DE GRUYTER OPEN

DOI 10.1515/pesd-2017-0035 PESD, VOL. 11, no. 2, 2017

# QUALITY OF ORGANIC VEGETABLES GROWN IN TWO CERTIFIED SITES ON THE OUTSKIRTS OF BUCHAREST MUNICIPALITY

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**Key words:** organic vegetables, soil fertility, mineral nutrition, mineral composition

**Abstract:** Soil fertility properties, irrigation water quality, mineral nutrition, and some vegetables mineral composition were studied in the frame of a project regarding yield quality monitoring in certified organic vegetable farms, in two farms placed on the outskirts of Bucharest Municipality which provide products for the town's organic market. Chemical analysis of the soil samples collected from the two farms reflects a good fertility, close to the natural one of this region soils, with well-balanced organic matter, total nitrogen, accessible phosphorus and potassium contents. The nitrates contents concord with the plants nutrition demands and don't present the risk to accumulate in vegetables or to leach into the groundwater. Slightly increased microelements, both total and soluble forms, occur. Soil microbiological properties are favorable for vegetable plants growth. A good biodiversity is noticed. There are differences between soil properties in open field and greenhouses, induced both by the type and degree of mechanical works and materials applied for fertilization and plant protection. Good conditions are generally created for plants mineral nutrition. Mineral nutrition status of the vegetables grown in organic conditions, assessed by the leaves mineral composition, doesn't differ from the one of the vegetables grown in conventional conditions. The vegetables (fresh material) harvested from the two studied farms have good, even high, concentrations of mineral elements important for the yield nutritional quality. The excessive microelements quantities noticed in soil don't transfer in the yield, so the latter quality and nutritional properties are not altered.

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## INTRODUCTION

Organic farming continuously evolves, in terms of occupied areas, number of farmers involved, grown yields, consumer's categories, markets. Social aspects are often approached regarding the impact of organic farming practices or conversion from conventional to organic farming, or of perception and behavior of consumers or potential consumers (Dumitrașcu and Ștefănescu, 2007). Not least, organic farming aims to contribute to environment quality improvement.

Although, according to the concept and regulation legislation, organic products quality lies in the manner in which they are obtained, more and more researchers, and not only them, become preoccupied of its qualitative and quantitative quantification. Pursuits developed regarding yield quality, as compared or not to the quality of products obtained in conventional agriculture. Researches developed in the frame of an excellence research program AGRAL financed through the University of Agronomic Sciences and Veterinary medicine Bucharest targeted the mineral composition and biochemical properties of some vegetables (tomatoes, pepper, egg plants, capsicum) grown in organic conditions, as compared to the same vegetables grown in conventional conditions (Lungu, 2007; Lungu et al., 2009).

Recent researches approached aspects regarding contents of substances beneficial to human health, for example antioxidants and vitamins (Calciu et al., 2010).

This paper presents the quality of vegetables grown in two organically certified farms on the outskirts of Bucharest Municipality. The researches were carried out in the frame of the Nucleus Program, financed through ANCSI, Project PN 09-28.04.04 Monitoring of the yield quality in organic vegetable farms.

## 1. MATERIAL AND METHODS

The Crevedia communal territory is placed in the south-eastern part of the Dâmbovița County, approximately 60 km from Târgoviște and 27 km from Bucharest. The organic farm „Ferma Cocani 100% natural was started here. The farm has 23 ha out of which 3 are cultivated with vegetables, 1.000 m$^2$ greenhouse, and the rest is cultivated with cereals. The society unfolds a contract with „Austria Bio Guarantee ", inspection and certification organism authorized by the Ministry of Agriculture. Four hectares are in the second year of reconversion; the rest of the land is already certified. Due to the small distance between the farm and the delivery point the vegetables can be sold after maximum one hour from harvest.

The fertilization level is very low. Garden mould from cow flop and poultry compost are applied. Natural extracts (hot pepper, with low efficiency, 1%) or organically certified products (LASER and NEEM, with very good efficiency, of 85-90%) are used for pest control. The crops portfolio includes tomatoes, cabbage, watercress, broccoli, peppers, marrows, cucumbers.

The Biodumbrava farm lies 15 km far from Bucharest, behind the Militari commercial area, on the Joița commune territory.

