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Aspects regarding the influence of some pre-harvest technological links on the crop and on the keeping of quality's white cabbage

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Abstract This paper shows the influence of the epoch of planting and density of culture both on the production of cabbage and on maintaining its quality during the cold storage. Cabbage of variety Buzoiana was planted at three different times (the first period - June 10; the 2nd period - June 20, 3rd period - June 30) and at three different culture densities (40,000 plants/ha; 50,000 plants/ha, 60,000 plants/ha). After establishing production in the field, cabbage was stored in refrigerated conditions (T = 0-2ºC, RH = 85-90%) for 110 days, then weight losses , the losses by conditioning and the total losses were determinated. The main biochemical components of cabage were determinated before and after storage. The result of the researches led to the conclusion that both production and its quality, and ability to preserve the quality during storage are significantly influenced by the two important links of the culture technology : the period of planting and the density of culture.

Key words

planting period and density, weight losses, qualitative depreciations

In Romania, cabbage ranks the second place in total area cultivated with vegetables, our country being in the top ten world producers of this plant, with an annual production of over one million tonnes (12).

A crop of cabbage can be an opportunity including for farmers who have land poorer in terms of soil permeability, this because most seeds of cabbage can be grown on land with structures rather sandy - loam or loam. It is well known that cabbage needs a good irrigation, it being a consuming water vegetative.

White cabbage is particularly rich in pro-vitamin A, vitamins C and E, vitamin B1, vitamin B2, vitamin PP and in fiber, elements that ensure cell health, confering them valuable therapeutic properties. After much studies and researches, Korobkina [6] concluded that cabbage is among the richest sources of vitamins of vegetable species which are widely cultivated.

Taking into consideration the economic and food importance of cabbage, worldwide there are many preoccupations regarding the cultivation and valorisation of this species.

Maintaining the quality of the cabbage, as with other horticultural products, is determined by many factors that are closely interdependent, of which a particular importance is the culture technology.

The method of setting up of culture and the date range for implementation of this work reflects on production, crop quality and storage capacity of the cabbages. Maier [7], Balasa et al. [3], Mihalache et al. [8], cited by Bogoescu [4] recommends setting up of cabbage culture by nurselings planting, according to different varieties, in the period ranging between 10 to 25 March (early white cabbage) and 20 June -5 July (autumn cabbage).

Other authors recommend, for the establishment of summer and autumn crops, sowing directly in the field [8.11].

Harvesting period of cabbage is determined by variety, date of culture establishment, applied technology, production destination etc. [5].

The quality storage capacity is also influenced by the degree of maturity at which cabbage are harvested, which is determined by destination of valorisation [9,10]. Histological structure of the variety largely influences the capability of the quality maintaining after harvesting [1]. Also an important role in achieving and maintaining the quality of cabbage it has the amount of fertilizer applied to culture [2].

The present work shows the influence of period and density of planting on production, on qualitative and quantitative losses and on the main biochemical components, during storage of white autumn cabbage of variety Buzoiana.

Material and Methods

The researches were conducted during period 2015-2016, using a Romanian variety of autumn cabage – Buzoiana, obtained in a vegetable farm located in an area of the Romanian seaside.

Approved in 2008, the variety of white cabbage "Buzoiana" is a late variety, with a growing season of 140 days from emergence to consumption maturity. Head of cabbage has an elliptical - circular shape, with a diameter between of 18-21 cm and weight about 2-4 kg (70% of plants). In terms of productivity, the variety of cabbage "Buzoiana" can provide about 60-70 tons/hectare, especially if it is planted in southern areas of the country. This variety is suitable both for fresh consumption and conservation by pickling.

The trial was organized as a bi-factorial experience, with following experimental factors:

A – epoch of planting:

a1 - 10 June (epoch I)
a2 - 20 June (epoch II)
a3 - 30 June (epoch III)

B - planting density (plants/ha) :

b1 - 40,000
b2 - 50,000
b3 - 60,000

At harvest, in the field, it was performed weighing of the obtained cabbage for each variant of plant density and epoch planting. After this, the cabbage has been conditioned and transported to the storage location.

The storage was effectuated in refrigeration conditions (temperature = 0-2ºC; air relative humidity = 85-90%) for a period of 110 days, thereupon the following determinations were effectuated:

- the weight losses, resulted by evaporate-transpiration
-the losses by conditioning, resulted by removing yellowed leaves, of diseased ones and of the spine
- the main biochemical components

The determination of biochemical components was performed with the following methods:

- the refractometric method, using the ABBE refractometer in order to determine the content of soluble dry substance;
- the Bertrand titrimetric method, for the determination of the content of soluble carbohydrates;
- the titrimetric method, for the determination of the titratable acidity;
- the spectofotometric method, for the determination of the ascorbic acid
- the gravimetric method, for the determination of the cellulose;

During storage the hydro-thermal factors in the storage room were verified on a daily basis in order to ensure the respecting of the optimal conditions for the maintaining of the quality. Also, the appreciations were made concerning the cabbage' capacity to maintain their quality during storage, as well as the possible occurrence and development of various specific diseases.

