

Vegetables Cultivated in Biological System and their quality

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Abstract

The regulations regarding Romania's accession to the European Union in 2007 imply a series of norms and the rigorous control of both production technologies and quality of agricultural products, fertilizers and pesticides. The implementation of the European norms must be complete into the biological farms which produce ecological products. A correct application of a technology, especially for the horticultural cultures, involves a large quantity of organic matter into the substrate which provides not only the required organic matter in the soil, but also the minimum necessary of nutrients.

The goal of this work was to establish the optimal doses of both cow manure and chicken manure in order to obtain ecological quality of horticultural products. The experiments were developed on a 120 m² unprotected cold frame greenhouse at the Vegetables Crops Department of the University of Agricultural Sciences and Veterinary Medicine – Bucharest. Chemical fertilizers were not applied to the soil and prior to start the organic fertilization, soil analyses were made. Six experimental variants - three with different doses of semi-fermented cow manure and three variants with fresh chicken manure were used. Organic fertilizers were applied together with the soil cultivation for planting the seedlings.

The biological material used for the experiments was represented by two hybrids of early cabbage – Musketeer and Piton. From the moment of planting the seedlings outdoor, culture was studied during the vegetation period and periodically (at seven days) morphometrical analyses were made regarding the diameter of rosettes at different phases of growth.

During the harvest period, agrochemical analyses were made, in order to investigate the quality of the products obtained. Also, the soil nutrient supply was studied in dynamics with the nutrients coming from the organic fertilizers used and their solubility in time. The yield was continuously registered during the harvest period. The morphometrical determinations recorded in dynamics during vegetation showed that from the point of view of the vegetative growth, the best result was obtained by variant V5 of Musketeer hybrid.

Comparing the fertilized variants with the control, unfertilized, at the same date the diameter of rosette was significantly superior for all the variants fertilized with chicken manure. The variants fertilized with chicken manure guaranteed plants with both significantly larger diameter and weight. Both absorption and metabolism of the nitrates is different in plant and vary with the harvest time and the hybrid. In the case of Musketeer hybrid, the nitrates were absorbed in larger amounts at the beginning of the vegetation period, going to the critical limits.

For the Piton hybrid, the nitrates absorption is slower so that it exceeds the critical limits of 900ppm (Order No. 1 from January 3rd 2002 of Romanian Government) at the middle of the harvest period. When cabbage is sold, a constant control of the cabbage producer is necessary in order that the heads to be harvested subsequently to the nitrates absorption, when their metabolism starts.

It was observed that the best results were obtained in the variant V5, fertilized with 15 kg/m² chicken manure. The production results showed that the variants fertilized with chicken manure are all significant comparing with the control.

Among the variants fertilized with semi-fermented cow manure, only the variant fertilized with 2 kg of cow manure/m² recorded distinct significant results. For the small farmers who will produce ecological cabbage, it is essential to test the cultures, the cultivars and the hybrids for the organic fertilization in order to know the doses of fertilizers used for fertilization.

Keywords: organic fertilization, Musketeer and Piton cabbage, greenhouse, nitrate absorption

Introduction

The effort of rehabilitation of the agricultural ecosystems must be realized by the entire human community, being known the importance of agriculture as the only source for human nutrition and one of the most active and efficient practices to improve the environment. Hence, there emerge new ideas, conceptions, schools and systems which elaborate solutions to recover and preserve the agricultural ecosystems. One of these is represented by organic agriculture which is more and more present and which, besides a very good conservation of the soil properties, promises healthy products.

Organic ecological agriculture is the non-polluting agriculture which uses cultural technologies free of negative effects over the soil or plants, that agriculture which renounces sometimes to the pesticides, fertilizers and other chemical compounds (Davidescu and Davidescu, 1994; Papacostea, 1981; Papacostea, 1994).

The regulations regarding the join of Romania to European Union in 2007 imply a series of norms and the rigorous control of both productions' technologies and quality of agricultural products, fertilizers and pesticides. The implementation of European norms must be complete in the biological farms which produce ecological products.