Only biological techniques are used on the farm to grow vegetables, certified in 2010 by „Austria Bio Guarantee "inspection body. The farm has 0.84 ha cultivated with vegetable, field and greenhouse, fruit trees, fruit bushes, and vine. Earth walls technology is used on the farm, very appreciated and popular especially in Germany. This method is efficient because it implies creating a productive micro climate by agglomerating several layers of dry straw over other garden mould layers and a top forest soil layer. Drip irrigation was also adopted. Trees and vegetables are sprayed with maceration extracts from plants specially grown on the farm (calendula, nettle, backwort, horse tail, garlic, absinth etc.) or with ecologically certified protection products: LASER, MIMOX, ALTOSAN, COPFORT, OVIPRON etc. Fertilization is done with macerated poultry compost and soil improvement with Delcamag (volcanic rock dust, amorphous dolomite). Weed control is done manually. The crops portfolio includes salad, spinach, cabbage, onion, garlic, scallion, carrots, celery, radishes, potatoes, beetroot, tomatoes, egg plants, peppers, cucumbers, marrows, beans, peas, raspberries, blackberries, blue berries, sea buckthorn, strawberries, and also recently introduced and very requested species such as kale or mangold.

From the farms described above soil samples were collected, 4 from Cocani and 6 from Biodumbrava, by depths, 0-20 and 20-40 cm, which were analyzed for physical, chemical, and microbiological characteristics.

Leaves and fruits samples were also collected from the vegetable plants. Leaves samples were dried and ground before analysis, and the fruits samples were analyzed as fresh material.

For soil and leaves samples the standardized analysis methodology applied in the ICPA laboratories (Răuță and Chiriac, 1980; Borlan and Răuță, 1981; Stoica et al., 1986) was used. The methodology applied for the fresh fruits samples is not standardized. It is occasionally used in the ICPA laboratories and is an adaptation of the standardized methods for dry substance and it provided reliable results over time. It was used both for vegetables mineral content assessment and gathering results for the method documentation.

Taxonomic identifications were made based on the cultural, morphologic and/or physiologic characteristics, according to Bergey and Holt (1994) and Domsch and Gams, 1972.

Soil respiration as global indicator of the soil microbial activity was determined by respiration method induced with a substratum adding. The results are expressed in mg $CO_2$/100 g dry soil.

## 2. RESULTS AND DISCUSSIONS

### 2.1. Soil conditions characterization

Soil conditions in organic farming are important but not defining and are very similar in the different organic farms that the authors studied down the years. Soil fertility state is important and especially the lack of some compounds, mainly nitrates, pesticides residues, and heavy metals.

The physical analyses (Tables 1 and 2) disclose medium loam texture at Cocani and silt loam at Biodumbrava. That means medium textures that create favorable conditions for both soil works and root development and plant nutrition.

**Table 1**. The texture of the soil samples taken from the Cocani farm

| Depth cm | Particle-size separates (mm) (% of the soil mineral part) | | | | | | | | | | | text. subcls. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coarse sand | | | | Fine sand | | | | Silt | Clay | | |
| | **2.0-0.2** | 2.0-1.0 | 1.0-0.5 | 0.5-0.2 | **0.2-0.02** | 0.2-0.1 | 0.1-0.05 | 0.05-0.02 | **0.02-0.002** | **<0.002** | <0.01 | |
| 0-20 | **3.5** | 0.2 | 0.8 | 2.5 | **39.5** | 1.7 | 0.1 | 37.7 | **24.6** | **32.4** | 45.9 | LL |
| 20-40 | **3.7** | 0.8 | 0.6 | 2.3 | **35.1** | 1.9 | 0.0 | 33.2 | **30.6** | **30.6** | 45.7 | LL |

Table 2. The texture of the soil samples taken from the Biodumbrava farm

| Identification | | Particle-size separates (mm) (% of the soil mineral part) | | | | | | | | | | | text. subcls. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Coarse sand | | | | Fine sand | | | | Silt | Clay | | |
| place, crop | Depth cm | **2.0-0.2** | 2.0-1.0 | 1.0-0.5 | 0.5-0.2 | **0.2-0.02** | 0.2-0.1 | 0.1-0.05 | 0.05-0.02 | **0.02-0.002** | **<0.002** | <0.01 | |
| field, egg-plants, cabbage, pepper crops | 0-20 | **0.4** | 0.0 | 0.1 | 0.3 | **35.8** | 2.2 | 0.2 | 33.4 | **36.2** | **27.6** | 47.6 | LP |
| field, egg-plants, cabbage, tomatoes crops | 20-40 | **0.4** | 0.1 | 0.0 | 0.3 | **36.1** | 1.5 | 0.2 | 34.4 | **34.9** | **28.6** | 48.7 | LP |

Cation exchange properties show that the samples collected from Cocani farm (Table 3) have average values for cation exchange capacity (T) and are base saturated. Average values are also registered in the samples collected from the Biodumbrava farm (Table 4) except for the solarium surface sample, under the tomatoes crop, which has a low capacity. pH values indicate carbonates presence which means that the samples are base saturated. From the soil fertility point of view, the total cation exchange capacity, which represents the exchange bases sum, indicates a high fertility.

