg)	0.193	0.45	0.2	0.63	0,2	0.6
Sale price (EUR/ha)	0.64	0.64	0.64	0.64	0.64	0.64
Total income (EUR/ha)	29940.9	31143.6	28668.2	22030.9	31461.8	23914.5
Profit (EUR/kg)	0.44	0.18	0.44	0.002	0.45	0,04
Profit (EUR/ha)	20859.1	8754.8	19652.7	117.3	22301.8	1547.9

*V1-culture established by direct sowing in April;
V2-culture established by planting seedlings, in April;
V3-culture established by direct sowing in May;
V4-culture established by planting seedlings in May;
V5-culture established by direct sowing in June;
V6-culture established by planting seedlings in June.

(June) when crop was started by direct seeding method (Tab. 3).

To determine the economic efficiency of cauliflower crop grown by two different methods and three culture ages, technological form (currency) were done for each variant. In order to determine the economic efficiency of cauliflower culture were considered: yields, direct costs and indirect production cost, selling price, total revenue and profit (Tab. 4).

Direct cost of cauliflower production = Clabor + Cmaterials + Cmechanization

Where,

Clabor = Cost of labor used

Cmaterials = Expenditure on al materials used (seeds, fertilizers, water etc.)

Cmechanization = Expenditure on mechanical works.

Indirect costs consist of taxes, depreciation of tools, machines.

In terms of production of cauliflower, the best crop production has been achieved by direct seeding at planting period 3 (June), while the lowest production was obtained in planting period 2 (May) when the culture was started with seedlings, which affects directly, the economic outcome (Tab. 4). Amol *et al* (2006) .state that when crops were established in April, May and June, productions were higher in the culture established by direct sowing in June, just like in this experiment. Total production costs are higher for variants that showed lower production, as in the embodiment of culture in planting period 2 (May) when the culture was started with seedlings and lower total costs for variants with high yields. Zhong and Jian (2003) concluded that cauliflower crops started with seedlings get less profit than those established by direct seeding Average price recovery of production considered for determining the economic efficiency was 0.64 EUR/kg of product. The profit per kg of product ranged from 0.02 EUR/kg, at variant V4- culture established by planting seedlings in May up to the highest of 0.45 EUR/kg, at variant V5- culture established by seeding directly, in July. Farmers achieved a higher profit per hectare, when cauliflower crops were started in May and June than in those started in autumn (Shaheen *et al.* 2009).

CONCLUSION

In the conditions of Transylvania Plateau, cauliflower culture can be practiced in open field using direct seeding method that provides the technological mechanization to a greater extent compared to cultures started with seedlings:

- To achieve economically profitable yields, crops need to be established by direct sowing in June, which allows the formation of inflorescence in a favorable climatic period.
- Practicing crop by direct seeding, with direct sowing in June, resulted in a profit of 0.45 EUR/ kg, respectively, 22295 EUR/ha.

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