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ENVIRONMENTAL PROTECTION STUDY REGARDING THE DEVELOPMENT OF THE ECOLOGICAL AGRICULTURE SYSTEM

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ABSTRACT

The purpose of the paper is to reveal the development of plants grown both traditionally and environmentally friendly and to achieve a comparison of advantages and disadvantages of the two systems of agriculture. An essential aspect on which there is an emphasis with a view to the practical application of the organic farming system is the soil fertilization, given the fact that most of the problems that have made the necessity to convert to this type of agriculture are a consequence of soil damage and affecting its quality. The researches have been performed on five species of plants grown in two systems of agriculture. The results obtained have a high theoretical and practical importance and reveal the importance of the organic farming within the framework of the activities of the environmental protection, even if the level of productivity is further reduced.

KEYWORDS: ecological agriculture, organic farming, environment protection

1. Introduction

Organic agriculture has the advantage of protecting the environment from the pollution generated by using fertilizers and pesticides [7, 19]. It respects the natural systems of self-regulation in fighting against diseases and pests found in plants, it avoids the excessive and uncontrolled use of pesticides, synthetic fertilizers, as well as the use of growth hormones or antibiotics [18]. Thus, other techniques are being used to support creation and maintenance of long-lasting ecosystems which contribute in reducing pollution [5]. Organic agriculture has a great contribution in long-term economic development and plays an important role in improving environmental conditions, in soil preservation, in water quality, in biodiversity and in protecting nature [24]. Organic agriculture can go forward in rural economy and make it viable by expanding economic activities with high added value and by generating employment opportunities in rural areas [27].

In most industries, such as handling food processing and wine production, there is a great lack of capacity to develop grapes, meat and vegetables, which limit the number of products that are meant to be exported [16].

To be validated as organic and to be marketed, the products must have explicit references on their labels mentioning the organic methods used in production, and the quality evaluation certificates issued by a supervisor organization [13].

Organic farms are a fairly new sector. Romania benefits from adequate conditions to promote the organic cultures, such as the fertile and productive soil [15].

Traditional Romanian agriculture is based on harmless approaches to the environment and there are uncontaminated organic areas where organic agriculture could be developed [3]. In order to develop the agro-organic field and to improve

competitiveness for organic products [12] on the export markets, the following aspects must be identified and implemented [21]:
- The intake of more value on the national component of the value chain by product orientation and sales of primary products and processing products [23], by promoting Romanian organic products meant for export;
- The cover of the existing market by identifying new export markets and by consolidating the existing ones [28];
- The implementation of an elaborate legislation for this sector to consolidate the control system through additional measures meant to supervise inspection and certification bodies to increase the quality of exported products [21];
- The creation of a suitable production, processing and marketing system for organic products meant to satisfy internal and external market needs [30];
- The promotion of exported Romanian organic products by developing research [17];
- The improvement of training on all the involved participants in the organic sector: farmers, processors, inspectors, experts from the ministry, exporters and importers [11];
- The creation of organized groups of producers to expend the production and the market [22].

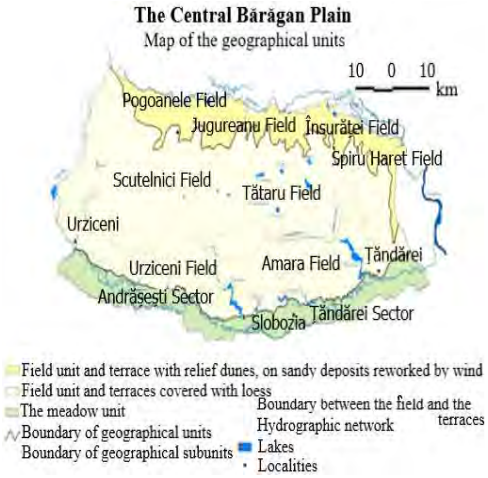


Fig. 1 Geographical placement [9]

2. Materials and working methods

2.1. The purpose of the paper

The purpose of the paper is to demonstrate the differences between traditional and ecological systems of agriculture.

