VEGETABLE GROWING ON ECOLOGICALLY CERTIFIED LAND

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***Abstract**: As an answer for a certain consumers category and in the frame of European concern for environment protection and healthier food, the Research-Development Station for Vegetable Growing, Bacău has been carying on, for several decades, researches for obtaining ecological vegetables. Researches of ecological agriculture are few, because, by definition and by legislation, ecological poducts have intrinsic value, exclusively detemined by the growing technologies. The Station has ecologically certified land ever since 1992. From the agrochemical point of view, the soil ment for ecological crops is normally developed, slightly acid, with a medium supply of the main nutritional elements, characteistic for the first terrace of the Siret river, suitable for vegetable gowing. The climate is moderately continental, with a multi-annual average temperature of 8,9ºC, characteristic for the second suitability zone for vegetable gowing, and the rainfall multi-annual average is 520 mm/m^2, the rainiest month is in summer – July, with a multi-annual average of 80 mm/m^2. Many vegetable species are grown of wich only a few: tomatoes, egg-plants and capsicum, are presented in this paper. Growing technologies are complex and include farm compost, green manure, and homologated and ecologically cetified products. The novelty of the researches carried on at SCDL Bacău consists of a complex approach having in view, at the same time, the preservation and improvement of the soil fertility properties, the plants nutritional status, the products mineral contents and their biochemical properties as compared to the same characteristics of conventionally grown vegetables. Increasing the yields, which are lower than those of the conventional vegetable growing, is also a goal, as well as improving the vegetables appearance, which is less pleasant than that of the conventional products. These last two aspects are limited by renouncing at the chemical fertilizers and pest control products. The final purpose of these researches, besides satisfying a certain consumers' category, is to create and maintain specialized markets and ensure an adequate profit for the farmers. The present paper presents results of these researches obtained in 2006 and 2007. The soil fertility status is maintained at an adequate level over the yeas, the nutritional status of the crops is comparable with that of the conventional crops, and the nutritional value of the products, expressed by the mineral contents and biochemical properties, is no different of those of the conventional products.*

***Key words:** ecological vegetables, soil fertility, nutritional status*

INTRODUCTION

Researches developped at the Research-Development Station for Vegetable Growing Bacău for almost 20 years aim to obtain practical informaton regarding soil fertility features evolution under ecological cultivation technologies, for a better management of ensuring an optimum plant nutrition. Conservation and improvement of soil fertility is pursued, as well as obtaining enough vegetable products with high nutritional qualities.

Even though the ecological agriculture principles are to be found in the rustic traditional agriculture, the production process needs to be brought up to the present knowledge level, as to maximize yields by minimizing risks, ensuring, at the same time, agricultural ecosystems protection, and to improve the quantity and quality of yields. The final goal is to develop a more efficient activity and to satisfy the growing demands of informed consummers.

As a relatively new activity, strictly regulated (Settlement CEE 1092/91), it hasn't been accompanied by a suitable research programme, in concordance with its spectacular developpment. The first specialized research centers were set up in Europe (France, Switzerland, Germany, England) less than 20 years ago and were directed towads varieties able to ensure efficient yields under ecological agriculture technologies and to identify natural bological means for pest contol.

The researches carried out at SCDL Bacău followed the same trend, starting in 1992. Varieties, species, crops cultivation and maintenance techniques were studied. Much attention was payed, in the last few years, to soil fertility, as maintaining and improving physical, biological, and agrochemical soil properties by specific means is of the gratest importance in ecological agriculture.

MATERIALS AND METHODS

The SCDL Bacău experimental field has a 7.5 ha surface. It's placed on the Bistrița – Siret interfluve, 4 km from their confluence, on a river terrace of 5-7 m relative altitude. The field was reconverted to ecological agriculture in the 1992-1995 period. Since 1999 the field is certified for ecological vegetable growing in rotation with other agricultural species.

The normally developped soil is a Cambic Chernozem moderately leached, formed on medium loam with loamy texture. It has a slightly acid reaction on the first 75-80 cm, a medium carbonates content in the carbonatic horizons, below 80 cm, 2.0-2.5% humus in the first 60 cm, the C/N ration is 10-12, and the base saturation degree is over 90%. It also has medium phosphorus (70-90 mg/kg) and potassium (165-195 mg/kg) supply. There are no restrictions for arable use and the field can be easily irrigated. The agrochemical index for vegetable growing suitability, according to DAVIDESCU AND DAVIDESCU, 1992, is 90 which includes the soil in the class of those verry good for vegetable growing.

