

THE INFLUENCE OF THE CULTIVAR AND PLANTING DENSITY UPON THE CHINESE CABBAGE (*BRASSICA CAMPESTRIS* L. VAR. *PEKINENSIS* (LOUR) OLSON) GROWTH, DEVELOPMENT AND YIELD IN OPEN FIELD CULTURES

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Abstract. To study the influence of the cultivar and planting density upon the Chinese cabbage growth, development and yield, a bifactorial experiment was organized at the University of Agricultural Sciences and Veterinary Medicine from Cluj-Napoca in the autumn of 2011. The two factors were the Chinese cabbage cultivar, with two graduations (Granat variety and Vitimo hybrid) and the planting density, with three graduation (66.67, 80 and 100 thousand plants/ha). The results revealed that the best developed plants and the highest yields were obtained at those variants which were established at the lowest planting densities.

Keywords: Chinese cabbage, growth, development, yield, open field cultures.

INTRODUCTION

Even if the spring Chinese cabbage culture is usually more common because it is a very profitable culture, given by its short vegetative period, high yield and of the high demand for fresh vegetable from that time of the year (Kalisz, 2005), the autumn culture shouldn't be overlooked. Chinese cabbage (*Brassica campestris* var. *pekinensis*) has a short vegetation period, and it belongs to that group of plants which are the fastest growing of all leafy vegetables, so it can be cultivated with success after a main culture, in good conditions heads can be cut ten weeks after sowing; loose-headed types two to three weeks sooner, while seedlings four to five weeks after sowing (Larcom, 2003).

In Transylvanian Tableland specific conditions the optimal planting density, which gives a high yield is 80 thousand plants/ha (Laczi et al., 2012), while studies effectuated by Hill (1991) shows that the best yield can be obtain when the planting density is higher too. These results are in contradiction with the studies of Chirasantchai and Sidathani (1994), who obtained highest production when the planting density was smaller, so the increasing of plants number on the surface had no effect on the increasing of the yield. Different planting densities were examined by Linqi (1993), the results underlined once more that high yield is possible when the planting density is reduced, but also that in this case the whole plants and the cabbage heads had higher weights.

MATERIAL AND METHOD

The research has been carried out in the experimental field from Vegetable Growing Department of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, from August to November, in 2011.

The purpose of the experiment was the establishment of that planting density for each used variety which provides, in the end, the highest yields of Chinese cabbage, in late crops in Transylvanian area.

Two cultivars of Chinese cabbage were used: Granat variety which forms a tall, cylindrical head, and Vitimo hybrid, which has a barrel type head, both of them could be consumed raw or cooked in different culinary dishes.

To achieve the objectives of this experiment a bifactorial experiment was organized, which involved the following factors:

- Factor A: variety:
 - a₁: - Granat
 - a₂: - Vitimo F1
- Factor B: planting density:
 - b₁: - 100000 plants/ha
 - b₂: - 80000 plants/ha
 - c₃: - 66667 plants/ha

By these factors combination six experimental variants were obtained, which are presented in table 1.

Table 1

Experimental variants of the experiment

Nr. of variant	Variety	Planting density
1.	Granat	100.000
2.	Granat	80.000
3.	Granat	66.667
4.	Vitimo F1	100.000
5.	Vitimo F1	80.000
6.	Vitimo F1	66.667

Each experimental variant was placed into three repetitions, the surface of an experimental plot being 3 m². The seedlings were produced in a polyethylene tunnel, the planting was done in 20th of August, using the following distances: between rows 0.50 m, while between plants on rows the distance ranged between 0.20-0.30 m, according to the used density. At planting, at one month after this and at harvest observations were made regarding plants growth and development. Harvest was realized in November, when cabbage heads reached maturity.

During the vegetative period general and special maintenance of the culture was realized, taking care of a proper irrigation, well being known that the lack of water and very high temperatures are playing a high part in the bolting of this species.

RESULTS AND DISCUSSION

At maturity, plants height varied between 19.67 cm at Vitimo hybrid, planted at a density of 100 thousand plants/ha and 38.33 cm, at Granat variety planted at a density of 66.67 thousand plants/ha, while the diameters between 38.33 and 50.00 cm, at the same variants. The lowest values of cabbage heads height and diameter were registered at Vitimo hybrid, at the highest planting density while the highest ones at Granat variety at the density of 80 thousand plants/ha (fig. 1).