V_1- onion, salad, radish V_2- onion, salad, radish

V_1 - spinach, peas V_2 - spinach, peas

Fig. 2 Experimental variants

2.2. Geographical location, relief, climate

The experiements were carried out on the land (a representative garden) belonging to the city Insuratei. The town of Însurăței is located in the eastern part of the Romanian Plain, in the north-eastern sector of the Central Bărăgan Plain (fig. 1). Within the county it occupies a central-southern position. It is located 48 km from the county capital, on the southwest direction.

The relief is characteristic of the hilly areas, in this area predominating the forests with oaks and acacias [4]. The relief found in this region is mostly plain (20-60 m) parasitized by wind-blown sands [29]. The bio-pedo-climate is steppe with psamosols and chernozems leached with a wide distribution in the territory, having a clayey sand texture [1,20]. It has fresh groundwater at 5-15 m [9]. The shape of the relief is characteristic to the lowland areas which cause an uniformity of the climate, with the average annual temperature of 11^0C and less rainfall [9].

The uniformity of the plain relief determines an obvious homogeneity of the climate characteristics. Summers are very hot, with light rainfall, which falls mainly in the form of showers. Winters are relatively cold, sometimes marked by strong blizzards, but also by frequent periods of warming, which cause discontinuities in the snow layer [2,9].

2.3. The organisation of the experiments

The paper presents observations and determinations on the plants cultivated in the two agricultural systems.

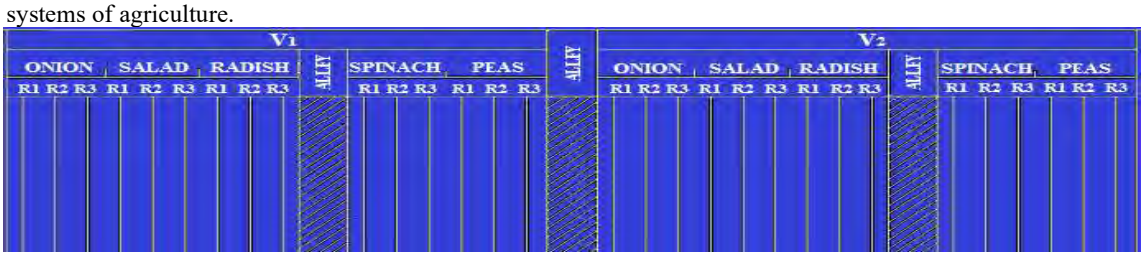


Fig. 3 Sketch of the experimental group

The experience took place in the spring, being an experience with two variants. The experimental variants are the traditional variant (V_1) and the ecological variant (V_2), (fig. 2). In the traditional version, the soil was fertilized with manure. Each variant has five species of plants (onion, lettuce, radish, spinach, peas), each plant being placed in three repetitions (fig. 2).

2.4. The biological material

The biological material used is "May King" lettuce seeds, "Cherry Belle" radish, "Semluca" spinach, "Dana" peas, chives.

2.5. The working method

The sowing was done on April 10, in rows with a length of 2 meters and a distance between rows of 30 cm (fig. 3). The mass emergence took place at a temperature of 10–15 °C as follows: onion 7-13 days, salad 7-15 days, radish 6-11 days, spinach 10-17 days, peas 9-14 days.

The soil works were as follows:

- weed control was done by manual plows, whenever necessary;
- breaking the crust after watering the plants in the soil, work that was done with a hoe.

3. Results and discussions

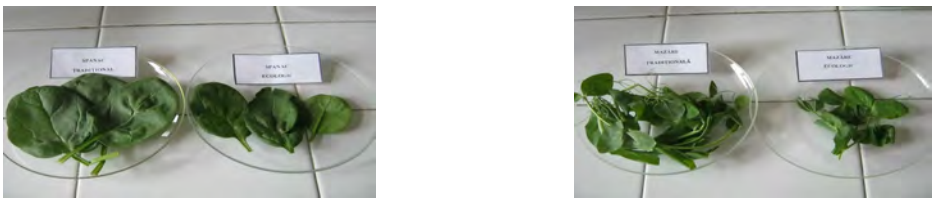
During the experiment were performed: determinations made on plants, determinations made on the ground and determinations of the water with which the plants were watered.

