

STUDY ON A VARIETY OF BROCCOLI HYBRIDS WHEN THE CULTURE IS STARTED BY DIRECT SOWING

Ardelean Laura, Maria Apahidean, Al. I. Apahidean

University of Agricultural Sciences and Veterinary Medicine,
3-5 Mănăștur Street, Cluj-Napoca, 400372, România, apahidean_alx@yahoo.co.uk

Abstract: The cultivar is a key factor in vegetable production and the financial result largely depends on it. Cultivar can influence the level of production, the commercial aspect and the period in which production is obtained. Choosing the right cultivar should take into account the specific ecological zone where the culture is performed. Cauliflower cultures are started mainly by seedlings, but there are concerns for its cultivation, in some cases, by direct sowing. Transylvania climatic conditions are favorable for growing broccoli mostly during spring and autumn when temperatures are favorable for the formation of quality inflorescences. The experience took place in 2012, in the Reghin, Mures County. In the experimental culture, started by direct sowing, the following varieties were used: Cezar, Calabrese Natalino, Ramoso Calabrese and Green Calabrese and the planting epochs were May, June and July.

Keywords: broccoli, hybrid, planting epoch, direct sowing

INTRODUCTION

Broccoli is grown for its hypertrophied inflorescence that is used to prepare various dishes. Unlike cauliflower, from broccoli you can also use the secondary shoots, that resemble the main inflorescence, only smaller.

Broccoli inflorescences have a biochemically rich content, consisting of 5.5% carbohydrates, 3.3% protein, 0.4% fat, 1.1% ash, vitamins (C, over 120 mg/100 gsp, A-3500 UI/100 gsp, B1-0, 10 mg/100 gsp, B2-0, 21 mg/100 gsp), calcium salts (105-130 mg/100 gsp), iron-2, 3 mg/100 gsp, GSP-470 mg/100 potassium, phosphorus-83 mg/100 gsp, amino acids, flavonoids, Inola, isotiocianat, lutein, glucosinolate, phenolic salts, and other volatile components, some unknown (Gray, 1982, quoted by Apahidean, 2011). One kilogram of broccoli contains 25 grams protine, a gram of proteins, 12 g carbohydrates, 700 mg ascorbic acid, vitamins A, B1, B2, PP, minerals (Patron, 1992). Broccoli may help strengthen the immune system, slow the aging process, protects the body from infection, is detoxifying, contributes to skin care and is indicated in fighting obesity. Sulforaphane can destroy the bacteria *Helicobacter pylori*, which is responsible for the occurrence of gastritis and gastric ulcers (Zavoianu, 2010).

Climatic conditions of Romania allow farmers to grow broccoli in spring and autumn in open field of production and to obtain early cultures broccoli is grown in polyethylene tunnels (Ciofu et al., 2003, Indra et al., 2007, Berar et al., 2012). The chosen hybrid is a key factor of production, it can have a great impact on the financial result. Cultivar can influence the level of production achieved, the commercial aspect and the period in which production is obtained. Choosing the right cultivar should take into account the specific ecological zone where the culture will be carried out.

Broccoli cultures are usually started with small seedlings, previously obtained (Stan and Munteanu, 2001, Ciofu et al., 2003, Indra et al., 2007, Mohanty and Srivastava, 2002). Direct sowing culture method is practiced to obtain mini broccoli (Chaux and Foury, 1994, Selvakumar et al., 2007).

MATERIAL AND METHOD

The experiments took place in Reghin, Mures County. The aim of the experience was to determine which varieties give the best results in direct sowing culture in the specific climatic conditions Transylvanian plateau. Objectives were to determine plant growth (plant height, rosette diameter, inflorescence size) and production.