The temperate climate of the region is specific to the Moldavia Tableland, with cold winters and hot summers, with a certain specfity due to the mountains proximity which sometimes moderates the summer excesive heat or increases the low spring and autumn temperatures. The average multiannual temperature is 8.9ºC, specific to the region II of vegetable growing suitability, the year's coldest month is January, with -4.3ºC, and the hottest month is July, with 20.3ºC. As compared to the South of the country, the vegetation period for vegetable species is, on an average, 3-4 weeks shorter, and this is a major criterion for choosing the vegetable species and sorts to grow in this region.

The multiannual rainfall average is approximately 520 mm/m^2, the most rainy month is in summer, June, with a multiannual average of 80 mm/m^2. The possible drought periods are compensated as the experimental field is part of a secure irrigation system supplied by the Bistrița river. The rainfall status has changed in the last few years, the multiannual average oscillates from excessive drought to ecessive rainfall.

The soil fertility evolution is studied by agrochemical monitoring of 20 lots. Two samples are taken from each one, twice a year, before setting up the annual crops and after harvest (April 1-15 and November 1-15). The soil reaction, humus and nitrogen contents, the C/N ratio, nitrates and ammonia, mobile phosphorus and potassium are determined in the samples, by standardized analytical methods.

The crops are organically fertilized, with farm compost and green manure. For pest control three vegetal extracts are used of three species cited in literature as having plant protection and fortyfing effect, stimulating transplants and young plants growth and preventing cryptogamic diseases of soil and plants. The planting material was twice sprinkled with 4%

copper sulphate and calcium hydroxide solution and treated with 0.075% Confidor. Green pepper was treated with Confidor before planting to fight an afides attack.

The soil fertility evolution was studied in a three lots experiment with four variants: unfertilized control, fertilizaton with 20 t/ha farm compost, fertilization with green mustard manure, and fertilization with both green manure and compost. On the first lot Mapamond cuccumbers were grown, solanaceae on the second, this time the green manure was wheat, and on the third lot Dulce de Bacău sweet corn and Cristina beans were grown, fertilized only with farm compost, 10 and 20 t/ha.

The vetables' nutritional status was studied on tomatoes, egg-plants, and capsicum crops. For tomatoes, a control was considered (V_1), a variant with green manure (V_2), two with farm compost 40 t/ha (V_3) and 10 t/ha (V_4), and two with both green manure and farm compost, 40 (V_5) and 10 (V_6) t/ha. Two variants were taken into account for egg-plants: control (V_1) and fertilization with green manure (V_2). Capsicum was fertilized only with farm compost: V_1 = un-fertilized control; V_2 = 10 t/ha farm compost; V_3 = 20 t/ha farm compost; V_4 = 40 t/ha farm compost.

The same variants as the tomatoes' experiment were used to analyse capsicum yields.

Leaves and fruits samples were taken in the crops' ripening period. Mineral elements contents were determined by standardized analytical methods. Biochemical determinations were also carried out on fresh fruits samples in order to assess the yields' quality. Yields were also measured and statistycally analysed.

RESULTS AND DISCUSSIONS

Soil fertility evolution

Soil reaction (Table 1) varies from slightly acid (5.95; DAVIDESCU AND DAVIDESCU, 1992) in the first lot control and very slightly acid (6.80) in the second lot control, up to practically neutral (7.15) in the compost fertilized variant of the first lot. It also gets very slightly acid (6,45) when both fertilizers are used in the second lot. It has a growing tendency under the influnence of organic fertilization (Figure 1). This tendency is stressed when applying both organic fertilizers (Figure 2).

Almost all of the pH values from the studied lots belong to the optimum domain for vegetable growing: 6.0-7.0 for cucumbers; 5.5-7.0 for tomatoes (DAVIDESCU AND DAVIDESCU, 1992).

The humus content (2.46-3.60%, Table 1) describes a medium fertility (Davidescu and Davidescu, 1992). According to the C/N ratios, the soils even reach the high fertility domain (C/N ratio 9-11, according to DAVIDESCU AND DAVIDESCU, 1992). The organic fertilization, with both green manure and farm compost, maintains the C/N ratio equilibrium, a sign of the good quality of both organic fertilizers and application technologies.

The mobile phosphorus supply starts from good (ICPA, 1981) in the Mapamond cucumbers lot. Adding compost increases this level, but when green manure or green manure and compost are used the supply level depletes down to low.

That happens because the compost obtained on the farm field is sometimes not homogenous as regards the nutritional elements contents. In the Solanaceae lot the mobile phosphorus supply is very good (>144 mg/kg, ICPA, 1981) and the registered values are more homogenous, even if lower than the control. In the lots differently fertilized with compost the mobile phosphorus supply increases with the compost dose but only up to a good supply.

The mobile potassium supply is low, according to ICPA, 1981. The organic fertilization increases this level in the first lot but not enough to outrun the supply class, while in the second lot the mobile potassium contents are lower under organic fertilization than the control.