Table 3. Cation exchange properties of the soil samples taken from the Cocani farm

| Identification | Depth cm | $Ca^{2+}+Mg^{2+}$ | $Na^+$ | $K^+$ | T-$NH_4$ | $Ca^{2+}+Mg^{2+}$ | $Na^+$ | $K^+$ | V |
|---|---|---|---|---|---|---|---|---|---|
| | | me/100 g soil | | | | % of T | | | |
| Garden soil sample | 0-20 | 22.82 | 0.27 | 1.22 | 24.31 | 93.9 | 1.1 | 5.0 | 100 |
| Garden soil sample | 20-40 | 23.20 | 0.22 | 0.89 | 24.31 | 95.4 | 0.9 | 3.7 | 100 |
| Solarium soil sample | 0-20 | 23.84 | 0.41 | 0.57 | 24.82 | 96.0 | 1.6 | 2.3 | 100 |
| Solarium soil sample | 20-40 | 22.82 | 0.31 | 0.67 | 23.81 | 95.9 | 1.3 | 2.8 | 100 |

Table 4. Cation exchange properties of the soil samples taken from the Biodumbrava farm

| Identification | Depth cm | T-$NH_4$ me/100 g soil |
|---|---|---|
| field, egg-plants, cabbage, tomatoes crops | 0-20 | 22.29 |
| | 20-40 | 22.79 |
| field, pepper crop | 0-20 | 22.79 |
| | 20-40 | 21.78 |
| solarium, tomatoes crop | 0-20 | 16.71 |
| | 20-40 | 21.27 |

Table 5. The reaction and macro elements contents of the soil samples taken from the Cocani farm

| Identification | Depth cm | $pH_{H_2O}$ | Humus | Nt | C/N | $P_A$ | $K_{AL}$ | N-$NO_3$ |
|---|---|---|---|---|---|---|---|---|
| | | | % | | | mg/kg | | |
| Garden soil sample | 0-20 | 7.93 | 3.64 | 0.198 | 12.4 | 131 | 407 | 17 |
| | 20-40 | 7.82 | 3.52 | 0.186 | 12.8 | 130 | 301 | 28 |
| Solarium soil sample | 0-20 | 7.55 | 4.06 | 0.198 | 13.9 | 92 | 200 | 42 |
| | 20-40 | 7.02 | 3.64 | 0.187 | 13.2 | 133 | 228 | 30 |

The reaction of the analyzed samples (Tables 5 and 6) lies in the neutral – slightly alkaline domain, favorable for vegetable crops. The values are a little higher in the samples from Biodumbrava farm exceeding the upper limit (7,00) of the optimum pH interval for horticultural crops (Davidescu and Davidescu, 1992), because amendments are use on the farm (Delcamag, previously mentioned).

Table 6. The reaction and macro elements contents of the soil samples taken from the Biodumbrava farm

| Identification | Depth cm | $pH_{H_2O}$ | Humus | Nt | C/N | $P_{AL}$ | $K_{AL}$ | $N\text{-}NO_3$ |
|---|---|---|---|---|---|---|---|---|
| | | | % | | | mg/kg | | |
| field, egg-plants, cabbage, tomatoes crops | 0-20 | 7.90 | 2.36 | 0.147 | 10.8 | 15 | 149 | 83 |
| | 20-40 | 8.29 | 2.24 | 0.134 | 11.4 | 4 | 110 | 34 |
| field, pepper crop | 0-20 | 8.08 | 3.33 | 0.075 | 30.2 | 49 | 171 | 15 |
| | 20-40 | 7.83 | 2.42 | 0.126 | 13.0 | 47 | 120 | 11 |
| solarium, tomatoes crop | 0-20 | 8.03 | 1.94 | 0.105 | 12.5 | 61 | 100 | 68 |
| | 20-40 | 8.13 | 2.42 | 0.146 | 11.2 | 32 | 92 | 22 |

The organic matter contents, appraised depending on the soil samples medium texture, are average so they ensure the mineral elements supply needed for plants growth. The medium total nitrogen contents balance the organic matter and the C/N ratios generally describe a good fertility state of the samples taken for analysis, even if the values range slightly above the upper limit of the optimum interval (9-11) defined by Davidescu and Davidescu (1992).