In the experience, these hybrids, were used: Caesar, Natalino Calabrese, Calabrese and Green Ramoso Calabrese, which were grown by direct sowing in the field. Planting epochs were May (05.05.2012) June (05/09/2012) and July (13/07/2012). By combining experimental factors 12 experimental variants resulted and were located in three repetitions. Plant emergence was recorded, 10 May, 14 June and 17 July 2012. Main inflorescence harvesting was done in the first decade of September for the first sowing date, in the first decade of October for the second sowing date and in the first decade of November for the third sowing date. During the vegetation period the specific technology for broccoli crops was applied and observations were made.

RESULTS AND DISCUSSION

Broccoli plant growth was affected by crop establishment period due to plant growth under different conditions of temperature and plant growth differed from one hybrid to another. After 30 days after emergence from the planting epoch I, plant height was between 5.6 cm at Calabrese Ramoso hybrid and 10.3 cm at hybrid Caesar (Table 1). Plants from the second planting epoch had a height between 5.1 cm Calabrese Ramoso and 8.7 cm at Caesar and plant from the III planting epoch had a height between 4.2 cm at Ramoso Green and 9.3 cm at Calabrese Calabrese. After 60 days from emergence broccoli plants were between 17.2 cm height (Ramoso Calabrese, planting epoch III) and 32.2 cm (Caesar planting epoch I). After 90 days the plants have reached a height between 30.6 cm (Calabrese Natalino, planting epoch III) and 57.4 cm (Ramoso Calabrese, planting epoch I). During the 90 days, the daily increase ranged from 0.34 cm / day at hybrid Ramoso Calabrese sown in III epoch to 0.64 cm / day at Ramoso Calabrese sown in epoch I.

Table 1
Influence of planting epoch upon plant growth at four broccoli hybrids
Reghin, 2012

Variant		Plant height (cm), after :			
Epoch	Hybrid	30 days	60 days	90 days	Daily growth
Epoch I	Cezar	10.3	32.2	49.3	0.54
Epoch I	Calabrese natalino	8.9	31.7	44.7	0.49
Epoch I	Ramoso calabrese	5.6	27.3	57.4	0.64
Epoch I	Green calabrese	12.8	35.9	47.4	0.52
EpochII	Cezar	8.7	22.9	44.3	0.49
Epoch II	Calabrese natalino	8.1	24.1	35.3	0.39
Epoch II	Ramoso calabrese	5.1	29.3	54.2	0.60
Epoch II	Green calabrese	6.9	25.5	31.6	0.35
Epoch III	Cezar	7.6	17.5	45.0	0.50
Epoch III	Calabrese natalino	7.1	20,0	30.6	0.34
Epoch III	Ramoso calabrese	4.2	17.2	45.6	0.51
Epoch III	Green calabrese	9.3	18.2	32.7	0.36

After 30 days from emergence the number of leaves / plant at planting epoch I was between 4.4 at Caesar Ramoso Calabrese hybrids, respectively 5.9 at Calabrese Green (Table 2). Plants sown in epoch II had between 2.9 leaves / plant at Calabrese Napolitano and 3.6 leaves / plant at Caesar and plants sown in epoch III era had between 2.5 leaves at Caesar and 4.2 leaves at Ramoso Calabrese. After 60 days from emergence broccoli plants had between 5.2 leaves (Calabrese Napolitano epoch II) and 14.0 (Green Calabrese, epoch I). After 90 days, the plants were growing between 13.6 leaves / plant (Calabrese Natalino, epoch II) and 20.5 (Ramoso Calabrese, epoch I). During the 90 days, the daily increase in the number of leaves / plant ranged from 0.15 at hybrid Natalino Calabrese sown in epoch II and 0.23 at Calabrese Ramoso cultivar sown in epoch I.