Table 1

The reaction and nutritional macro-elements contents of the soils from the experimental field after differentiated fertilization with green manure and farm compost

Fertilization	pH_{H2O}	$N\text{-}NO_3$ mg/kg	Humus %	Total N %	C/N	P_{AL} mg/kg	K_{AL} mg/kg
Mapamond cucumbers crop							
Control	5.95	18	3.12	0.184	11.5	119	205
20 t/ha compost	7.15	18	3.00	0.198	10.2	141	219
Mustard green manure	7.06	25	3.60	0.202	12.1	104	226
Mustard green manure and 20 t/ha compost	6.95	14	3.36	0.204	11.1	60	246
Solanaceae crop							
Control	6.80	36	3.00	0.204	9.9	186	296
20 t/ha compost	7.00	27	3.06	0.170	12.2	166	252
Wheat green manure	6.63	31	3.24	0.172	12.7	151	205
Wheat green manure and 20 t/ha compost	6.45	24	3.18	0.194	11.1	138	199
Dulce de Bcău sweet corn crop							
10 t/ha compost	6.27	52	3.06	0.184	11.2	37	287
20 t/ha compost	6.35	4	2.82	0.174	11.0	46	199
Cristina beans crop							
10 t/ha compost	6.90	19	2.46	0.180	9.2	60	170
20 t/ha compost	6.35	17	2.76	0.176	10.6	114	168

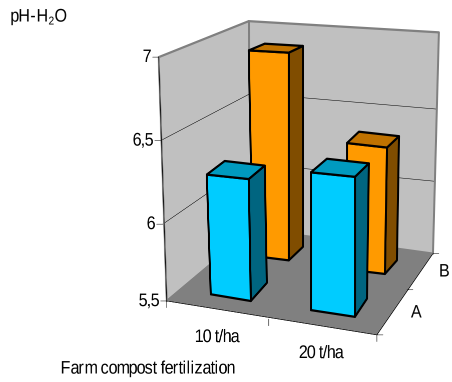

Figure 1 The variation of soil reaction in the ecological certified experimental field under the influence of differentiated compost fertilization
A – Mapamond cuccumber crop
B – Solanaceae crop

As compared to the normal contents of the vegetable growing soils (60-80 mg/kg N-NO_3, VINTILĂ et al., 1984) and especially to those usually encountered in the fertilized soils (90-200 mg/kg, LĂCĂTUȘU et al., 2004), the nitrate contents (Table 1) are much inferior because both the green manure and farm compost obtained through correct technologies are almost free of these compounds. Besides, the lack of nitrates is one of the requests towards ecologic products and the growing technologies take good care in avoiding them. Nitrogen plant nutrition is mostly based on introducing annual and perennial leguminosae in the rotation.

The contents of mobile macro-elements (zinc, copper, iron, manganese, Table 2) are homogenous. The mobile zinc contents are lower than the lower limit of the normal variation interval (3-10 mg/kg, LĂCĂTUȘU, 2006) but the conditions for zinc deficiency (neutral-alkaline reaction, high phosphorus content, LĂCĂTUȘU, 2006) don't come together. The copper contents belong to the normal variation domain (3-50 mg/kg, LĂCĂTUȘU, 2006). So we can assume that the plant's nutrition, on these soils, takes place at the lower limit of favorable conditions.

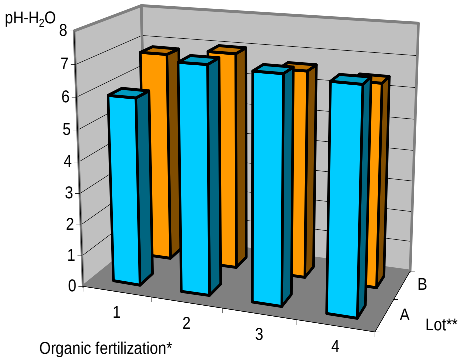

Figure 2 The variation of soil reaction in the ecological certified experimental field under the influence of differentiated green manure (mustard or wheat) fertilization

*1 – Control
2 – 20 t/ha compost
3 – Green manure
4 – Green manure and 20 t/ha compost
**A – Mapamond cuccumber crop
B – Solanaceae crop

Table 2

The mobile microelements contents (mg/kg) of the soils from the ecologically cerified experimental field of SCDL Bacău, after differentiated fertilization with farm compost and green manure