Statistical elaboration of the experimental data was effectuated by analysis of variance, and the testing of significances of the differences between variants was done using the multiple comparison test – Duncan test.

Results

Results regarding the production of cabbage

The data obtained (Table 1) show that both epoch planting and density cabbage culture influences the production of cultivar Buzoiana. The biggest production of cabbage was recorded in culture planted in epoch II (20 June) that were earned on average 64.17 t/ ha, followed by the first period (10 June), with 60.60 t/ha, last place ranking, from this point of view, cabbage planted in epoch III (30 June), with 54.63 t/ha. The differences between all three variants are significant.

Table 1

The influence of the interaction between the period of planting and the plant density upon the cabbage's crop

M.U.=tones/ha

Epoch of planting	Planting density (thousand plants/ha)			Average per epoch of planting
	40	50	60	
I (June 10)	66.2 a	61.3 b	54.3 d	60.60 B*
II (June 20)	68.8 a	64.6 c	59.1 b	64.17 A
III (June 30)	60.8 b	53.2 d	49.9 e	54.63 C
Average per plant density	65.27 M	59.70 N	54.43 O	

*In the case of a group of letters (A…C for the average per epoch of planting, M…O for the average per plant density and a…e for the interaction between the epoch of planting and the plant density) the values sharing the same letter do not display significant differences at a level of 5% according to the Duncan test.

Evaluating the influence of planting distance, regardless of the epoch of planting, the highest production was obtained from the cabbage planted at a density of 40,000 plants/ha (65.27 t/ ha), and the smallest production was obtained from the cabbage planted at a density of 60,000 plants/ha (54.43 t/ha), with significant differences between the three densities of culture.

Analysing the influence of interaction epoch of planting x plant density highlights the fact that of the nine variants of epoch and planting density was noted production obtained from the culture of cabbage planted in the second period , at the density of 40,000 plants/ha (68.8 t/ha), with significant differences compared to others variants. The smallest production (49.9 t/ha) was obtained from the culture of cabbage planted in epoch III, at density of 60,000 plants/ha.

Results regarding the maintaining of the quality of cabbages

The data obtained (table 2) reveals that after 110 days of cold storage, regardless of culture density (40,000; 50,000; 60,000 plants/ha) planting epoch influences weight losses during storage. Thus, they increased from 8.77% at cabbage planted in the first period, to 10.43% at the epoch III, registering significant differences between the averages of three periods.

Table 2

The influence of the interaction between the period of planting and the plant density upon the quantitative losses during the storage of the white cabage

M.U.=%

Epoch of planting	Planting density (thousand plants/ha)			Average per epoch of planting
	40	50	60	
I (June 10)	7.0	8.2	11.1	8.77 A*
II (June 20)	7.9	9.1	12.4	9.80 B
III (June 30)	8,2	10.0	13.1	10.43 C
Average per plant density	7.70 M	9.10 N	12.20 O	

*In the case of a group of letters (A…C for the average per epoch of planting, M…O for the average per plant density) the values sharing the same letter do not display significant differences at a level of 5% according to the Duncan test.

It also finds that the density of culture influences weight losses, averages increasing with density (from 7.70% for the density of 40,000 plants/ha, up to 12.20% for the density of 60,000 plants/ha), with significant differences between the three densities of culture.

Losses by conditioning - qualitative depreciations (table 3) have also increased from the first period to the epoch III, registering minor differences between the first period (14.0%) and epoch II (14.9%), but significant between these and epoch III (16.7%).

Table 3

The influence of the interaction between the period of planting and the plant density upon the qualitative depreciation during the storage of the white cabage

M.U.=%

Epoch of planting	Planting density (thousand plants/ha)			Average per epoch of planting
	40	50	60	
I (June 10)	13.1	14.2	14.7	14.0 A*
II (June 20)	14.0	15.1	15. 6	14.9 A
III (June 30)	16.3	16.8	17. 5 0	16.7 B
Average per plant density	14.47 M	15.37 N	15.77 N	

*In the case of a group of letters (A…B for the average per epoch of planting, M…N for the average per plant density) the values sharing the same letter do not display significant differences at a level of 5% according to the Duncan test.

It was found that this type of losses also increased with density of culture, registering significant differences between density of 40,000 plants/ha (14.47%) and the other two variants of density of culture, but not significant between density of 50,000 plants/ha (15.37%), and 60,000 plants / ha (15.77%).

The total losses, resulting from adding the weight losses and those by conditioning, recorded values increasing from the first period to the epoch III and from the density of 40,000 plants/ha at that of 60,000 plants/ha, with significant differences between the three periods and three planting densities.

Table 4

The influence of the interaction between the period of planting and the plant density upon the total losses during the storage of the white cabbage

M.U.=%

Epoch of planting	**Planting density (thousand plants/ha)**			**Average per epoch of planting**
	40	50	60	
I (June 10)	20.1 a	22.4 b	25.8 cd	22.77 A*
II (June 20)	21.9 b	24.2 c	28.0 e	24.70 B
III (June 30)	24.5 c	26.8 d	30.1 f	27,13 C
Average per plant density	22.17 M	24.47 N	27.97 O	

*In the case of a group of letters (A…C for the average per epoch of planting, M…O for the average per plant density and a…f for the interaction between the epoch of planting and plant density) the values sharing the same letter do not display significant differences at a level of 5% according to the Duncan test.