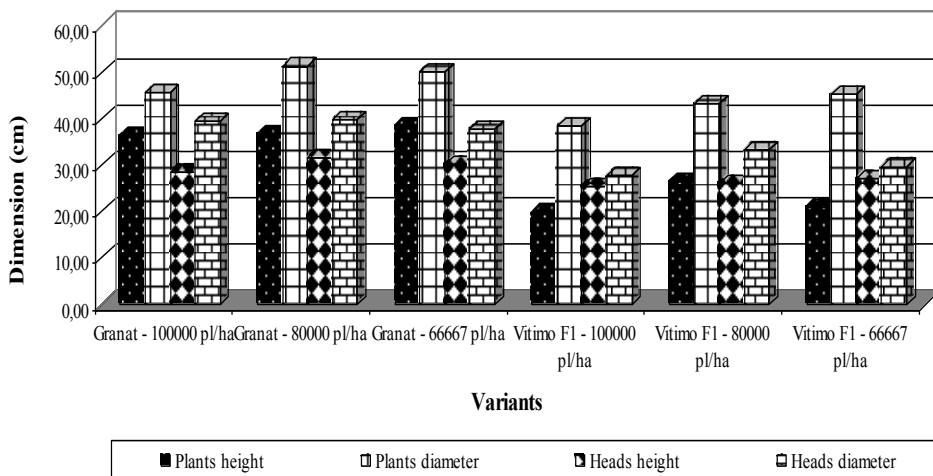


Fig. 1. Plants and cabbage heads height and diameter at harvest

From the total number of leaves point of view, in fig. 2. can be observed, that, in average, Vitimo hybrid had a higher number of leaves (which varied between 42.00 and 53.33), while Granat variety had in average only 36.90 leaves. The rosettes were formed from 6.33-9.00 leaves and the cabbage heads from 28.17-47.33 cm. Overall the results showed that a low density provided a higher number of leaves.

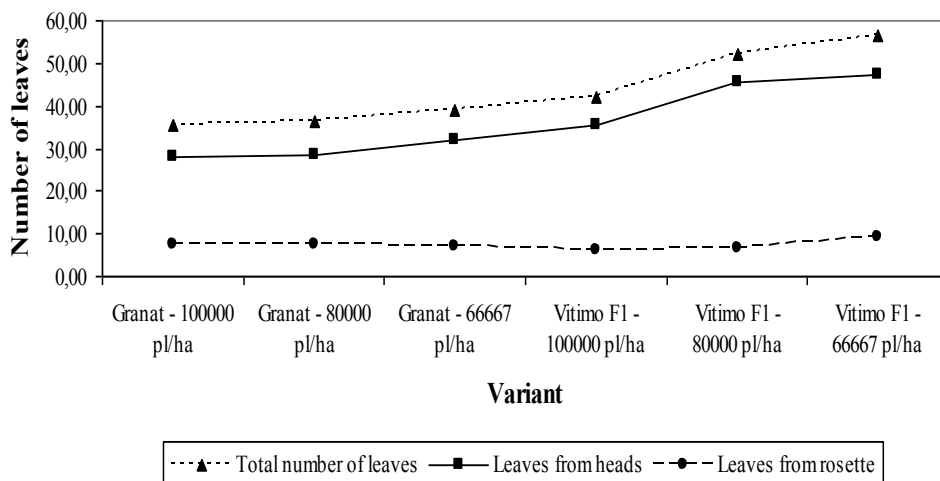


Fig. 2. Leaves layout at Chinese cabbage

The weight difference between the whole plants and cabbage heads varied between 80 g, at Vitimo hybrid, planted at the highest density, and 300 g, at Granat variety, planted at the lowest density. Compared the two cultivars, it can be observed that the waste due to outer leaves elimination, were higher at Granat variety (in average 180 g) compared to Vitimo hybrid (in average 120 g).

The highest weight of the whole plants (0.88 kg) as well as the cabbage heads (0.86 kg) were observed at Granat variety at a density of 80 thousand plants/ha (fig. 3.).