Fertilization	Zn	Cu	Fe	Mn
Mapamond cucumbers crop				
Control	2.3	9.9	31.9	25.3
20 t/ha compost	2.0	9.9	29.7	37.5
Mustard green manure	2.1	9.6	27.3	29.5
Mustard green manure and 20 t/ha compost	1.7	10.9	36.6	30.4
Solanaceae crop				
Control	3.0	13.0	40.4	28.6
20 t/ha compost	2.9	10.0	33.9	25.2
Wheat green manure	2.9	10.4	32.4	26.2
Wheat green manure and 20 t/ha compost	2.2	8.0	34.7	19.1
Dulce de Bcău sweet corn crop				
10 t/ha compost	1.8	10.2	53.0	24.1
20 t/ha compost	2.2	8.8	47.9	28.0
Cristina beans crop				
10 t/ha compost	2.9	8.2	29.8	25.3
20 t/ha compost	1.6	6.7	38.5	18.8

So, the long term exclusively organic fertilization doesn't significantly add to the soil nutritive elements supply, it has though the great merit to preserve the soil fertility features along with the natural equilibrium between the nutritional elements.

Vegetables' nutritional status

The total nitrogen contents of the tomatoe leaves (3.27-4.91%, Table 3) belong to the normal content domain. The total nitrogen contents of the egg-plants' leaves tend to outrun those of the tomatoes' leaves.

The phosphorus contents (0.20-0.40%) belong to the normal content interval too but they tend to outrun its limits, both towards the low and high contents domains.

The potassium contents exceed the normal contents domain for tomatoe leaves. The values corresponding to the green manure fertilized variant and the variant with both green manure and 40 t/ha farm compost stand out. The values of the egg-plants leaves (4.02-4.94%) are close to those of the tomatoes leaves. More potassium accumulates in the green manure fertilized variant.

Table 3

The mineral elements contents of the tomatoes, egg-plants, and capsicum leaves

Crop/ Variant	Total N	P	K	Ca	Mg	Zn	Cu	Fe	Mn	Pb	Ni	Cr	Co
			%						mg/kg				
Tomatoes													
V_1	3.27	0.40	4.50	5.79	0.81	34.7	60.5	599	83	6.3	17.3	11.9	7.8
V_2	3.49	0.36	5.26	5.99	0.88	54.1	33.7	750	86	6.3	23.8	7.7	10.4
V_3	4.91	0.40	4.90	7.79	0.81	53.3	54.6	734	113	9.4	20.5	3.5	10.4
V_4	4.41	0.39	4.78	6.29	0.85	38.4	40.6	541	92	9.4	14.0	3.5	5.1
V_5	4.72	0.37	5.21	5.79	0.77	49.7	28.9	371	70	6.3	17.3	7.7	5.1
V_6	4.76	0.25	4.82	10.29	0.65	34.7	89.9	564	62	6.3	23.8	11.9	18.3
Egg-plants													
V_1	4.89	0.20	4.02	10.49	0.81	19.4	104.6	595	63	3.1	30.3	7.7	20.9
V_2	4.90	0.40	4.94	5.79	0.63	36.2	65.5	734	82	6.3	23.8	11.9	10.4
Capsicum													
V_1	4.08	0.46	5.90	7.79	1.10	62.8	8.5	166	50	3.1	20.5	11.9	5.1
V_2	3.06	0.52	5.93	5.93	0.98	94.1	10.5	193	54	3.1	23.8	16.1	7.8
V_3	3.56	0.51	6.09	6.09	0.87	61.7	10.3	135	47	6.3	20.5	11.9	10.4
V_4	4.12	0.43	5.58	5.58	0.82	46.8	8.8	158	31	3.1	17.3	16.1	13.0

Calcium contents of the tomatoe leaves (5.79-10.49%) are at and over the upper limit of the normal content interval. The variant fertilized with green manure and 10 t/ha farm compost stands out. The egg-plants control leaves exceed twice the green manure fertilized variant (10.49 as compared to 5.79%).

Magnesium contents (0.65-0.88%) belong to the tomatoes' normal content interval. The fact can be noticed that the leaves of the tomatoes fertilized with green manure and 10 t/ha farm compost and those of the green manure fertilized egg-plants accumulate less magnesium (0.65 and 0.63%, respectively).

The microelements contents of the tomatoes' leaves have a diverse distribution. The zinc values correspond to the low content domain (19.4-54-1 mg/kg d.m.), the copper exceeds the high content level (33.7-104.6 mg/kg d.m.) which is normal taking into account that many pest control substances allowed in the ecological agriculture have important quantities of this element. As neither the zinc contents are as low as the poor content domain nor the copper ones are exaggerated there can be no nutritional desequilibrium. Besides, the normal zinc plant nutrition takes place, for most plants, in the interval 20-150 mg/kg d.m. (ICPA, 1980). However, this aspect must be observed in order to avoid the desequilibrium occurrence.

Iron contents exceed twice and even more times the upper limit of the tomatoes' leaves normal content interval. Excessive iron concentrations (>400 mg/kg d.m.) have been attributed to the zinc nutrition disturbance (TIFFIN, 1972, cited in ICPA, 1980). Iron toxicity however hasn't been noted.