The phosphorus contents soluble in the ammonium lactate acetate solution at pH 3.7 are very high in the samples collected from the Cocani farm and those of potassium soluble in the same extracting are high and very high. These contents obviously proceed from organic fertilization which is a very important aspect taking into account that Romania soils have generally poor phosphorus contents.

In the Biodumbrava farm the phosphorus contents are very low – low beneath the egg-plants, cabbage, tomatoes crop in the field and belong to the chemical soil background, while beneath the pepper in the field and tomatoes in the solarium the values are medium and high, as a consequence of organic fertilization.

The nitrates contents in the soil samples from Cocani farm range in the normal values domain for unfertilized and fertilized soils ploughed layer (up to 20 mg/kg, respectively 20-40 mg/kg, after Lăcătușu, 2016).

Higher nitrate quantities are noticed in the Biodumbrava farm, both in field and solarium samples, specific for soils with horticultural use (vegetable intensive crops, fruit trees, and vine, Lăcătușu, 2016).

Heavy metals total contents in the samples collected from the Cocani farm (Table 7) generally slightly outrun the normal values domain. As a consequence, the mobile forms contents, soluble in the ammonium acetate – EDTA solution at pH 7, are also high (Lăcătușu et al., 1987). The most likely source of zinc and copper excessive quantities is represented by the pest control products (accepted in organic farming) used. Lead and cadmium excessive concentrations source must be identified and eliminated.

Table 7. Microelements total forms contents of the soil samples taken from the Cocani farm

| Identification | Depth cm | Zn | Cu | Fe | Mn | Pb | Cd | Cr | Co | Ni |
|---|---|---|---|---|---|---|---|---|---|---|
| | | mg/kg | | | | | | | | |
| garden | 0-20 | 83.10 | 24.9 | 26.586 | 759 | 20.6 | 0.35 | 32.4 | 9.6 | 31,2 |
| garden | 20-40 | 79.40 | 27.7 | 28.742 | 805 | 14.2 | 0.56 | 29.6 | 14.7 | 31,3 |
| solarium | 0-20 | 73.20 | 29.7 | 28.471 | 795 | 16.9 | 0.39 | 27.8 | 14.7 | 31,3 |
| solarium | 20-40 | 75.90 | 25.1 | 28.721 | 741 | 14.6 | 0.49 | 28.2 | 13.6 | 30,4 |
| Normal contents* | | 50 | 20 | | | 15 | 0.3 | | 5 | 20 |
| Maximum allowable limits** | | 300 | 100 | | | 100 | 3 | | 50 | 50 |

* after Fiedler and Rösler, 1988, cited by Lăcătuşu et al., 2000
** after Kloke, 1980, cited by Lăcătuşu et al., 2000

Biodumbrava farm (Table 8). As a matter of fact, heavy metals loadings above the normal contents domain limit have been often encountered in laboratory practice in soil samples collected from different parts of the Country, even un-affected by anthropic impact.

Table 8. The total microelements forms contents in the soil samples taken from the Biodumbrava farm

| Identification | Depth cm | Zn | Cu | Fe | Mn | Pb | Cd | Cr | Co | Ni |
|---|---|---|---|---|---|---|---|---|---|---|
| | | mg/kg | | | | | | | | |
| field, egg plants, cabbage, tomatoes crops | 0-20 | 86.5 | 38 | 35.544 | 905 | 15.0 | 0.51 | 36.3 | 16.2 | 43,0 |
| | 20-40 | 84.1 | 38.5 | 36.523 | 953 | 17.0 | 0.6 | 41.0 | 17.7 | 44,4 |
| field, pepper crop | 0-20 | 74.3 | 25.0 | 29.623 | 840 | 12.9 | 0.53 | 29.7 | 16.4 | 33,0 |
| | 20-40 | 64.4 | 22.5 | 29.222 | 826 | 14.2 | 0.58 | 30.2 | 15.2 | 36,3 |
| solarium, tomatoes crop | 0-20 | 45.8 | 17.8 | 19.767 | 569 | 5.4 | 0.39 | 20.3 | 11.3 | 20,3 |
| | 20-40 | 62.7 | 23.1 | 28.648 | 784 | 14.8 | 0.63 | 27.6 | 16.0 | 36,7 |
| Normal contents* | | 50 | 20 | | | 15 | 0.3 | | 5 | 20 |
| Maximum allowable limits** | | 300 | 100 | | | 100 | 3 | | 50 | 50 |

* after Fiedler and Rösler, 1988, cited by Lăcătuşu et al., 2000
** after Kloke, 1980, cited by Lăcătuşu et al., 2000

Zinc and copper contents soluble in the EDTA – ammonium acetate solution of the samples collected from the Cocani farm describe a high supply (Table 9).