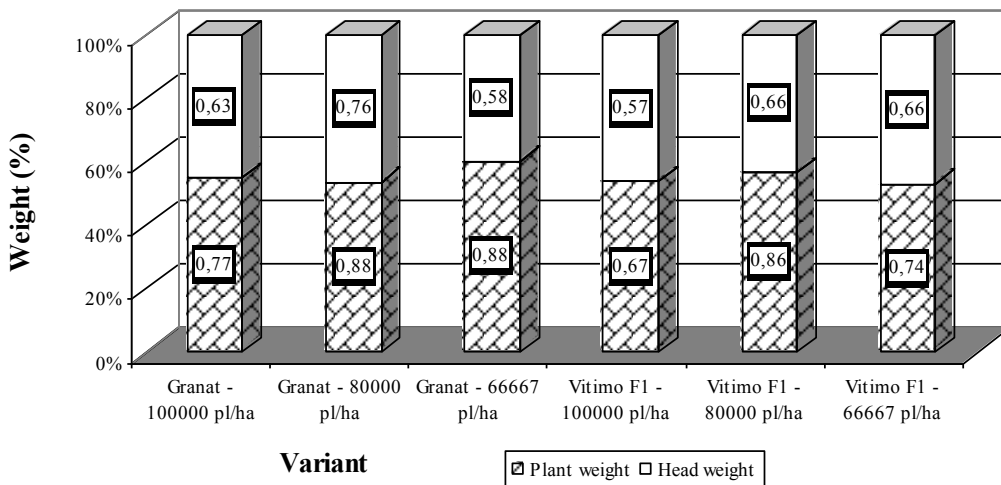


Fig. 3. Plants and cabbage heads weight comparison

The bolting of the Chinese cabbage is one of the most damaging physiological disorder of the culture, which can cause serious financial losses. In fig. 4. it can be observed that at Granat variety, at one month after planting, and at harvest too, there was registered a higher number of bolted plants than at the other cultivar, the bolting percentage varying between 4.17-6.67% at the first registration and between 5.00-13.00% at harvest.

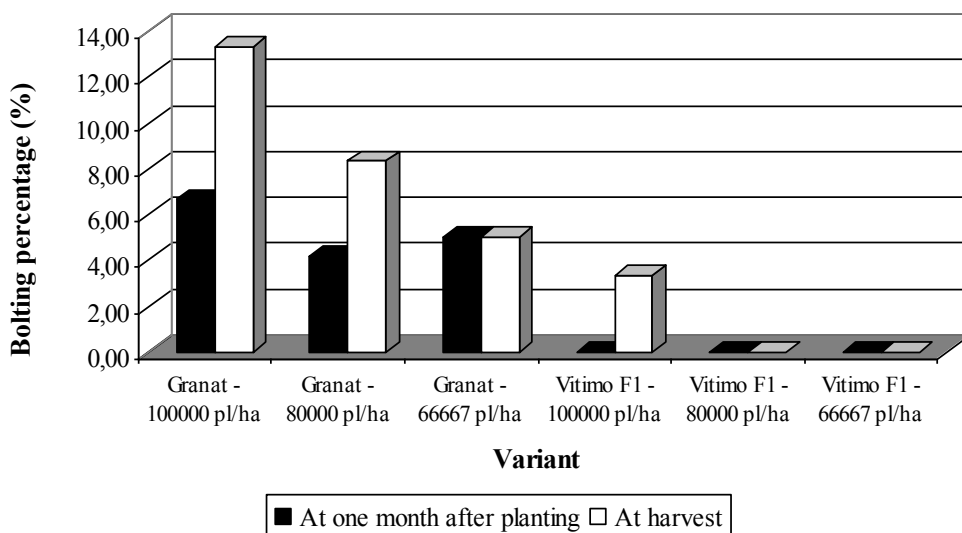


Fig. 4. Bolting percentage at Chinese cabbage

As can be observed in table 2., the cultivar didn't assured high differences, although the yield was higher with 1.27 t/ha when Granat variety was used.

Table 2

Unilateral influence of cultivar upon the Chinese cabbage yield

Cluj-Napoca, 2011

Variant / Cultivar	Average yield (t/ha)	Relative yield (%)	Difference (t/ha)	Significance	Relative yield (%)	Difference (t/ha)	Significance
Granat	57,37	100,0	0,00	Ct.	101,1	0,64	-
Vitimo F ₁	56,10	97,9	-1,27	-	98,9	-0,64	-
Average	56,74	-	-	-	100,0	0,00	Ct.

LSD (p 5%)

8,44

8,44

LSD (p 1%)

12,12

12,12

LSD (p 0,1%)

14,11

14,11

Regarding the unilateral influence of the planting density upon the yield, in table 3. can be observed that the yields varied between 41.22 t/ha, at the highest density and 67.67 t/ha, at the lowest one, so it can be concluded that a low density provided a higher production.

The yield obtained at the density of 80 thousand plants/ha was lower with 6.34 t/ha, while at the density of 100 thousand plants/ha with 26.45 t/ha compared to the control variant (the density of 66.67 thousand plants/ha), the differences being distinct and very significant negatives.