It follows that both epoch and density of culture influences losses over a period of 110 days of cold storage of the cabbage variety Buzoiana, the lowest losses being recorded in the first period of planting (June 10th) and the density of 40,000 plants/ha. The cabbage planted in the epoch I has a longer period of vegetation to mature and the accumulation of dry matter and cellulose, which contributes to the success of keeping, while at density of 40,000 plants/ha plants have a larger area of nutrition, allowing the accumulation of these substances.

Also it was found that the main chemical components of cabbage are influenced by the epoch of planting (Table 5) and the density of culture.

Table 5

The influence of the period of planting upon the main biochemical components at harvest **and after the cold storage of the white cabbage**

Specification	**M.U.**	**Moment of determination**	**Variant**		
			a1	**a2**	**a3**
Soluble dry matter	%	I* II**	6.9 6.7	6.6 6.5	6.1 6.0
Ascorbic acid	mg/100g	I II	37.41 35.75	33.14 31.34	28.22 26.26
Titratable acidity	%	I II	0.14 0.16	0.17 0.20	0.21 0.25
Soluble carbohydrates	%	I II	5.18 4.83	4.67 4.07	3.90 2.71
Cellulose	%	I II	0.84 0.82	0.75 0,70	0.71 0.66

* at harvest
** after 110 days of cold storage

Values of soluble dry matter, soluble carbohydrates, cellulose and ascorbic acid decreased from the first epoch to the epoch III and from the density of planting of 40,000 plants/ha to those of 60,000 plants/ha, while the titratable acidity increased from epoch I to epoch III and from density of the planting of 40,000 plants/ha to those of 60,000 plants/ha.

After 110 days of cold storage, the values of these indices were lower than those recorded at harvest, except for titratable acidity, whose values increased during storage.

Conclusions

Epoch of planting and density of cabbage culture, variety Buzoiana, influence both the average production per unit area, and its losses during storage in cold conditions.

The highest production (68.8 t/ha) were obtained in culture planted on 20 June (epoch II), with a density of 40,000 plants/ha, while the lowest crops (49.9t/ha) established on 30 June (epoch III) with a density of 60,000 plants/ha.

During cold storage, the lowest total losses (20.1%) are registered at cabbage coming from culture planted on 10 June (first epoch), with a density of 40,000 plants/ha, and the highest (30.1%) at cabbage coming from culture founded on 30 June (epoch III) with a density of 60,000 plants / ha.

In case of planting in the first epoch (June 10), with the density of 40,000 plants/ha, cabbage accumulate a higher content in soluble dry matter , soluble carbohydrates and cellulose, that contribute to the success of keeping cabbage.

During the storage of the cabbage reductions occurring in soluble dry matter content, soluble carbohydrates, cellulose and ascorbic acid, and acids accumulations, regardless of epoch of planting and culture density.

References

1. Alexe Constanta, Lamureanu Gh., Chira Lenuta, Pricop Simona, 2014. Assessment of storage capacity of some white cabbage varieties according to histological and histochemical structure. Journal of Horticulture, Forestry and Biotechnology, vol 18 (3), 2014 - Banat University of Agricultural Sciences and Veterinary Medicine Timosoara
2. Alexe Constanta, Vintila M., Lamureanu Gh., Chir A., Chira Lenuta, 2016. Maintaining of the quality after harvesting of the white cabbage, depending on nitrogen fertiliser doses aplied to the crop. Scientific papers, series b. Horticulture, vol. LVIV,I 2016. USAMV Bucuresti
3. Balasa M., Voican V., Savitchi C., Stan N., 1984. Legumicultura generala si seciala. Ed. Didactica si edagogica
4. Bogoescu M., 2014. Valorificarea verzei. Editura Cernaqrint, Bucuresti
5. Dumitrescu N., Nistor M., Mihalache M., Tudor S., 1972. Indrumatorul fermierului legumicol, Ed. Ceres, 1972:345
6. Korobkina Z. V.,1980. O kasifikatii qlodov i ovoscei qosoderjamis vitaminov. Konservnaia I ovoscesusilnaia qromaslenost.
7. Maier I., 1969. Cultura legumelor. En.Agrosilvica, Bucuresti
8. Mihalache M., Voican V., oescu V., 1985.Ghid entru meseria de legumicultor. Ed. Ceres
9. Salunkhe,D.K., S. S. Kadam S.S.,Chavan J.K.,1985. Postharvest Biotechnology Of Food Legumes Hardcover ; 115-129
10. Salunkhe,D.K., S. S. Kadam S.S., 1998. Handbook of Vegetable Science and Technology: Production, Compostion,
11. Welch H. C., 1998. Cabbage yeld and nutriant uqtake. California agriculture.
12. ttps://www.stiriagricole.ro/cele-mai-cultivate-soiuri-de-varza-din-romania