The manganese values soluble in the common reagent, interpreted depending on soil texture, describe a low up to high supply (Lăcătuşu et al., 1987).

Table 9. The microelements mobile forms contents, extractable in the ammonium acetate – EDTA solution at pH 7, of the soil samples from the Cocani farm

| Sampling place | Depth cm | Zn | Cu | Fe | Mn | Pb | Cd |
|---|---|---|---|---|---|---|---|
| | | mg/kg | | | | | |
| garden | 0-20 | 8.10 | 4.7 | 33.4 | 17.6 | 3.6 | 0.37 |
| garden | 20-40 | 7.70 | 5.5 | 43.4 | 12.3 | 2.3 | 0.36 |
| solarium | 0-20 | 4.20 | 6.5 | 42.5 | 9.2 | 2.3 | 0.28 |
| solarium | 20-40 | 5.10 | 6.1 | 95.1 | 50.3 | 3.6 | 0.30 |

The zinc supply is average at the Biodumbava farm, the copper one high – under the influence of the applied pest control products – and the manganese one is low.

Table 10. The microelements mobile forms contents, extractable in the ammonium acetate – EDTA solution at pH 7, of the soil samples from the Biodimbrava farm

| Identification | Depth cm | Zn | Cu | Fe | Mn | Pb | Cd |
|---|---|---|---|---|---|---|---|
| | | mg/kg | | | | | |
| field, egg plants, cabbage, tomatoes crops | 0-20 | 0.90 | 5.4 | 8.4 | 13.6 | 2.3 | 0.23 |
| | 20-40 | 1.10 | 5.3 | 12.1 | 12.2 | 2.3 | 0.17 |
| field, pepper crop | 0-20 | 2.60 | 4.0 | 9.5 | 12.2 | 2.3 | 0.21 |
| | 20-40 | 1.30 | 3.6 | 15.9 | 10.1 | 2.3 | 0.20 |
| solarium, tomatoes crop | 0-20 | 3.20 | 4.0 | 8.2 | 11.3 | 1.0 | 0.19 |
| | 20-40 | 1.50 | 2.8 | 6.6 | 6.4 | 2.3 | 0.15 |

The biologic and micro-biologic properties of the soil are important both for plants growth and environment health. Differences between the samples collected from the field and those collected from the solarium and between the samples collected from underneath different crops are highlighted in the laboratory study. There is generally a good biodiversity and the micro-biologic conditions favor vegetable crops growing.

Therefore, the soil fertility properties in the studied farms are good, like those usually encountered in the organic farms.

### 2.2 Mineral nutrition state of the vegetable plants

The nitrogen contents of the vegetable plants leave from the Cocani farm are low as compared to the normal contents mentioned in the literature (Table 11). But the normal contents values were established in conventional agricultural conditions and part of them could be represented by the nitrate nitrogen either incompletely metabolized in the plant or even excessive, proceeded from fertilizers. Thus, for example, the tomatoes leaves can normally accumulate 5,000-15,000 mg/kg nitrate nitrogen, the pepper ones 12,000 mg/kg, and the cabbage ones 7,000 mg/kg (Răuță and Chiriac, 1980). In the Tables 11 and 12 the contents reported in the frame of prior studies, in the ecologically certified experimental fields of SCDL Bacău and in the ICDLF Vidra solariums cultivated in organic conditions, are presented along with the normal contents domains in order to outline an as complete image as possible.

The beans leave accumulated phosphorus quantities higher than the normal ones. A little higher and a little lower values were also registered in the leaves of other vegetable plants but the studied literature doesn′t generally specify domains of high and excessive or deficiency values.