3.1. Plant analysis

3.1.1. Determination of the green mass content

Two-stage samples were collected for each plant species on an area of 1 dm^2. For the first stage, the harvest took place on May 16th (fig. 4), and for the second stage on May 27th for lettuce, radishes, spinach and on June 20 for onions and peas (fig. 5). The green mass content for all the studied plants is represented in fig. 6 for each method used and for each stage.

1. Onion 2. Salad 3. Radish



4. Spinach 5. Peas

Fig. 4 First harvest (stage I): traditional method (left photo); ecological method (right photo)

1. Onion 2. Salad 3. Radish

4. Spinach 5. Peas

Fig. 5 Second harvest (stage II): traditional method (left photo); ecological method (right photo)

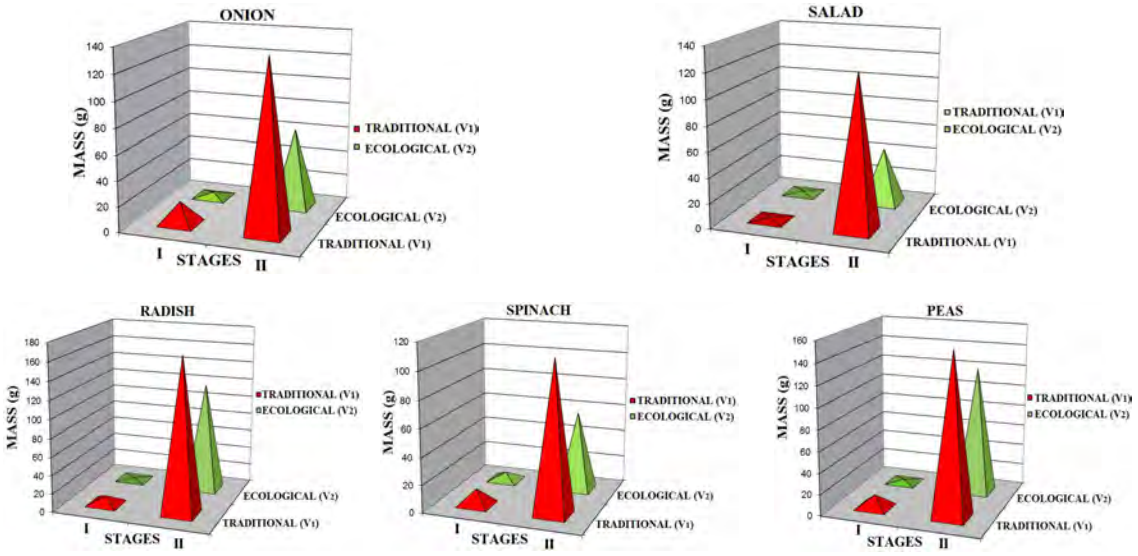


Fig. 6 Determination of the green mass content (g/dm^2)

3.1.2. Determination of the dry matter content and of the humidity

For the plants harvested in stage I, the dry matter and the humidity were determined. The humidity (U%) was determined by the gravimetric method, more precisely by measuring the loss of water content after drying in the oven at 105℃ (table 1, fig. 7-8).

3.1.3. Biometric determinations

The biometric measurements were performed to establish the plant capacity to grow and to develop. The biometric measurements are shown in table 2 for the roots and in table 3 for the aerial parts. The mature plants were harvested and weighed (fig. 9).

3.1.4. Determination of the ash content

The ash content of the plant material was determined by the calcination method at 550℃. The results are shown in Table 4.

3.2. Soil analysis

3.2.1. Determination of soil pH

The results of the determinations made on the soil are given in table 5. The reaction of the soil was determined by the potentiometric method in aqueous suspension soil: water of 1: 2.5. Soil pH is an element that depends on the ability of plants to absorb nutrients from the soil.