Manganese contents belong to the normal content interval.

A high cobalt accumulation is noticed (5.1-20.9 mg/kg d.m.), especially in egg-plants, which could bring about the iron and manganese nutrition disturbance, but only when these elements have a low availability, which is not the case. Besides, cobalt accumulations toxic to plants and animals are unlikely in natural soils (ICPA, 1980).

So we can say that the tomatoes and egg-plants of the ecologically certified experimental field of SCDL Bacău have a well-balanced mineral nutrition.

The total nitrogen contents in the capsicum leaves belong to the normal variation interval (0.2-6.0% d.m., ICPA, 1980) and no variation is noticed due to farm compost administering. In general, no nutritional element presents a variation related to farm compost administering. The latter role is quantitatively reflected by the yields and fruit quality. The high zinc content can be noticed though in the 10 t/ha farm compost fertilized variant and the double lead quantity in the 20 t/ha farm compost fertilized variant. Far from excessive, these deviations are punctual accidents due to the manner of administering farm compost and pest control treatments.

The fruits mineral quality

The tomatoes total nitrogen contents (141-161 mg/100 g fresh material, Table 4) differ very little (with approximately 12.5%) in favor of the variants fertilized with both green manure and farm compost. It can be noticed that egg-plants accumulate more total nitrogen in the control than in the green manure fertilized variant (240 as compared to 179 mg/100g fresh material).

Table 4

The mineral elements contents of tomatoes, egg-plants, and capsicum grown at SCDL Bacău on ecologically certified land

Crop/ Variant	Total N	P	K	Ca	Mg	Zn	Cu	Fe	Mn	Pb	Ni	Cr	Co
	mg/100 g fresh material												
Tomatoes													
V_1	149	238	85	12.8	7.7	0.13	0.022	0.46	0.059	0.013	0.035	0.007	0.010
V_2	145	241	89	8.8	8.0	0.17	0.025	0.75	0.058	0.006	0.041	0.024	0.016
V_3	141	248	86	7.8	8.2	0.14	0.018	0.34	0.062	0.013	0.035	0.007	0.021
V_4	167	234	81	8.8	6.4	0.15	0.020	0.47	0.054	0.013	0.035	0.015	0.021
V_5	160	206	65	6.3	3.9	0.12	0.017	0.26	0.051	0.013	0.022	0.015	0.026
V_6	161	231	82	7.8	5.1	0.12	0.024	0.29	0.065	0.006	0.028	0.015	0.010
Egg-plants													
V_1	240	255	89	12.8	11.6	0.23	0.034	0.59	0.095	0.013	0.028	0.007	0.021
V_2	179	226	84	8.8	10.9	0.19	0.029	0.72	0.092	0.006	0.022	0.015	0.016
Capsicum													
V_1	96	255	86	7.8	5.5	0.14	0.022	0.27	0.050	0.006	0.028	0.007	0.010
V_2	187	293	89	6.3	6.6	0.17	0.027	0.33	0.061		0.028	0.015	0.016
V_3	129	290	88	7.8	6.5	0.14	0.030	0.25	0.060	0.013	0.035	0.007	0.010
V_4	123	304	88	3.8	8.2	0.18	0.027	0.35	0.056	0.006	0.028	0.007	0.010

On the background of relatively similar phosphorus contents (206-255 mg/100 g fresh material) a lower content (206 mg/100 g fresh material) is noticed in the variant fertilized with green manure and 40 t/ha farm compost in tomatoes and a relatively high difference (255 as compared to 226 mg/100 fresh material) in favour of the egg-plants control.

The potassim contents in tomatoes is lower as well in the variant fertilized with green manure and 40 t/ha farm compost (65-89 mg/100 g fresh material). The other potassium contents values are very close to each other.

In the case of calcium, the same variant, fertilized with green manure and 40 t/ha farm compost, presents a lower value, and, again, the egg-plants control has a higher content (12.8 as compared to 8.8 mg/100 g fresh material).

Magnesium has a larger variation, from 3.9-5.1 mg/100 g fresh material in the tomatoes variants fertilized with green manure and farm compost to 8.0 and 8.2 mg/100 g fresh material in the variants fertilized with green manure, respectively 40 t/ha farm compost, and up to 10.9-11.6 mg/100 g fresh material in egg-plants.

Likewise, from the data presented in Table 4, it results that egg-plants accumulate more zinc (0.19-0.23 as compared to 0.12-0.17 mg/100 g fresh material), copper (0.029-0.34 as compared to 0.017-0.25 mg/100 g fresh material), iron (0.59-0.72 as comapred to 0.26-0.75 mg/100 g fresh material), manganese (0.092-0.095 as comapred to 0.051-0.065 mg/100 g fresh material). Except for the tomatoes iron content in the green manure fertilized variant (0.75 mg/100 g fresh material) which exceeds the egg-plants contents.