Table 11. Mineral elements contents of the leaves collected from Cocani farm

| Identification | | | N | P | K | Ca | Mg | Zn | Cu | Fe | Mn | Pb | Cd | Cr | Co | Ni |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| plant | place | vegetation phase | % | | | | | | | mg/kg | | | | | | |
| tomatoes | solarium | fruit maturation | 1.39 | 0.386 | 2.84 | 5.78 | 0.75 | 28.6 | 19.8 | 306.6 | 43.3 | 6.3 | 1.01 | bdl | 0.003 | 2,3 |
| tomatoes | garden | fruit maturation | 2.25 | 0.346 | 3.27 | 4.92 | 0.53 | 29.0 | 10.3 | 235.7 | 47.0 | 4.7 | 1.11 | bdl | bdl | 1,3 |
| pepper | garden | blooming | 1.50 | 0.226 | 6.22 | 2.69 | 0.57 | 46.4 | 6.1 | 161.6 | 50.7 | 4.9 | 0.91 | bdl | 0.287 | 2,6 |
| pepper | field | fruit maturation | 2.73 | 0.199 | 7.10 | 2.47 | 0.46 | 59.1 | 48.5 | 196.5 | 52.7 | 4.9 | 1.44 | bdl | bdl | 7,3 |
| cabbage | garden | head forming | 2.45 | 0.378 | 4.01 | 1.74 | 0.25 | 31.4 | 4.7 | 54.0 | 18.1 | 5.0 | 0.42 | bdl | bdl | 1,0 |
| beans | garden | blooming | 2.40 | 0.679 | 8.02 | 1.94 | 0.72 | 41.4 | 18.5 | 184.0 | 93.4 | 3.6 | 0.76 | bdl | bdl | 3,9 |
| beetroot | garden | | 1.41 | 0.224 | 3.06 | 6.17 | 0.41 | 24.7 | 7.2 | 280.7 | 51.2 | 3.8 | 0.43 | bdl | bdl | 2,2 |
| normal contents (Răuță and Chiriac, 1980) | | beans | 5,10 | 0.40 | 2.0 | | | 20-26 | | | 40-940 | | | | 0.19-0.40 | |
| | | beetroot | | | | | | 19 | | | | | | | | |
| | | sugar beet | 4,3-5,0 | 0.31-0.60 | 0.5-2.0 | 0.2-2.5 | 0.1-2.5 | 20-80 | | 60-140 | 26-360 | | | | | |
| | | stock beet | | | | | | | 6-10 | | | | | | 0.40 | |
| | | tomatoes | 3,4-4,0 | 0.18-0.22 | 2.5-4.9 | 0.82-1.78 | 0.42-1.05 | 41-100 | 3.1-12.2 | 31-300 | 35-240 | | | | | |
| | | pepper | 3,0-4,5 | 0.30-0.70 | | 0.4-0.6 | 1.0-1.7 | | 10-20 | | | | | | 0.31 | |
| | | cabbage | 5,2-6,0 | 0.30-0.50 | 4.4 | 1.5-3.5 | 0.25-0.45 | 20-30 | 2.5-5.0 | 30-60 | 25-50 | | | | 0.07 | |
| contents at SCDL Bacău | | tomatoes | 3,27-4,91 | 0.25-0.40 | 4.50-5.21 | 5.79-10.29 | 0.65-0.88 | 34.7-54.1 | 33.7-89.9 | 371-750 | 62-113 | 6.3-9.4 | | 3.5-11.9 | 5.1-18.3 | |
| contents at ICDLF Vidra in solarium | | tomatoes | 1,80 | 0.37 | 1.92 | 6.19 | 1.28 | 48 | 470.4 | 295 | 54 | 10.5 | | 1.3 | 7.5 | 20.5 |
| | | pepper | 2,73 | 0.29 | 6.37 | 4.16 | 1.66 | 93 | 5.0 | 249 | 50 | 18.3 | | 2.5 | 5.0 | 14.1 |

Bdl: below detection limit

Further study of the analytical values that describe the mineral composition of the vegetable plants leaves generally reveals normal contents.

Certain lead and cadmium quantities were also registered in the leaves, proceeded from soil through absorption, maybe from air deposits too. The values are not alarming and don't raise distrust regarding the plants mineral nutrition. As previously mentioned, the heavy metals presence in the environment impacts many samples that end in the analytic laboratory even if they haven't been taken from areas affected by polluting impact.

Table 12. Mineral elements contents of the leaves collected from Biodumbrava farm