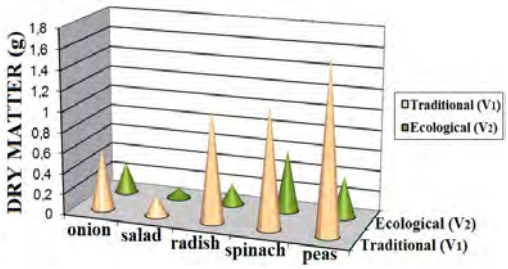


Fig. 7 Determination of the dry matter content

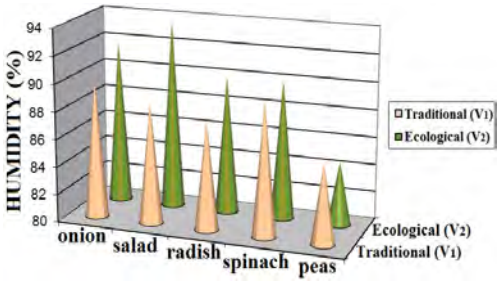


Fig. 8 Determination of the humidity content

Table 1. Data on the dry matter and the humidity of the green mass

Version	Species	Green mass (g)	Dry matter (g)	Humidity (%)	Dry matter (%)
Traditional (V_1)	onion	17,5	0,6	96,00	4,00
	salad	1,8	0,2	88,80	11,20
	radish	9,1	1,1	87,91	12,09
	spinach	11,7	1,2	89,74	10,26
	peas	12	1,7	85,83	14.17
Ecological (V_2)	onion	3,7	0,3	91,89	8,11
	salad	1,6	0,1	93,75	6,25
	radish	2	0,2	90,00	10,00
	spinach	6,1	0,6	90,16	9,84
	peas	2,6	0,4	84,61	15,39

Table 2. Biometric measurements of the bulbous plant root

Version	Plant	Root - stem diameter (cm)	Average/ plant		
			Root diameter (cm)	Root length (cm)	Root weight (g)
Traditional (V_1)	onion	1,7	5,75	4.2	78,7
	radish	4,05	4,86	5,48	44,4
Ecological (V_2)	onion	1,2	4,60	3.8	53,1
	radish	3,1	3,43	5,43	27,96

Table 3. Biometric measurements of the aerial parts

Version	Plant	Height	Number of leaves	Foliar surface* (cm^2)/ plant
Traditional (V_1)	onion	56	12	40,112
	salad	15	9	64,978
	radish	23	9	33,788
	spinach	24,5	11	56,138
	peas	114	41	6,360
Ecological (V_2)	onion	46	5	29,094
	salad	13,2	6	43,118
	radish	22,5	9	33,851
	spinach	19,8	10	26,525
	peas	108	29	6,188

*) Calculation of the leaf area: L x l x k, where:
L is the height of the leaf, l is the width of the leaf and k is the experimentally determined plant coefficient: onion (k = 0.65), salad, radishes and spinach (k = 0.68) and peas (k = 0.67)

V_1 - onion = 5 kg; V_2 - onion = 3,5 kg; V_1 - salad = 5,45 kg; V_2 - salad = 2,65 kg

V_1- radish = 3,55 kg; V_2- radish = 3,3 kg

V_1- spinach = 2,3 kg; V_2- spinach = 1,2 kg; V_1- peas = 2,6 kg; V_2- peas = 2,1 kg

Fig. 9 Harvested and weighed plants

Table 4. The ash content of the plant material

Version	Plant	Ash (%)
V_1	onion	16,66
	salad	20,00
	radish	14,28
	spinach	25,00
	peas	11,11
V_2	onion	14,00
	salad	18,00
	radish	12,00
	spinach	16 ,25
	peas	9,00

3.2.2. Determination of the soluble salts in the soil

The total content of the soluble salts was determined as shown in fig. 10 by the conductometric method in aqueous soil extract at a soil:water ratio of 1:5. Distilled water without CO_2 was used. From the value of the electrical conductivity of the aqueous extract 1:5 (expressed in S/cm at 25℃), the total content of soluble salts is estimated.