The aim of this work was to establish the optimal doses of both cow manure and chicken manure in order to obtain ecological quality horticultural products (Davidescu and Davidescu, 1999).

Materials and Methods

The experiments were developed at the Vegetables Crops Department of the University of Agricultural Sciences and Veterinary Medicine – Bucharest, into a 120 m² unprotected cold frame greenhouse, unused for production for at least four years.

Culture was conducted with six experimental variants, representing different doses of organic fertilizers, which were applied according to the experimental scheme presented in table 1. The incorporation was made during the soil cultivation. Prior to this incorporation, the soil was analyzed regarding the content of fertilizers, pesticides and other polluting elements which can influence the quality of ecological production (Neața et al., 2005).

Table 1. The scheme of experimental variants

No. crt.	Variant	Hybrid	Fertilization
1.	V ₀	Musketeer F ₁	Control
2.	V ₁		20t/ha cow manure
3.	V ₂		40t/ha cow manure
4.	V ₃		60t/ha cow manure
5.	V ₄		10t/ha chicken manure
6.	V ₅		15t/ha chicken manure
7.	V ₆		20t/ha chicken manure
8.	V ₀ ¹	Piton F ₁	Control
9.	V ₇		20t/ha cow manure
10.	V ₈		40t/ha cow manure
11.	V ₉		60t/ha cow manure
12.	V ₁₀		10t/ha chicken manure
13.	V ₁₁		15t/ha chicken manure
14.	V ₁₂		20t/ha chicken manure

The fertilizers were spread before the culture establishment. The bifactorial type of experience considered the “a” factor being the hybrid with two graduations: Piton F1 and Musketeer F1 and the “b” factor being the dose of fertilizer which was applied in six graduations, respectively: 20, 40 and 60 t/ha cow manure and 10, 15 and 20 t/ha chicken manure. The control consisted in unfertilized variants of both hybrids, Piton and Musketeer.

The biological material was represented by two hybrids, **Piton F1** and **Musketeer F1**, both of them created by Novartis Seeds - B.V. - Vegetables & Flowers – Holland.

The sowing for obtaining the seedlings was made on 27th of January 2005. Seven days before field planting, the seedlings were acclimated and planted after that. For each hybrid, six variants were realized; each variant covered 10 m², so the total area for each hybrid was 60 m². The total number of plants per variant was about 66 plants.

The planting work was performed on March 25 following a planting scheme of 60x25cm, with a final density of 6.6 plants/m².

Starting with the moment of field planting, we observed and analyzed the culture during the vegetation period, measuring the rosette diameter in different growth phases.

With the purpose of testing the quality of the products, agrochemical analyzes were performed during the harvest period. We studied in dynamics the soil nutrient supply with the nutrients coming from the organic fertilizers used and their solubility in time. The yield was recorded continuously during the harvest period.

Results and Discussion

In the frame of the proposed experiments, the substrates were analyzed from the point of view of agrochemical characteristics.

The agrochemical characteristics indicated a slightly alkaline soil (the pH values were between 7.28 and 7.66), with a low content of soluble salts (between 0.046 and 0.124%), a low concentration of nitrogen, a good content of phosphorus and medium content of potassium. These results were according with a soil with high content of organic matter since the lots were unused for 2-3 years before this experiment.

Table 2. Agrochemical characteristics of the substrates before experiments
Date: 25.03.2005

Variants		pH	% soluble salts	Content in ppm			
				NH ₄ ⁺	NO ₃ ⁻	PO ₄ ³⁻	K ⁺
1	V ₀ (Mt)	7.54	0.046	1.25	2.75	39.0	45
2	V ₁	7.59	0.053	1.30	7.75	33.1	50
3	V ₂	7.66	0.059	2.15	8.20	42.8	65
4	V ₃	7.57	0.057	2.15	8.75	35.0	40
5	V ₄	7.54	0.067	1.35	9.5	34.5	45
6	V ₅	7.28	0.124	1.25	7.25	25.6	70
7	V ₆	7.27	0.057	1.25	6.50	30.7	45

The biometric measurements performed during the vegetation were represented by: the height of the plants, the number of leaves, the heads diameter and weight at harvest.