Differences are also noticed in the case of cobalt contents: the farm compost fertilized tomatoes and the control egg-plants accumulate more cobalt (0.021 mg/100 g fresh material), and the most accumulate the tomatoes fertilized with green manure and the maximum farm compost dose (0.026 mg/100 g fesh material).

From the relative nutritional value point of view (VOICAN AND LĂCĂTUȘ, 1998), the tomatoes calcium contents are close, the phosphorus ones much higher (about 10 times), iron quantities are similar, and potasium ones much lower. The latter is the only element that can impede on the yield quality. The low potassium values occur because no chemical substances are used but it doesn' affect the health status of the plants or of their consummers.

A considerable growth of total nitrogen accumulation is noticed in capsicum when farm compost is applied (123-187 as compared to 96 mg/100 g fresh material). Phosphorus also accumulates better in the variants in which farm compost was applied. In this case, the growth is similar in all three farm compost fertilized variants. Farm compost application improves the capsicum nutrition with nitrogen and phosphorus.

No differences have been noticed in the case of the other macro- and micro-nutritional elements. Exept for magnesium in the variant in which the maximum farm compost dose was applied: 8.2 as compared to 5.5-6.6 mg/100 g fresh material. Higher chrome and cobalt contents are also noticed (0.015 and 0.016 mg/100 g fresh material) in the 10 t/ha farm compost fertilized variant, but not as high as to indicate a bigger accumulation.

The determined mineral elements contents of fruits and leaves describe a good and uniform growth of plants and a quality yiled.

Biochemical properties of the yields

The tomatoes grown at SCDL Bacău, on ecologically certified land, have a 92-95% water content (Table 5), at the upper limit of the normal content interval, which means they are technologically immature. That's because they were sampled for analysis before full ripeness.

Table 5

Biochemical properties of the tomatoes grown at SCDL Bacău on ecologically certified land

Variants	d.m. %	U %	Glucose %	Cellulose %	Pectin %	Acidity %	Vitamin C mg/100 g	Non-reductive Glucides %	Reductive Glucides %	Licopene mg/100 g
V_1	5.45	94.55	1.69	0.18	0.050	0.95	13.04	1.80	1.18	2.32
V_2	6.00	94.00	4.66	0.28	0.120	0.87	14.70	2.53	2.13	2.12
V_3	4.91	95.09	3.27	0.16	0.054	1.03	14.37	1.80	1.47	1.99
V_4	5.50	94.50	3.98	0.31	0.110	0.84	15.27	2.19	1.79	3.19
V_5	5.70	94.30	4.00	0.44	0.165	0.95	12.30	2.20	1.80	2.50
V_6	6.67	93.33	3.63	0.32	0.083	1.06	17.02	1.74	1.89	2.92

The reductive glucides vary between 1.18 and 2.13%, as compared to a 2.3% normal average, which indicates physiological insufficiency because of the unripeness. The total glucides contents are over the 3.46% average value cited in the literature, except for the unfertilized control. The best variant is the one fertilized with green manure.

The cellulose contents is lower than the 0.68% average cited in literature, certifying a high cellulolitic activity.

Pectins are trifling as comapred to the dry substance, showing fruits unsuitable for processing. Besides, the yield is ment for being consummed fresh.

The high acidity values, as compared to a 0.3-0.5% average cited by the literature, indicate technological immaturity. So does the ascorbic acid contents, 30-50% lower than the

22.42mg/100 g fresh material average and the carotenoids, expressed as licopen, contents (1.99-3.19 mg/100 g fresh material, as comapred to a literature average of 4.40 mg/100 g fresh material).

The water contents of the egg-plants are lower than those cited in literature (91.64-93.60%).

Table 6

Biochemical properties of the egg-plants grown at SCDL Bacău, on ecologically certified land

Variants	d.m. %	U %	Glucides %	Cellulose %	Acidity %	Pectin %	Chlorophyll %
V_1	8.46	91.54	5.18	1.59	0.25	0.39	2.99
V_2	8.02	91.98	3.78	1.59	0.30	0.57	3.75

Glucides contents are higher than the average value cited in literature (table 6). Their structure in the control is 2.45% reductive glucides and 2.73% non-reductive glucides. From among them the sugars (2.13-4.00%) consist of glucose, fructose, saccharose and less galactose. The values are in the upper part of the normal content interval, indicating a valuable edible material.

Soluble pectin contents vary between 0.39 and 0.57%, and the cellulose ones are 1.59%, within the normal content domain for pectin and at its upper limit for cellulose, indicating a physiologically rippened material.