| Identification | N | P | K | Ca | Mg | Zn | Cu | Fe | Mn | Pb | Cd | Cr | Co | Ni |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | | | | | mg/kg | | | | | | | | |
| egg plants, field crop | 3.29 | 0.124 | 3.37 | 5.94 | 0.45 | 22.4 | 28.8 | 143.8 | 44.8 | 4.4 | 0.52 | bdl | bdl | 0.9 |
| beans, field crop | 3.54 | 0.176 | 2.76 | 4.92 | 0.45 | 61.3 | 26 | 153.7 | 48.8 | 5.1 | 0.49 | bdl | bdl | bdl |
| green pepper, field crop | 4.09 | 0.130 | 5.81 | 4.89 | 0.49 | 45.3 | 35.3 | 142.9 | 37.6 | 6.2 | 0.63 | bdl | bdl | 0.8 |
| beetroot, field crop | 4.80 | 0.179 | 3.88 | 4.36 | 1.06 | 20.2 | 9.4 | 167.0 | 110.3 | 11.4 | 0.44 | bdl | bdl | 2.7 |
| yellow pepper, field crop | 3.49 | 0.208 | 1.81 | 7.00 | 1.56 | 31.2 | 35.7 | 124.3 | 90.9 | 6.6 | 1.14 | bdl | bdl | 3.0 |
| tomatoes, solarium crop | 3.34 | 0.163 | 0.77 | 7.83 | 0.90 | 21.6 | 471.2 | 167.4 | 69.8 | 8.0 | 0.81 | bdl | 0.03 | bdl |
| normal contents (plant analysis methodology, ICPA) | | | | | | | | | | | | | | |
| beans | 5.10 | 0.40 | 2.0 | | | 20-26 | | | 40-940 | | | | 0.19-0.40 | |
| beetroot | | | | | | 19 | | | | | | | | |
| sugar beet | 4.3-5.0 | 0.31-0.60 | 0.5-2.0 | 0.2-2.5 | 0.1-2.5 | 20-80 | | 60-140 | 26-360 | | | | | |
| stock beet | | | | | | | 6-10 | | | | | | 0.40 | |
| tomatoes | 3.4-4.0 | 0.18-0.22 | 2.5-4.9 | 0.82-1.78 | 0.42-1.05 | 41-100 | 3.1-12.2 | 31-300 | 35-240 | | | | | |
| pepper | 3.0-4.5 | 0.30-0.70 | | 0.4-0.6 | 1.0-1.7 | | 10-20 | | | | | | 0.31 | |
| contents at SCDL Bacău | | | | | | | | | | | | | | |
| tomatoes | 3.27-4.91 | 0.25-0.40 | 4.50-5.21 | 5.79-10.29 | 0.65-0.88 | 34.7-54.1 | 33.7-89.9 | 371-750 | 62-113 | 6.3-9.4 | | 3.5-11.9 | 5.1-18.3 | |
| contents at ICDLF Vidra in solarium | | | | | | | | | | | | | | |
| tomatoes | 1.80 | 0.37 | 1.92 | 6.19 | 1.28 | 48 | 470.4 | 295 | 54 | 10.5 | | 1.3 | 7.5 | 20.5 |
| pepper | 2.73 | 0.29 | 6.37 | 4.16 | 1.66 | 93 | 5.0 | 249 | 50 | 18.3 | | 2.5 | 5.0 | 14.1 |

Bdl: below detection limit

The total nitrogen contents of the vegetable plants leave from the Biodumbrava farm range within the normal contents domain limits, with small and insignificant exceptions. The phosphorus contents lie at the lower limit of the normal contents domain and below this which is normal taking into account the low contents of this element in the analyzed soil samples. The potassium contents tend to outrun the normal contents domain, except for the tomatoes, the calcium values are much above the normal contents, and the magnesium one lie within them. The zinc, copper, iron, manganese contents are generally normal, only in the case of copper higher values are registered proceeded from the applied pest control products.

As for Cocani farm the general image is that of plants enjoying good growing and balanced mineral nutrition conditions. It can be noticed that the nutrition state of organically grown vegetables doesn't differ from that of the conventionally grown ones.

The plants seem to take up from the soil the high lead and cadmium quantities which were referred to earlier. The more has the source of these microelements to be identified and excluded.

Chromium, cobalt, and nickel present another situation: although present in soil in slightly higher quantities than the normal contents domain they're not to be found in leaves, so the plants don't absorb all the available quantities.

### 2.2. Vegetables quality

In similar research carried out in the ecologically certified experimental field of SCDL Bacău and in ICDLF Vidra solariums cultivated in organic farming conditions a fruits mineral composition was highlighted similar to conventionally grown vegetables. As compared to the data obtained at the time a better nitrogen content is ascertained, more phosphorus than in the vegetables from Vidra and less than in those of Bacău, relatively low potassium and calcium contents, comparable contents of microelements involved in physiologic processes and important for human nutrition, except for the cobalt which appears in smaller quantities. It is very important that lead and cadmium don't transfer into the vegetables edible parts. Egg plants seem to accumulate a little more lead than other vegetables but in insignificant quantities.