In the case of the Musketeer hybrid, the growth and development of plants was influenced by the organic fertilizers used for fertilization. The height of the plants varied between 12.68cm in variant V₀ (Mt) and 14.98cm in variant V₅ (fertilized with 15t/ha). The

best variants were those fertilized with 15t/ha chicken manure (V₅) and V₃ fertilized with 60t/ha cow manure.

Regarding the number of leaves, the variants fertilized with cow manure registered the highest values, respectively 26.1 in V₁ fertilized with 20t/ha cow manure and 17.5 in V₂ fertilized with 40t/ha cow manure.

All the variants fertilized with chicken manure presented close values for the number of leaves, between 11.20 and 11.92, respectively.

The cabbage heads diameters for the Musketeer hybrid varied between 18.2 and 24.32cm. In the case of cow manure fertilization, the use of a quantity of 40t/ha determined a mean diameter of 24.04cm.

Table 3. Biometrics measurements for the cabbage hybrids cultivated in organic system

Variant	Hybrid	The mean height of plants (cm)	The mean no. of leaves/plant	The mean diameter of rosette (cm)	The mean weight of heads g
V ₀	Musketeer F ₁	12.68	4.8	18.2	690.3
V ₁		13.52	26.2	19.28	701.3
V ₂		13.93	17.5	24.32	831.1
V ₃		14.6	11.48	23.27	927.6
V ₄		14.26	11.2	21.16	881
V ₅		14.98	11.92	24.04	889.8
V ₆		13.66	11.76	22.36	947.1
V ₀ ¹	Piton F ₁	15.52	11.16	23.62	1151.5
V ₇		17.02	10.92	24.92	1392.7
V ₈		18.32	29.2	26.7	1542.5
V ₉		18.12	11.56	27.34	1368.5
V ₁₀		18.78	12.08	27.86	1818.5
V ₁₁		20.6	12.36	32.26	1836
V ₁₂		16.5	11.16	25.12	1887

The mean weight of the heads varied between 690.3 and 947.1g. The best variants were obtained when the soil was fertilized with doses of 20t/ha chicken manure and 80t/ha cow manure.

For the Piton hybrid, the fertilization with chicken manure determined a higher height of the plants. The best variant was V₁₁ fertilized with 15t/ha, which recorded a height of 20.6cm.

Concerning the number of leaves the best variant was variant 8, fertilized with 40t/ha cow manure (29.2cm) and V₁₁ fertilized with 15t/ha chicken manure (12.36cm).

The greatest rosette diameters were obtained from the chicken manure fertilization with 10 and 15t/ha. For this parameter, the results were 32.26cm for V₁₁ (15t/ha chicken manure) and 27.86cm for V₁₀ (10t/ha chicken manure).

Analyzing the results regarding the weight of the heads, we observed that the variants fertilized with chicken manure recorded the biggest values, which varied between 1887g for V₁₂ (20t/ha chicken manure) and 1818.5g for V₁₀ (10t/ha chicken manure).

The quality of the cabbage was investigated at the beginning of the harvest and for all the period of harvest. We remarked that the Musketeer cabbage reached the maturation faster than the Piton cabbage.

The agrochemical quality analyses of the cabbage heads were quite different for the major nutrients (N, P, K) and in close relationship with the quantity and type of manure applied.

The content of N-NO_3^- for the **Musketeer hybrid** varied with the harvest time. The highest values varied between 500ppm in the control plants and 1025ppm (V5-15 t/ha chicken manure) and they were recorded at the first period of harvest (13.06.2005). The data showed that the variants fertilized with chicken manure registered high values of nitrates in the cabbage heads. The variants fertilized with cow manure were assimilated close quantities of nitrates, the values registered being between 760ppm and 815ppm N-NO_3^- . The nitrates content in this period of harvest were above the critical limits of 900ppm N-NO_3^- established by the Order of the Romanian Ministry of Agriculture regarding the ecological products.