The water level of the capsicum is within the data range cited in literature, namely 91.79% (table 7).

Table 7

Biochemical properties of capsicum grown at SCDL Bacău on ecologically certified land

Variant	d.m. %	U %	Total Glucides %	Reductive glucides %	Non-reductive glucides %	Pectin %	Acidity %	Vitamin C mg/100 g	Chlorophyll mg/100 g	Capsantine mg/100 g
V_1	8.63	91.37	6.70	3.72	2.98	0.991	0.0830	101.0	6.5	14.07
V_2	8.49	91.51	7.07	3.82	3.25	0.799	0.0830	123.7	5.8	15.39
V_3	7.64	92.36	6.19	3.54	2.65	0.695	0.0768	154.8	7.1	11.05
V_4	8.28	91.72	6.77	3.69	3.08	0.699	0.0768	193.0	5.9	13.77

The chlorophyl contents show a light coloured material, with commercial value. The glucides contents are higher than the normal cotnent interval, proving a genetically good material from this point of view. The acidity, expressed as malic acid, points out physiological unripness.

Only the variant fertilized with the maximum dose of farm compost reaches the average Vitamin C values cited in literature.

The pigments contents (capsantine) are clearly inferior to the data cited in literature, which means a visible technological unripness. Cholorophyl has a 6.3 mg/100 g fresh material average and is higher in the 20 t/ha farm compost fertilized variant. As compared to a literature average of 0.75%, the pectines belong to the normal content interval.

The yields' biochemical properties describe well formed fruits with good nutritional value. The slight immaturity noticed with tomatoes and capsicum comes from an early sampling for analises.

Yields

The tomatoes yield increased distinctly significant and very significant with the application of green manure and farm compost growing quantities (Table 8). Green manure administering ensured significant yield increase both on its own or combined with farm compost. Yields increases were 19%, respecitvely 28-30%. The increases of the variants in which only farm compost was used are not statistically ensured.

Table 8

The synthesis of the tomatoes yields

Variants	Yields t/ha	Relative yields %	Differences t/ha	Differences Significance
V_1, control	22.90	100	-	-
V_2, green manure	27.37	119	+ 4.47	* *
V_3, 40 t/ha compost	26.68	116	+ 3.78	-
V_4, 10 t/ha compost	26.93	117	+ 4.03	-
V_5, green manure + 40 t/ha compost	29.40	128	+ 6.50	* * *
V_6, green manure + 10 t/ha compost	29.83	130	+ 6.93	* * *
Experiment average	*27.15 t/ha*			
cv	*2.68%*			
DL 5% *DL 1%*	*4.25* *5.89*			

Table 9

Synthesis of capsicum yields measurements

Variants	Yields t/ha	Relative yields %	Differences t/ha	Differences Significance
V_1, control	19.45	100	-	-
V_2, green manure	20.73	107	+ 1.28	* *
V_3, 40 t/ha compost	20.50	105	+ 1.05	* *
V_4, 10 t/ha compost	20.93	108	+ 1.48	* * *
V_5, green manure + 40 t/ha compost	22.50	116	+ 3.05	* * *
V_6, green manure + 10 t/ha compost	23.28	119	+ 3.83	* * *
Experiment average	*20.90 t/ha*			
cv	*2.97%*			
DL 5% *DL 1%*	*0.94* *1.30*			

The capsicum yields, analysed in an experiment with the same variants as the tomatoes' one, also increased distinctly significant and very significant (table 9). All the fertilized variants achieved higher yields than the unfertilized control and the differences were statistically ensured.

The average effect of green manure is aproximately equal to that of the farm compost (+1.28 t/ha** as compared to 1.27 t/ha**, significantly higher than the control).

The interaction green manure – farm compost is obviously superior to their average effect and the difference is also statistically ensured (+3.44 t/ha** as compared to 1.28 t/ha**).

The products' aspect

The fact is well known that one cannot expect, from ecological agriculture, exceptionally beautiful products. The tomatoes' aspect is not very uniform nore pleasant, but healthy (Photo 1). This happens with ecological yields when the accepted standards and the legislation in force are observed in vegetable growing. There is one more reason, though, for the un-uniform colour: the tomatoes were sampled before full rippening, which the biochemical analysis also showed. The aspect of the fruits of the control (V_1) and the variant fertilized with only green manure (V_2) were the most affected. This did not affect the mineral compozition and quality of the tomatoes yields, as is was already shown, but made their marketing more difficult, the more the ecological products have higher prices.

Uniform tomatoes, both in colour and dimensions, were obtained when farm compost (V_4) and green mannure associated with farm compost (V_5) were administered.