Soil sample filtration Soil samples after filtration

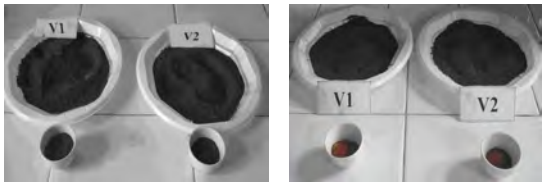
Fig. 10 Determination of the salts in the soil

3.2.3. Determination of the phosphorus content

The assimilable phosphorus was determined by the Egner Riehn Domingo method of extraction with ammonium lactate acetate solution (AL), as shown in fig. 11. By the Nikolov method, the dosing in the form of molybdenum blue was determined, using ammonium molybdate and a mixture of reducing agents: stannous chloride and ascorbic acid.

The dosing was performed by the colorimetric method at a wavelength of 715 nm.

Fig. 11 Determination of the phosphates in the soil



Soil samples before calcination Soil samples after calcination at 800℃

Fig. 12 Determination of the soil organic matter

3.2.4. Determination of the soil organic matter

The organic matter content was determined by the calcination method at 800℃. The organic matter in the soil is mainly responsible for soil fertility, acting as a reservoir of nutrients. Organic carbon in the soil supports its structure, improving the physical environment for the roots to penetrate the soil.

Table 5. Determinations made on the soil

Parameter	V_1	V_2
pH (-)	8	8.1
Salts (mg/100 g soil)	70	50
Phosphorus (ppm)	58	51
Organic matter (%)	7.59	6.32

3.3. Determinations of the water for irrigation

Regarding the water destined for irrigation the plants subjected to this study, the pH was determined (fig. 13), for which the registered value was of 8 units. Also, the salt content was determined (fig. 14), the registered value being of 0.528 g/l.

Fig.13 Determination of the irrigation water pH

Fig.14 Determination of the salts in the water

4. Results and recommendations

1. The green mass content recorded high values in the traditional system, compared to the ecological system, as follows:
- the green mass content of the onion was 2.5 times higher;
- the green mass content of the salad was double;
- the green mass content of radishes was 2.5 times higher;
- the green mass content of spinach was double;
- the green mass content of peas was 2.5 times higher.

2. The accumulations of dry matter and wet matter present differences, the differences being determined by the unequal development of the plants from the two agricultural systems. The accumulation of the dry substances is higher in the traditional version because the metabolism of the plants is more active.

3. Biometric determinations of roots and aerial parts found that the traditional system benefits plant development. Plant height and number of leaves per plant varied depending on the crop variant and the

climatic conditions. The dynamics of the leaf surface registered significant increases in the traditional agriculture system as a result of the use of manure.

4. The ash content of the plant matter is variable by the plant species, decreasing in the ecological version compared to the traditional version.

5. The pH of the soil is within normal limits, because the plants from the experimental variants grow well on weakly alkaline soils. The soil is unsalted and fertile in this regard. The supply of phosphorus to the soil is moderate. The organic matter in the soil is within normal limits.

6. The pH and the salts in the water are within normal limits for the irrigation water.

The study reveals that it can be obtained higher yields in the traditional system than in the ecological system. As the traditional option is more productive, organic farming must take into account traditional knowledge and integrate it into all its branches alongside scientific advances in order to provide consumers with quality products.

From this paper can be obtained immediate information, useful for local agricultural practice, but with a low degree of generalization.

5. Conclusions

1. Organic farming has the advantage of protecting the environment from pollution caused by the application of fertilizers and pesticides. It respects natural self-regulatory systems in the fight against plant diseases and pests, avoids the excessive and uncontrolled use of pesticides, herbicides, synthetic fertilizers, as well as the use of growth hormones or antibiotics [26]. Instead, techniques are used to promote the creation and maintenance of sustainable ecosystems and help reduce pollution.