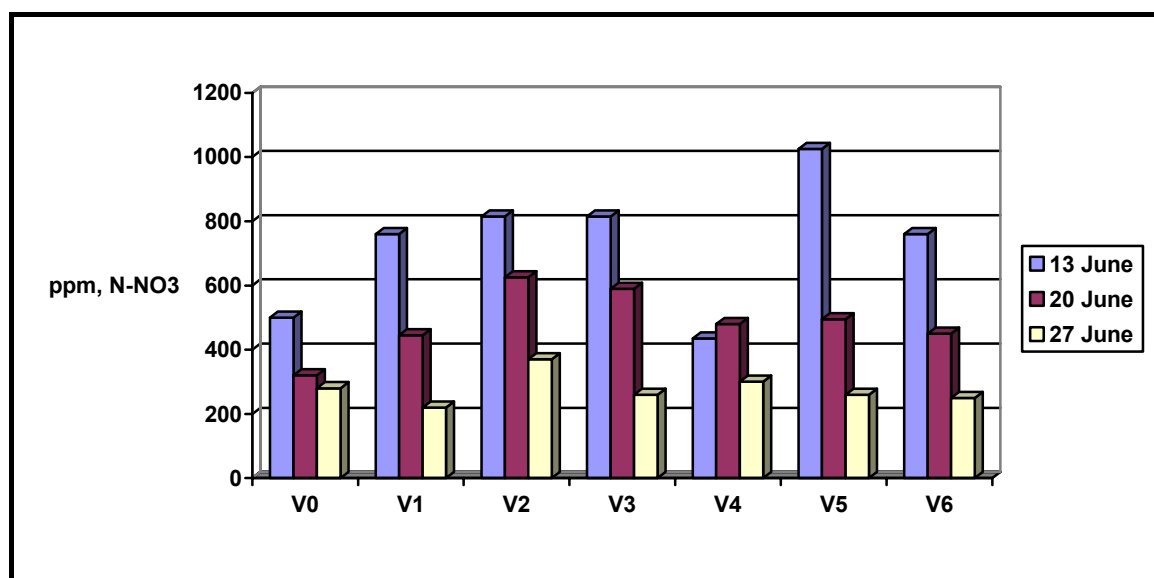


Figure 1. The nitrates content in cabbage heads for the Musketeer hybrid

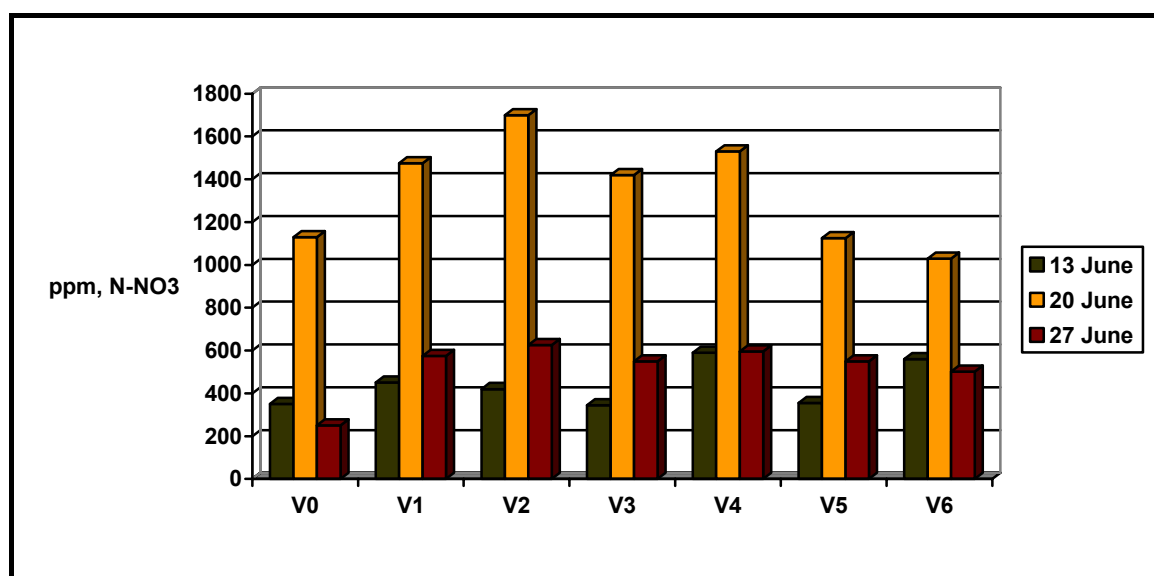


Figure 2. The nitrates content in the cabbage heads of Piton hybrid

The agrochemical analyses showed low contents of nitrates, between 345 and 590ppm, in the