Table 2
The influence of sowing epoch upon leaf number at four broccoli hybrids
Reghin, 2012

Variant		Leaf number, after			
Epoch	Hybrid	30 days	60 days	90 days	Daily growth
Epoch I	Cezar	4.4	9.9	18.9	0.21
Epoch I	Calabrese natalino	4.8	11.6	17.7	0.19
Epoch I	Ramoso calabrese	4.4	12.0	20.5	0.23
Epoch I	Green calabrese	5.9	14.0	19.7	0.22
EpochII	Cezar	3.6	10.7	18.6	0.20
Epoch II	Calabrese natalino	2.9	5.2	13.6	0.15
Epoch II	Ramoso calabrese	3.0	10.3	16,9	0.19
Epoch II	Green calabrese	3,0	8.0	16,5	0.18
Epoch III	Cezar	2.5	13,0	19.4	0.21
Epoch III	Calabrese natalino	4.0	10.5	15.8	0.17
Epoch III	Ramoso calabrese	4.2	9.0	16.8	0.18
Epoch III	Green calabrese	3.6	10.8	20,1	0.22

Table 3
The influence of planting epoch upon rosette diameter at four broccoli hybrids
Reghin, 2012

Variant		Rosette diameter (cm), after :			
Epoch	Hybrid	30 days	60 days	90 days	Daily growth
Epoch I	Cezar	13.0	35.6	50.0	0.55
Epoch I	Calabrese natalino	11.3	49.0	60.0	0.66
Epoch I	Ramoso calabrese	6.7	50.6	81.0	0.90
Epoch I	Green calabrese	16.4	57.3	62.7	0.69
EpochII	Cezar	10.0	33.6	64.3	0.71
Epoch II	Calabrese natalino	6,0	26.1	59.9	0.66
Epoch II	Ramoso calabrese	6.1	41.0	76.1	0.84
Epoch II	Green calabrese	15.3	23.3	47.6	0.52
Epoch III	Cezar	6.9	34.1	74.4	0.82
Epoch III	Calabrese natalino	10.4	50.2	61.1	0.68
Epoch III	Ramoso calabrese	4.7	27.9	71.6	0.79
Epoch III	Green calabrese	10.2	52.3	71.5	0.79

After 30 days from emergence, plant leaf rosette diameter of epoch I, was between 6.7 cm at Ramoso Green and 16.4 cm at Calabrese Calabrese (Table 3). Plants sown in

epoch II have a rosette diameter between 6.0 cm at Natalino Calabrese and 15.3 cm at Calabrese Green and the rosette from the plants from epoch III, had a diameter between 4.7 cm at Ramoso Calabrese and 10.4 cm at Calabrese Natalino. After 60 days from emergence, plants had a rosette diameter between 23.3 cm (Green Calabrese, epoch II) and 57.3 cm (Green Calabrese, epoch I). After 90 days the plants rosette diameter was between 47.6 cm (Green Calabrese, epoch II) and 81.0 cm (Ramoso Calabrese, epoch II). During the 90 days, the daily increase of leaf rosette diameter ranged from 0.52 cm at hybrid Green Calabrese (II epoch) and 0.90 cm at Ramoso Calabrese (epoch I).

Broccoli different plant growth in the three planting epochs have influenced the production of the four hybrids. Average broccoli production ranged from 15.35 t / ha in epoch III and 23.80 t / ha in epoch I (Table 4). Output in epoch III was lower by 8.45 t / ha compared with that obtained in epoch I.

Table 4
The influence of planting epoch upon broccoli production

Reghin, 2012

Variant	Production		Difference to control (t/ha)	Significance
	t/ha	%		
Epoch I (May)	23.80	100.0	0.00	-
Epoch II (June)	23.50	98.7	-0.30	-
Epoch III (July)	15.35	64.5	-8.45	000
DL (p5%)			1.31	
DL (p1%)			1.81	
DL (p0.1%)			2.49	

Broccoli production ranged from 16.00 t / ha for hybrid Green Calabrese and 25.85 t / ha for hybrid Caesar (Table 5). Compared with hybrid Ramoso Calabrese, hybrid Caesar made a production increase of 22.0% compared to the control output gap is very significant.