2. The organic farming has a great contribution to lasting economic development and plays an important role in improving the condition of the environment, preserving the soil, improving the water quality, the biodiversity and the nature protection [14]. The organic farming can move the rural economy forward and make it viable by expanding high value-added economic activities and creating jobs in the rural areas. In most food processing and winemaking industries there is a great lack of capacity for the capitalization of grapes, meat and vegetables, which limits the volume of exportable products. In order to be validated as organic and to be placed on the market, foodstuffs must bear on the labels explicit references to their organic production methods and to the quality assessment certification issued by a supervising organization [8]. Organic farms are a fairly new sector. Romania enjoys appropriate conditions to promote organic farming, such as:

- fertile and productive soil;
- traditional Romanian agriculture is based on approaches that do not harm the environment and there are possibilities to identify unpolluted ecological areas where organic agriculture could be developed.

In order to develop the agro-ecological sector and to improve the competitiveness of organic products on export markets, the following must be identified and implemented:

- capturing and retaining more value on the national component of the value chain by orienting production and sales to primary products and processing products, promoting Romanian organic export products;
- covering the existing market niche by identifying new export markets and consolidating existing markets;
- implementation of the legislation developed for this sector in order to strengthen the control system through additional measures meant to supervise the inspection and certification bodies in order to increase the quality of the exported products;
- creating an appropriate production, processing and marketing system for the organic products, designed to meet the needs of internal and external markets;
- promoting the exports of Romanian ecological products by developing the research activity;
- improving the professional training of all factors involved in the ecological sector: breeders, processors, inspectors, ministry experts, exporters and importers;
- creation of organized groups of producers to expand production and the market.

4. The main qualitative objective of EU agricultural policy on rural development is to promote and develop a compatible relationship between agriculture and the environment. The quantitative objective is to expand the area cultivated by ecological methods to 150,000 hectares and to create an internal market with ecological products. Romania has great opportunities to promote and develop organic agriculture due to an agricultural area of 14.8 million hectares and unpolluted soils.

5. The organic farming is an alternative that can solve a number of problems of the contemporary world, in which intensive chemical agriculture has failed to find, for now, convenient solutions. These issues include climate change, which is currently difficult to adapt to. It is recognized that organic farming is a type of modern agriculture, in the sense that it uses the latest discoveries in science, the result of work and research in recent years. In no case should we look at the organic farming system as a return to the rudimentary, traditional or empirical agricultural model. The widespread implementation of the organic farming is considered to contribute to the protection of the environment, food security and the improvement of the quality of life [10].

6. From the point of view of the advantages brought to the environment, the ecological agriculture

can determine significant benefits in the economic and the social plan in the rural areas, but also in the urban areas. The development of the agricultural sector, ensured by the achievement of a sustainable agriculture, is supported by financial aids or other incentive measures that favour the conversion to an ecological agriculture and that stimulate the development of the sector as a whole.

7. The organic farming must be seen as an integral part of a sustainable way of agricultural production and, at the same time, as a viable alternative to traditional agriculture [6]. What distinguishes organic farming from other forms of agricultural production is that it emphasizes the use of unconventional resources and recycling, returning to the soil the nutrients obtained from the wastes.

8. The organic farming is the main component of the sustainable development. The sustainable development is the proposed concept for the reconciling of the agri-food production with the conservation of non-renewable resources and the environmental protection [25]. To achieve this goal, farmers must take into account the effects that specific agricultural activities will have on the environment, respectively the environmental impact of systems on which they apply. For this reason, farmers, consumers, but also politicians have shown a special interest in organic farming, which is proving to be an advantageous way to reconcile man with nature.

REFERENCES

[1] **Borlan Z., Hera C.** – *Metode de apreciere a stării de fertilitate a solului în vederea folosirii raţionale a îngrăşămintelor*; Ed. Ceres, Bucureşti, 1973.

[2] **Borlan Z., Răuţă C.** – *Metodologie de analiză agrochimică a solurilor în vederea stabilirii necesarului de amendamente şi îngrăşăminte;* vol. 2.; Seria: Metode, rapoarte, îndrumări; ICPA nr. 3, 1981.

[3] **Bran, F., Ioan, I., Trică, C.** – *Eco-economia ecosistemelor şi biodiversitatea*, Editura ASE, Bucureşti, 2004.

[4] **Canarache A.** – *Fizica solurilor agricole*, Editura Ceres, Bucuresti, 1990.