beginning of the harvest period of Piton cabbage. Later, at the second harvest, the nitrates content increased dramatically to 1030 and 1530ppm, over the critical limits admitted by the Order of the Romanian Ministry of Agriculture regarding the ecological products (900ppm N-NO₃). At the third period of harvest, the nitrates values started to decrease, reaching values between 250 and 625ppm.

During the harvest period of Musketeer hybrid, we recorded the yield of each variant and these are presented in table 3.

Table 4. Statistical interpretation of yield results of Musketeer hybrid, using Fisher Test

Variant	Yield (kg / m ²)	Significance
Control	6.3	-
V ₁	6.6	* *
V ₂	6.0	*
V ₃	6.2	*
V ₄	7.8	* * *
V ₅	9.8	* * *
V ₆	7.6	* * *

DL 5% = 4.4 kg / m²

DL 1% = 6.54 kg / m²

DL 0,1% = 6.69 kg / m²

Table 5. Statistical interpretation of yield results of Piton hybrid, using Fisher Test

Variant	Yield (kg / m ²)	Significance
Martor	10.5	-
V ₇	9.3	-
V ₈	11.1	* * *
V ₉	10.9	* *
V ₁₀	12.8	* * *
V ₁₁	10.8	* *
V ₁₂	10.0	*

DL 5% = 9.81 kg / m²

DL 1% = 10.20 kg / m²

DL 0,1% = 10.82 kg / m²

Comparing the variants fertilized with cow manure and those with chicken manure, one can observe that the highest yields (between 7,6 and 9,8 kg/m²) were obtained from the variants V₄, V₅ and V₆ which were fertilized with 10 t/ha, 15 t/ha and 20 t/ha chicken manure. The best yield was recorded in V₅ fertilized with 15 t/ha chicken manure.

Analyzing the yield results of Piton hybrid (table 4), one can remark that these are qualitatively better compared with Musketeer hybrid. The highest yield was registered by variant V₁₀ fertilized with 10 t/ha chicken manure.

The statistical interpretation of yield results presents very significant values for variant V₇ (20 t/ha cow manure) and V₁₀ (10t/ha chicken manure).

Conclusions

The experiments with organic fertilizers can be concluded in the following results:

1. Regarding the height of cabbage plants, it was remarked that the variants fertilized with chicken manure determined the best results. For the Musketeer hybrid, the best results for height, respectively of 14.98cm were registered by variant V₅ fertilized with 15t/ha chicken manure, and for the Piton hybrid, variant 11 with a height of 20.6cm;

2. The leaves number was strongly influenced by the presence of cow manure. Hereby, the Musketeer cabbage variant 1, fertilized with 20t/ha cow manure, obtained a mean number of 26.2 leaves, and the Piton cabbage variant 8, fertilized with 40t/ha cow manure, 29.2 leaves.
3. The mean diameter of heads was influenced by medium doses of organic fertilizers. Thus, the biggest diameters were registered by the variants fertilized with 40t/ha cow manure and 15t/ha chicken manure.
4. The nitrates content, as an indicator of quality of cabbage heads showed that the absorption of this element is higher at the beginning of harvest period for the Musketeer hybrid and second period for the Piton hybrid. These results involve a quality heads certification during the harvest period, in order to sell this product after the maximum absorption of nitrates.
5. The yield results showed that the variants fertilized with chicken manure are very significant compared with the control.
6. Among the variants fertilized with semi-fermented cow manure, only the variant fertilized with 40t/ha cow manure recorded distinctly significant results.
7. It is necessary to continue the experiments by increasing the cow manure doses.

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