Table 3

Unilateral influence of planting density upon the Chinese cabbage yield

Cluj-Napoca, 2011

Variant / Planting density (plants/ha)	Average yield (t/ha)	Relative yield (%)	Difference (t/ha)	Significance	Relative yield (%)	Difference (t/ha)	Significance
66 667	67,67	100,0	0,00	Ct.	119,3	10,93	**
80 000	61,33	90,6	-6,34	oo	108,1	4,59	-
100 000	41,22	60,9	-26,45	ooo	71,7	-15,52	oo
Average	56,74	-	-	-	100,0	0,00	Ct.

LSD (p 5%)

5,96

5,96

LSD (p 1%)

8,68

8,68

LSD (p 0,1%)

13,01

13,01

The combined influence of the two factors (table 4.) reveals that both cultivars registered high yields at the lowest planting densities, while the lowest yields were observed at the higher density, yields varying between 38.67-70.13 t/ha at Granat variety and between 43.78-72.00 t/ha at Vitimo cultivars.

Compared to the average yields, distinct significant differences were observed at Granat variety planted at 80 thousand plants/ha density (the yield being higher with 22.2%) and at Vitimo hybrid which was planted at a density of 66.67 thousand plants/ha (the yield increase having a value of 15.90 t/ha).

Table 4
 Combined influence of planting density and cultivar upon the Chinese cabbage yield
 Cluj-Napoca, 2011

Variant		Average	Relative	Difference	Significance	Relative	Difference	Significance
Planting density (plants/ha)	Cultivar	yield (t/ha)	yield (%)	(t/ha)		yield (%)	(t/ha)	
66 667	Granat	63,33	100,0	0,00	Ct.	110,4	5,96	-
80 000	Granat	70,13	110,7	6,8	-	122,2	12,76	**
100 000	Granat	38,67	61,1	-24,66	ooo	67,4	-18,71	ooo
Average		57,38	-	-	-	100,0	0,00	Ct.
66 667	Vitimo F ₁	72,00	100,0	0,00	Ct.	128,3	15,90	**
80 000	Vitimo F ₁	52,53	73,0	-19,47	ooo	93,6	-3,57	-
100 000	Vitimo F ₁	43,78	60,8	-28,22	ooo	78,0	-12,32	oo
Average		56,10	-	-	-	100,0	0,00	Ct.

LSD (p 5%)

8,44

8,44

LSD (p 1%)

12,27

12,27

LSD (p 0,1%)

14,12

14,12

CONCLUSIONS

1. Plants and cabbage heads height and diameter had higher values at the lowest planting densities at Granat variety, while Vitimo hybrid provided plants with the higher number of leaves.

2. Even if Granat variety insured the heaviest cabbage heads, its bolting potential is higher than that of Vitimo hybrid.

3. The influence of the studied factors upon the yield reveals that higher yields can be obtained if a low planting density is used.

REFERENCES

- Chirasantchai, D. and K. Sitadhani, 1994, Effect of plant spacing on yield of Chinese cabbage in off season, Proceedings of the second symposium on vegetable and legume research, Kasetsart University, Research and Development Institute, Tropical vegetable research Center, Bangkok (Thailand), 142-146.
- Hill, T. R., 1991, Effect of plant spacing and nitrogenous fertilizer on the yield and plant conformation of Chinese cabbage (*Brassica campestris* ssp. *pekinensis*), Australian Journal of Experimental Agriculture, vol. 30 (3), 437-439.
- Kalisz, A., 2005, Usefulness of some Chinese cabbage (*Brassica pekinensis* Rupr.) cultivars for spring production, Zeszyty Naukowe Akademii Rolniczej we Wroclawiu Rolnictwo, vol. 515 (86), 223-229.
- Laczi Enikő, Al. S. Apahidean, Al. I Apahidean, 2012, Research Regarding the Planting Density Influence upon the Growth, Development and Yield of Chinese Cabbage (*Brassica campestris* var. *pekinensis* (Lour.) Olson) in Early Protected Crops in Transylvanian Tableland Specific Conditions, Bulletin USAMV, serie Horticulture, vol. 1., 189-197.
- Larkcom Joy, 2003, The Organic Salad Garden, Frances Lincoln Limited, London, 31-33.
- Linqi, S., 1993, Plant Density Effect on Chinese Cabbage Yield and Yield Component, AVRDC Publication