[5] **Davidescu D., Davidescu V., Lăcătuşu R.** – *Sulful, calciul şi magneziul în agricultură;* Ed. Academiei RSR, Bucureşti, 1984.

[6] **Davidescu D., Davidescu V., Lăcătuşu R.** – *Microelementele în agricultură;* Ed. Academiei RSR, Bucureşti, 1988.

[7] **Davidescu, D., Davidescu, V.** – *Agricultura biologică,* Editura Ceres, București, 1994.

[8] **Dormeanu A.** – *Concepţii moderne în fertilizarea organică a solului,* Editura Ceres,Bucuresti, 1994.

[9] **Eftene, C.A.** – *Bărăganul central – Sinergism microrelief – depozite – sol,* Editura Fundației "România de Mâine", 2015.

[10] **Florea N.** – *Degradarea, protecţia şi ameliorarea solurilor şi a terenurilor,* Editura Universitară, Bucuresti, 2003.

[11] **Florea, N., Munteanu I.** – *Sistemul Român de Taxonomie a Solurilor,* realizat în ICPA – Institutul de Cercetare pentru Pedologie și Agrochimie, Editura Estfalia, București, 2003.

[12] **Fukuyama, F.** – *Viitorul nostru postuman. Consecinţele revoluţiei biotehnologice*, Editura Humanitas, Bucureşti, 2004.

[13] **Gedda, A.** – *Grădina de legume ecologice*, Editura Polirom, 2007.

[14] **Ghinea L.** – *Apărarea naturii*, Editura stiințifică și pedagogică, Bucuresti, 1978.

[15] **Ghinea, L.** – *Viaţa în sol,* Editura Ceres, Bucureşti, 1994.

[16] **Gruia, R.** – *Managementul eco-fermelor*, Editura Ceres, București, 1982.

[17] **http://www.fermierul.ro/modules.php**, Institutul de bioresurse alimentare. Actualitate, perspective, certificarea conformității.

[18] **Ionescu, A.** - *Agricultura ecologică*, Editura Ceres, București, 1982.

[19] **Lăcătuşu R.** – *Agrochimie,* Ed. Helicon, Timişoara, 2000.

[20] **Lăcătuşu R.** – *Mineralogia şi chimia solului,* Ed. Universității „Al. I. Cuza" Iași, 2000.

[21] **Matei, D.** – *Cadrul legal al agriculturii ecologice, Seria „Agricultura ecologică – paşi spre viitor",* nr.3/2004, Editura Terra Nostra, Iaşi, 2004.

[22] **Matei E.** – *Ecosisteme umane*, Editura Universitară, Bucuresti, 1988.

[23] **Mănescu, B. –** *Strategia dezvoltării ecologice a agriculturii*, Editura Tribuna Economică nr.1-3,1994.

[24] **Oancea, I.** – *Tratat de agricultură*, Editura Ceres, București, 1996.

[25] **Pohoaţă, P.** – *Dezvoltarea durabilă. Strategii si politici europene de dezvoltare durabila,* Note de curs, Universitatea Alexandru Ioan Cuza Iaşi, Centrul de Studii Europene https://docplayer.fr/40169149-Strategii-si-politici-europene-de-dezvoltare-durabila-prof-dr-ion-pohoata.html.

[26] **Răuţă C., Cârstea S.** – *Prevenirea si combaterea poluării solului*, Editura Ceres, Cluj, 1983.

[27] **Sisești, V.I., Papacostea, P., Stefanic, G.** – *Compostul – îngrăşământ din deşeuri organice*, Editura ştiințifică și enciclopedică, București, 1985.

[28] **Toncea, I.** – *Ghid practic de agricultură ecologică*, Editura Napoca 2002.

[29] **Vintilă I., Borlan Z., Răuţă C., Daniliuc D., Ţigănaş L.** – *Situaţia agrochimică a solurilor din România; Prezent şi viitor;* Ed. Ceres, Bucureşti, 1984.

[30] **Zecca, F.** – *Aspetti tecnici, gestionali e amministrativi dell'agricoltura biologica*, Ed. Universita degli Studi di Perugia (Ce.S.A.R.), 1998.