Table 13. Mineral composition of the vegetables collected from Cocani farm

| Identification | N | P | K | Ca | Mg | Zn | Cu | Fe | Mn | Pb | Cd | Cr | Co | Ni |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mg/100 g fresh matter | | | | | | | | | | | | | |
| tomatoes | 133 | 114 | 31.8 | 3.3 | 4.01 | 0.09 | 0.03 | 1.06 | 0.027 | 0.0078 | 0.0004 | 0.0020 | 0.0006 | 0.0020 |
| pepper | 119 | 115 | 37.3 | 3.2 | 4.39 | 0.10 | 0.05 | 0.32 | 0.030 | 0.0057 | 0.0007 | 0.0199 | 0.0028 | 0.0158 |
| beetroot | 208 | 98 | 19.1 | 12.0 | 8.75 | 0.07 | 0.02 | 1.35 | 0.107 | 0.0059 | 0.0001 | 0.0021 | 0.0010 | 0.0043 |
| SCDL Bacău | | | | | | | | | | | | | | |
| tomatoes | 141-167 | 206-248 | 65-89 | 6.3-12.8 | 3.9-8.2 | 0.12-0.17 | 0.01-0.02 | 0.26-0.75 | 0.051-0.065 | 0.006-0.013 | | 0.007-0.024 | 0.010-0.026 | |
| ICDLF Vidra | | | | | | | | | | | | | | |
| tomatoes | 85 | 37 | 97 | 8.3 | 7.0 | 0.08 | 0.018 | 0.18 | 0.037 | 0.028 | | 0.007 | 0.020 | |
| pepper | 107 | 37 | 101 | 5.9 | 8.9 | 0.23 | 0.030 | 0.28 | 0.042 | 0.019 | | 0.016 | 0.015 | |

Table 14. Mineral composition of the vegetables collected from Biodumbrava farm

| Identification | N | P | K | Ca | Mg | Zn | Cu | Fe | Mn | Pb | Cd | Cr | Co | Ni |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mg/100 g fresh matter | | | | | | | | | | | | | |
| eggplants, field crop | 212 | 65 | 37.3 | 3.5 | 5.75 | 0.10 | 0.06 | 0.87 | 0.05 | 0.067 | 0.0002 | 0.0130 | 0.0005 | 0.080 |
| green pepper, field crop | 149 | 104 | 26.6 | 2.4 | 4.35 | 0.11 | 0.05 | 0.77 | 0.03 | 0.002 | 0.0006 | 0.0003 | bdl | 0.004 |
| beetroot, field crop | 121 | 117 | 59.4 | 17.8 | 4.29 | 0.18 | 0.06 | 0.42 | 0.10 | 0.008 | 0.0015 | 0.0055 | bdl | 0.010 |
| yellow pepper, field crop | 159 | 108 | 21.1 | 1.5 | 3.27 | 0.09 | 0.04 | 0.82 | 0.03 | 0.005 | 0.0005 | 0.0010 | bdl | 0.003 |
| tomatoes, solarium crop | 99 | 100 | 19.1 | 2.3 | 2.50 | 0.06 | 0.03 | 0.73 | 0.03 | 0.006 | 0.0004 | 0.0080 | bdl | 0.006 |
| SCDL Bacău | | | | | | | | | | | | | | |
| tomatoes | 141-167 | 206-248 | 65-89 | 6.3-12.8 | 3.9-8.2 | 0.12-0.17 | 0.01-0.02 | 0.26-0.75 | 0.051-0.065 | 0.006-0.013 | | 0.007-0.024 | 0.010-0.026 | |
| ICDLF Vidra | | | | | | | | | | | | | | |
| tomatoes | 85 | 37 | 97 | 8.3 | 7.0 | 0.08 | 0.018 | 0.18 | 0.037 | 0.028 | | 0.007 | 0.020 | |
| pepper | 107 | 37 | 101 | 5.9 | 8.9 | 0.23 | 0.030 | 0.28 | 0.042 | 0.019 | | 0.016 | 0.015 | |

## Conclusions

The texture and cationic exchange properties of the soil samples taken from gardens, solarium, and field denote a good soil fertility and favorability for vegetable growth. The soil reaction of the analyzed samples ranges in the neutral-slightly alkaline domain, favorable for plant growth. Nutrition elements (nitrogen, phosphorus, potassium, micro elements) supply from organic fertilization varies from low to very good and ensures vegetable plants nutrition on one hand and on the other soil enrichment and its fertility augmentation.

The nitrates contents range in the normal values domain for the un-fertilized and fertilized soils ploughed layer in the Cocani farm and are characteristic for the horticultural use soils in the Biodumbrava farm.

Vegetables nutrition state in the two studied farms is generally good and comparable to those grown in conventional system.

The mineral composition and thereby the nutritional quality of fruits ranges in adequate limits both in the organic products limitary context and in the conventionally obtained products larger one.

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