THE INFLUENCE OF CULTIVAR AND PLANT DENSITY ON CAULIFLOWER PRODUCTION UNDER THE TRANSYLVANIAN PEDOCLIMATIC CONDITIONS

Apahidean, Al. S.[1)], Al. I. Apahidean[1,*)], Brînduşa Rusu[1)]
[1]University of Agricultural Sciences and Veterinary Medicine, 3-5 Mănăştur Street, Cluj-Napoca, 400372, România; [*]Corresponding author: apahidean_alx@yahoo.co.uk

Abstract: Cauliflower is grown for hypertrophic inflorescences used in the preparation of various meals and pickles or in the canning industry. Inflorescences have a high water content (90%). The energy value of cauliflower inflorescences is low (118.5 kj / 100g) due to the relatively low content of energy. The cauliflower culture is practiced in the field as well as in protected areas. The pedo-climatic conditions in Transylvania are favorable for the cultivation of cauliflower because it behaves like a wet and cool climate plant. The hot and dry periods in the inflorescence phase have a negative effect on plant growth but also on production.The experience was carried out during 2016, in the Apahida-Juc area, Cluj County. Experimental factors were the cultivar and plumage of plants. Experimental culture was set up in the field in June.

Keywords: leaf, yield, inflorescences, hybrid.

INTRODUCTION

Cauliflower can be used in a boiled, preserved, pickled and marinated state (Apahidean and Apahidean, 2016). The energetic value of cauliflower inflorescences is low, about 30 calories/100g due to the low energy substances (Stan and Munteanu, 2001). Due to the low content of cellulose and the presence of essential amino acids for the human body, it can be used as a dietary product in the feeding of children and sick people (Patron, 1992). Cruciferous vegetables contain isothiocyanates that have an anticancer effect, inhibiting the formation of tumors (Gherghi et al., 2002). Some authors point out that the risk of cancer, especially gastrointestinal (Prohens and Nuez, 2008), can be reduced by eating cruciferous vegetables. 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 (Savitchi et al., 2013). Cauliflower is grown all over the globe except wet tropical areas (Ciofu et al.,2003) and occupies the 13th place in the world after the areas it owns. World production of cauliflower and broccoli in 2015 totaled 18.5 mil.tone (FAOSTAT, 2015). In Europe is grown on large areas in Western European countries: Spain (29.0 thousand ha-17.6 tonnes/ha), France (26.0 thousand ha-14.2 t/ha), United Kingdom (16.4 thousand ha – 11.4 t / ha), Italy (17.800 ha – 23.9 t/ha) and Poland (15,600 ha - 16,1 t/ha). In Romania grows in all areas but on much smaller areas compared to cabbage (Indrea et al., 2012). Cultures are practiced mainly by seedlings (Mohanty and Srivastava, 2002) planted at distances of 70-75 cm between rows and 30-35 cm between plants per row (Popescu and Zăvoianu, 2011) or 70 cm between rows and 35-40 cm between plants/row (Lagunovschi L., 2016). Seedlings can be produsedwithout having them transplated in order to reduce costs related to culture starting (Posta, 2008).

MATERIAL AND METHOD

Experiences were carried out in the years 2015-2016, being located in the Apahida-Juc vegetable area, Cluj County, on a land located in Somesul Mic meadow.

The purpose of the experience was to determine how some cauliflower hybrids behave if cultivated at different densities. The objectives were to determin plant growth (plant height, rosette diameter, inflorescence size) and achieved yield. In the experience the following hybrids were used: Valiente F1, Nautilus F1, Stargate F1 and Sevilla F1.

Valiente F1 is a highly productive tardy hybrid with a vigorous foliar system that ensures good inflorescence protection. The vegetation period is 75-80 days from planting and the recommended density is 26 thousand plants/ha. Forms large, round-shaped, white, compact inflorescence, with a mean weight of 1-2 kg. The optimal temperature during the headforming period is 12-18ºC.

Nautilus F1 is a early hybrid, having a vegetation period of 65-75 days after planting. It has a vigorous foliar system with erect leaves that cover very well the inflorescence. Inflorescences are round and dense with an average weight of 1.5-2 kg. Recommended for spring, summer and autumn crops. It has increased resistance to higher summer temperatures. The recommended density is 25-35 thousand plants/ha.

Stargate F1, is a vigorous hybrid, reaches harvest maturity 72 days after planting. The foliar system ensures good protection of the inflorescence. The inflorescence is compact, white, with an average weight of 1-1.5 kg. It is recommended for spring and summer cultures.

Seville F1 is semi-late to late hybrid, recommended for early, summer and autumn crops, harvested approximately 75 days after planting. The inflorescence is large, globular, white, well covered by the vigorous foliage system with an average weight of 1.5-2.0 kg. The recommended density is 26 thousand plants/ha.