Table 5
Hybrid influence upon broccoli production

Reghin, 2012

Variant	Production		Difference to control (t/ha)	Significance
	t/ha	%		
Ramoso calabrese	21.20	100.0	0,00	-
Cezar	25.85	122.0	+4.67	***
Calabrese natalino	20.45	96.5	-0.73	-
Green calabrese	16.00	75.5	-5.20	000
DL (p5%)			1.49	
D L(p1%)			2.26	
DL (p0.1%)			3.63	

Table 6

Combined influence of planting epoch and hybrid upon broccoli production

Reghin, 2012

Variant		Production		Difference to control (t/ha)	Significance
Epoch	Hybrid	t/ha	%		
Epoch I	Cezar	29.47	100.0	0.00	-
Epoch II	Cezar	29.60	100.5	+0.13	-
Epoch III	Cezar	18.53	62.9	-10.93	000
Epoch I	Calabrese natalino	24.27	100.0	0.00	-
Epoch II	Calabrese natalino	24.40	100.5	+0.13	-
Epoch III	Calabrese natalino	12.73	52.5	-11.53	000
Epoch I	Ramoso calabrese	22.53	100.0	0.00	-
Epoch II	Ramoso calabrese	23.07	102.4	+0.53	-
Epoch III	Ramoso calabrese	18.00	79.9	-4.53	00
Epoch I	Green calabrese	18.93	100.0	0.00	-
Epoch II	Green calabrese	16.93	89.4	-2.00	-
Epoch III	Green calabrese	12.13	64.1	-6.80	000
DL (p5%)				2.62	
DL (p1%)				3.61	
DL (p0.1%)				4.97	

Generally broccoli hybrids studied had achieved lower production when sowing was done in epoch III (July). Maximum yields were obtained in epoch II (Table 6).

CONCLUSIONS

Based on the results of the research conducted with the four hybrids of broccoli grown by direct seeding in three epoch of culture, the following conclusions emerged:

- During the 90 days, daily growth ranged from 0.34 cm / day at hybrid Ramoso Calabrese (epoch III) to 0.64 cm / day at Ramoso Calabrese (epoch I).
- The daily increase in leaf rosette diameter ranged from 0.52 cm at Green Calabrese hybrid (epoch II) and 0.90 cm at Ramoso Calabrese cultivar (epoch I).
- Production of broccoli ranged from 16.00 t / ha for hybrid Green Calabrese and 25.85 t / ha for hybrid Caesar
- In general broccoli hybrids studied had achieved lower production when sowing was done in epoch III (July). Maximum yields were obtained in epoch II.

REFERENCES

1. Apahidean Al. I., 2011, Cercetări privind cultura protejată de conopidă și broccoli in condițiile pedoclimatice ale podișului Transilvaniei. Teză de doctorat, Cluj-Napoca
2. Berar V., Maria Bălă, Olimpia Iordănescu, A. Dobrei, G. Poșta, 2012, Horticultură practică, Ed. de Vest, Timișoara
3. Ciofu Ruxandra, N. Stan, V. Popescu, Pelaghia Chilom, S. Apahidean, A. Horgoș, V. Berar, K.F. Lauer, N. Atanasiu, 2003, Tratat de Legumicultură, Ed. Ceres, București
4. Chaux Cl., Cl. Foury, 1994, Productions legumieres, Tome 2, TEC-DOC, Paris
5. Indrea D., Al. S. Apahidean, Maria Apahidean, D. Măniuțiu, Rodica Sima, 2009, Cultura legumelor, Ed. Ceres, București

6. 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
7. Patron P., 1992, Legumicultură, Ed. Universitas, Chișinău, R.Moldova
8. Stan, N., N. Munteanu, 2001, Legumicultură. Vol. II, Ed. „Ion Ionescu de la Brad”, Iași.
9. 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
10. Zăvoianu Roxana, 2010, Cercetări privind biologia și tehnologia speciei *Brassica oleracea* L., convar. *botrytis* L., var. *Cymosa Duchesne*, Teză de doctorat, București