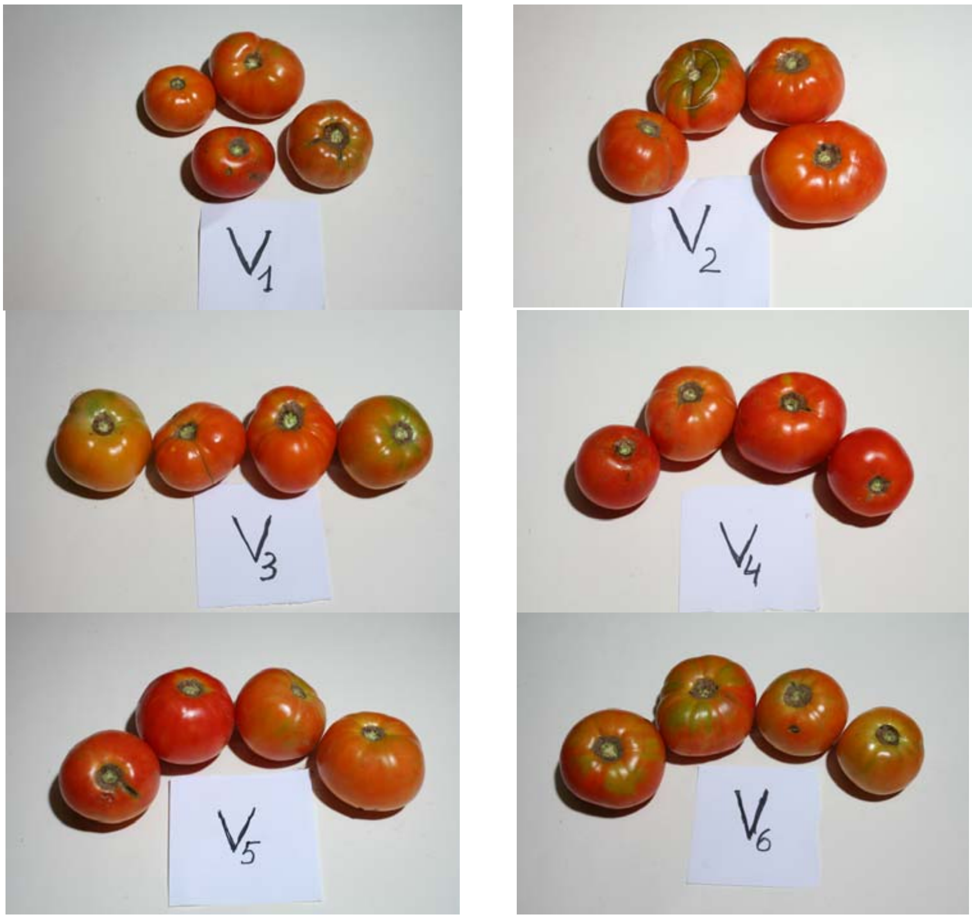

Photo 1 The aspect of the tomatoes grown at SCDL Bacău on ecologically certified land

Though smaller than the conventionally obtained ones, the egg-plants have a pleasant aspect and a uniform colour (Photo 2). Besides, the biochemical analyses also relvealed a good quality yield from the nutritional point of view. The aspect was better in the green manure fertilized variant.

Figure 2 Egg-plants grown at SCDL Bacău, on ecologically certified land

As for the capsicum, the yield aspect was good, large, uniform in size, and healthy fruits, not uniform in colour because they were sampled before full rippening.

CONCLUSIONS

The normal evolution of the soil from the ecological agriculture lot as well as the fact that the type of soils are specific to the First Terrace of most rivers of Moldavia on which vegetables are grown allows the assessment that the results of the presented researches are valid at least for the whole East side of the country.

Organic fertilization in ecologic agriculture is a "maintenance" one. Applied for 15 years on ecologically certified land ensured the conservation of the soil fertility features, not at the best but enough to obtain ecologic vegetables yields.

Tomatoes, egg-plants, and capsicum crops were studied under the influence of organic fertilzation with green manure and farm compost.

The leaves laboratory analysis revealed a well-balanced mineral nutrition of the studied vegetables. The determined mineral elements contents of fruits describe a good and uniform growth of plants and a quality yiled.

The yields' biochemical properties describe well formed fruits with good nutritional value. The slight immaturity noticed with tomatoes and capsicum comes from an early sampling for analises.

Statistically ensured yield increases were found due to fertilization with green manure and farm compost.

The tomatoes' aspect is not very uniform nor pleasant, but healthy. Farm compost and green manure associated with farm compost had a good influence on obtaining uniform tomatoes, both in colour and dimensions. Though smaller than the conventionally obtained ones, the egg-plants had a pleasant aspect and a uniform colour. The capsicum yield aspect was good, the fruits were large, uniform in size, and healthy, not uniform in colour though because they were sampled before full rippening.

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