The planting of the seedlings was carried out at a distance of 75 cm between the rows and 0.35 cm between the plants/row (for a density of 38.1 thousand plants/ha) and 0.45 cm between the plants/row (for a density of 29.6 thousand plants/ha.

From the combination of the two experimental factors (cultivar and density) eight experimental variants have resulted, that were placed in three rehearsals.

For the setting up of the crop, untransplanted seedlings, aged 45 days at the time of planting (20 June 2016), were planted. During the vegetation period, the crop-specific field crop technology was applied and the observations made by the experimental protocol were performed. The harvest was carried out in September, depending on the vegetation period of each cultivar.

RESULTS AND DISCUSSION

The growth of cauliflower plants was different, depending on the cultivar and planting density. Plant height averaged between 77.0 cm at Valiente hybrid and 81.5 cm in the Nautilus and Sevilla hybrids (Table 1). The diameter of leaf rosette varied on average between 70.6 cm at Sevilla hybrid and 76 cm at Valiente and the leaf/plant number ranged between 15.5 (Valiente, Sevilla) and 18.2 (Nautilus).

All hybrids cultivated had a lower leaf rosette diameter at a density of 38.1 thousand plants/ha compared to 29.6 thousand plants/ha, similar results were obtained by Selvakumar et al. in 2017 during his reserch. The planting of seedlings at a distance of 35 cm between plants/row determined a reduced number of leaves/plant compared to those planted at 45 cm.

Table 1

Growth and development of cauliflower plants before harvest

Variant		Plant hight (cm)	Rosette diameter (cm)	Number of leafs
Cultivar	Density thousands pl/ha			
Valiente F_1	29.6	75.0	78.0	17.5
Valiente F1	38.1	79.0	74.0	13.9
Valiente F1	*Average*	*77.0*	*76.0*	*15.5*
Nautilus F1	29.6	80.0	78.0	21.0
Nautilus F1	38.1	83.0	66.0	15.5
Nautilus F1	*Average*	*81.5*	*72.0*	*18.2*
Stargate F1	29.6	80.3	78.9	18.5
Stargate F1	38.1	74.9	66.5	16.6
Stargate F1	*Average*	*77.6*	*72.7*	*17.5*
Sevilla F1	29.6	88.6	71.7	16.8
Sevilla F1	38.1	74.5	69.5	14.2
Sevilla F1	*Average*	*81.5*	*70.6*	*15.5*

Table 2

Degree of cauliflower inflorescences development at harvest

Variant		Inflorescences height (cm)	Inflorescence diameter (cm)	Average inflorescences weight (kg)
Cultivar	Density thousands pl/ha			
Valiente F1	29.6	21.3	25.5	1.56
Valiente F1	38.1	20.3	24.0	1.23
Valiente F1	*Average*	*20.8*	*24.7*	*1.39*
Nautilus F1	29.6	25.4	26.5	1.48
Nautilus F1	38.1	22.7	24.0	1.25
Nautilus F1	*Average*	*24.1*	*25.2*	*1.36*
Stargate F1	29.6	22.7	26.6	1.35
Stargate F1	38.1	21.8	24.9	1.18
Stargate F1	*Average*	*22.2*	*25.7*	*1.26*
Sevilla F1	29.6	24.3	27.2	1.47
Sevilla F1	38.1	20.5	24.9	1.26
Sevilla F1	*Media*	*22.4*	*26.1*	*1.36*

The development degree of the inflorescences was influenced by the experimental factors (Table 2). The height of the inflorescences was on average between 20.8 cm (Valiente) and 24.1 cm (Nautilus). The diameter of the inflorescences ranged between 24.7 cm at Valiente and 26.1 cm at Seville. The average weight of the inflorescences was lower at Stargate (1.26 kg) and higher at Valiente (1.39 kg). By planting the seedlings at smaller distances and thus achieving a larger plant growth in culture, we have obtained inflorescences with smaller dimensions and a lower average weight. From the analysis of the unilateral influence of the cultivar on cauliflower yield, it was found that it ranged between 43.79 t/ha (Stargate) and 46.07 t/ha (Valiente). Compared to the average of the experience, there were no statistical differences in production ensured statistically (Table 3).

Table 3

Cultivar influence upon cauliflower yield

Cultivar	Yield		Differnce to control (t/ha)	Significance
	t/ha	%		
Valiente F_1	46.07	101.63	0.74	-
Nautilus F_1	45.71	100.83	0.38	-
Stargate F_1	43.79	96.60	-1.54	-
Sevilla F_1	45.75	100.92	0.42	-
Average	45.33	100.00	-	-
DL P 5%	4.02			
DL P1%	7.65			
DL P 0.1%	9.74			

By selecting different densities in cauliflower crops, cauliflower yield varied (Table 4). The production was higher at the density of 38.1 thousand plants/ha, the production increase compared to the density of 29.1 thousand plants/ha being of 10.53% and the production difference was significant.

Table 4

Unilateral influence of plant density on cauliflower production

Density thousands pl/ha	Production		Differnce to control (t/ha)	Significance
	t/ha	%		
29.6	43.14	100.00	-	-
38.1	47.53	110.53	4.39	*
DL P 5%	3.62			
DL P1%	6.47			
DL P 0.1%	9.14			

Table 5

Combined influence of cultivar and plant density upon cauliflower production

Variant		Production		Differnce to control (t/ha)	Significance
Cultivar	Density thousands pl/ha	t/ha	%		
Valiente F1	29.6	45.28	99.88	0.05	-
Valiente F1	38.1	46.86	103.37	1.53	-
Nautilus F1	29.6	43.80	96.62	-1.53	-
Nautilus F1	38.1	47.62	105.05	2.29	-
Stargate F1	29.6	39.96	88.15	-5.37	0
Stargate F1	38.1	47.62	105.05	2.29	-
Sevilla F1	29.6	43.51	95.98	-1.82	-
Sevilla F1	38.1	48.00	105.89	2.67	-
Average		45.33	100.00	-	-
DL P 5%	3.95				
DL P 1%	6.72				
DL P 0.1 %	9.44				

Analyzing the combined influence of the cultivar and the planting density on the production it was found that at the density of 38.1 thousand plants/ha all cultivars achieved higher yields compared to the density of 29.6 thousand plants/ha (Table 5). Compared with the average of the experience, no significant production differences were recorded, with the exception of the Stargate hybrid, which at a density of 29.6 thousand plants/ha recorded a significant negative production difference.

CONCLUSIONS

Based on the results obtained from the field research of cauliflower crops, under the specific conditions of the Apahida-Juc area, using the Valiente, Nautilus, Stargate and Sevilla hybrids at different densities of 29.6 and 38.1 thousand plants per hectare, the following conclusions were drawn:

- plant root, leaf rosette diameter and leaf/plant number had different values depending on the cultivar;
- at the density of 38.1 thousand plants/ha the diameter of the leaf rosette and the number of leaves/plant had lower values compared to the density of 29.6 thousand plants/ha;
- the density of 38.1 thousand plants/ha has ensured higher yields for all hybrids without significant production differences compared to the average of the experience;
- the highest yield (48 t/ha) was recorded by cultivating the Sevilla hybrid at a density of 38.1 thousand plants/ha.

REFERENCES

1. Apahidean Al.S., Al.I. Apahidean. (2016). Legumicultura, Ed.Risoprint, Cluj-Napoca.
2. Ciofu Ruxandra, N. Stan, V. Popescu, Pelaghia Chilom, S. Apahidean, A. Horgoş, V. Berar, K.F.Lauer, N.Atanasiu. (2003). Tratat de Legumicultură, Ed.Ceres, Bucureşti, 712-714.
3. Draghici Elena. (2002). Legumicultura, Ed.GRANADA, Bucuresti.
4. Gherghi A., I. Burzo, Miruna Bibicu, Liana Mărgineanu, Liliana Bădulescu (2002). Biochimia şi fiziologia legumelor şi fructelor, Ed. Academiei Române, Bucureşti.
5. Indrea D., Al.S. Apahidean, Maria Apahidean, D. Măniuţiu, Rodica Sima (2012). Cultura legumelor, Ed.Ceres, Bucureşti.
6. Lagunovschi-Luchian Viorica, C.Vînătoru. (2016). Legumicultură, Ed.ALPHA MDN, Buzău.
7. Mohanty S., B.K. Srivastava. (2002). Effect of time of planting and method of crop raising on seed production of "Pant Shubhra" midseason cauliflower (*Brassica oleracea, var. botrytis, subvar. cauliflora L.),* Indian Journal of Agricultural Sciences, 72 (11), 682-684.
8. Patron P. (1992) Legumicultura, Ed. Universitas, Chişinău, R.Moldova.
9. Popescu V., Roxana Zăvoianu, 2011, Cultura legumelor din grupa verzei, Ed. M.A.S.T., Bucureşti.
10. Prohens J., F Nuez (2008). Vegetables I, *Asteraceae, Brassicaceae, Chenopodiaceae and Cucurbitaceae*, Handbook of Plant Breeding, Vol.1, Springer, New York .
11. Poşta Gh. (2008). Legumicultură, Ed. Mirton, Timişoara
12. Savitçhi P., N. Munteanu, I. Andriescu (2013). Legumele din grupa verzei-Cercetare ştiinţifică, Ed.Ion Ionescu de la Brad, Iaşi.
13. Selvakumar P., S.N. Sinha, V.K. Pandita. (2007). Hybrid seed production in cauliflower (*Brassica oleracea, var. botrytis, subvar. cauliflora L.)* Indian Journal of Agricultural Sciences, 77 (10), 649-651.
14. Stan N., N. Munteanu. (2001). Legumicultura, vol.II, Ed." Ion Ionescu de la Brad", Iasi.
15. www.faostat.org