PRELIMINARY STUDIES REGARDING THE OPTIMIZATION OF SOME TEHNOLOGICAL FACTORS FOR VEGETABLES GROWING IN AN ECOLOGICAL SYSTEM

STUDII PRELIMINARE PRIVIND OPTIMIZAREA UNOR FACTORI TEHNOLOGICI DE CULTIVARE A LEGUMELOR ÎN SISTEM ECOLOGIC

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Abstract. *The goal of this paper is a reviewing of the most prominent technological factors and how they can influence the sustainability of crops. The evaluation of these factors is based on a comparative analysis of their influence in conventional and organic vegetable growing systems.*

Key words: technological factors, organic vegetables, sustainability, comparativ analysis.

Rezumat. *Lucrarea de faţă îşi propune trecerea în revistă a celor mai de seamă factori tehnologici şi a modului în care aceştia pot influenţa sustenabilitatea culturilor. Evaluarea acestor factori se face pe baza unei analize comparativă a influenţei lor în sistemele de legumicultură convenţională şi legumicultură ecologică.*

Cuvinte cheie: factori tehnologici, legume ecologice, sustenabilitate, analiză comparativă.

INTRODUCTION

Vegetable plants grow, develop and carry out the planned harvest in the local environmental conditions, adjusted by the technological conditions or technological factors. Technological factors vary in quality and / or quantitatively, depending on their nature; their value is determined by the amount of natural conditions, in circumstances which the production process runs, but also the technical possibilities at their disposal (the base material, labor etc.) (Rusti, 2007).

The optimization of technological factors has been a constant concern and appeared early on in chronological cultivation of vegetable plants, reaching its peak in the twentieth century. As a result, new technologies for growing vegetables, more complex and focused on a greater number of technological factors developed (Săulescu and Săulescu, 1967; Davidescu and Davidescu, 1982 cited by Rusti, 2007).

Thus, J. B. Boussignault (1834), studied the effect of fertilizer and crop rotation in France. Liebig (1840), had concerns about the usefulness of using mineral fertilizers based on the theory of plant nutrition in Germany. J.B. Sawes

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and H. Gilbert (1843), at the Rothamsted Experimental Station - England, had performed experiments of fertilization and rotation of the main agricultural crops and crop rotation. They were the pioneers of European agricultural experimental research.

The study of complex technological factors and placing them in the process of technologies optimization has been a constant concern in the second half of the twentieth century. This thing was possible due to progresses made in biometrics and biological and experimental statistic field, accomplished at the beginnings by Fischer, Snedecor, Cochran and Cox (Săulescu and Săulescu, 1967).

The knowledge of the influence of technological factors in agriculture and how they can be directed represents a continuous issue for agricultural science and practice. The promotion of new agricultural systems, such as ecological agriculture, requires the development of new technologies based on the knowledge of the influence of technological factors in production.

As a result, this paper presents a comparative analysis of the main technological factors from both organic and conventional vegetables growing systems.

MATERIAL AND METHOD

This paper was based on the existing factual analysis, registered and managed by different authorities and institutions. To achieve the goal and objectives, there was a case study on the main experimental factors and the way they "make their mark" on the culture of vegetables in both conventional and ecological system.

Working material consisted of documents from numerous sources of public character.

As working methods in the study of case were used notes, comparative analysis, comparative and systematic group based on goal.

RESULTS AND DISCUSSIONS

Technological factors that have proved to be essential in the vegetable growing, ensuring the sustainability of both culture systems (conventional and organic) are: crop rotation, soil tillage, the biological material and cultivar, crop density, sowing time, the provision of irrigation, fertilization, weed, pest and disease control.

Crop rotation represents the rotation of crops in time and space. It involves dividing the whole surface in equal size plots, filled with one or more species which have similar agro-technical and environmental requirements. Usually, a vegetable crop rotation has a duration of 4-5 years. The restrictions regarding weeds, pests and diseases that occur in organic vegetable growing system, makes the crop rotation a main link in achieving sustainability of the system.

The soil tillage aims to create favorable conditions for plant growth and development, improving the physical characteristics and increasing the chemical processes of soil (Stan and Stan, 2010). These tillage are divided into basic (leveling maintenance, basic fertilization, deep plowing, deep soil loosening) and seedbed preparation work (soil modeling, chemical weed control). It is

recommended to avoid deep plowing with furrow return, especially for vegetable crops in ecological farming practice, because it requires deep burial of fertile arable layer, with all living organisms and aerobic bacteria, leading over time to reduce the number of microorganisms, humus and fertility (Stoleru and Imre, 2008).

The cultivar (variety) remains a main factor of production in both culture systems. Due to the great importance of the variety as the main factor of production, a lot of researches on new varieties and hybrids took place since the second half of the nineteenth century till nowadays. The choice of varieties and hybrids resistant to pests and diseases is necessary both in protected and early field crops, due to very high investments, requiring the elimination of all risks and losses. The improvement of varieties and hybrids for ecological vegetable growing is also based on the induction of different resistances considering the restrictiveness to pest and disease control of this vegetable growing system.

Modern technologies for cultivation of vegetable plants, based on the use of advanced cultivars, mechanization, irrigation and chemical administration imposed detailed researches on schemes of crop establishing, distance between plants, plant density and planting dates.

Planting dates are determined by the system of culture, by the biological peculiarities of the vegetable species and the time the yield harvesting (Stan and Stan, 2010).

Standard water quantity represents the amount of irrigation water that is given to crops an entire growing season. Due to restrictions of organic farming in the treatment of fungal diseases favored by high humidity, the provision of irrigation for organic production cycle is recommended to be much lower than the conventional system. However, Stoleru and Imre (2007) show that the removal of intensive irrigation and non-use of synthetic chemical fertilizers and pesticides in ecological system provides water to normal standards and avoid waste, thus achieving water sustainability.

Crop density represents the number of plants per hectare. It varies greatly depending on the scheme of crop establishing. Table 1 presents the distances between plants and the densities achieved in ecological vegetable growing for some important crops which have proved to be sustainable in terms of revenue.

Fertilization is a technological factor with a major impact in increasing the amount of harvest. Stoian (2005) considers that fertilization is the most important technological factor which makes the greater difference between the two croping systems (conventional and organic).By practicing the ecological agriculture it is avoided the excessive accumulation of mineral salts in the arable layer that can lead to pollution of groundwater and surface water, and also to soil and crop.

In conventional agriculture, the fertilization is based on the careful chemical administration, particularly the use of organic and chemical fertilizers, while the basic link in ecological agriculture is represented by the compost. Also, the methods of fertilization must take into account the actual purpose: maintaining or increasing fertility and improving the nutrition of the growing season (Stan and Stan, 2010).

Table 1

Distances and densities for the establishment of some vegetable crops

(after Stoian, 2005)

Nr. crt.	Species	Number of rows per furrow	Distance between plants in row (cm)	Density thousand plants/ha
1.	Pepper	2	20-22	65-70
2.	Long pepper	2	18-20	70-80
3.	Fiber pepper	2	20-25	57-70
4.	Climbing cucumber	2	20-22	64-72
5.	Mechanically planted onions	4	3-4	700-900
6.	Garden bean	2	7-10	145-210
7.	Climbing beans	2	13-15	70-90
8.	Cantaloupe	1	50-55	13-15
9.	Lettuce	3	25-30	71-86
10.	Early tomatoes	2	30-32	45-47
11.	Summer tomatoes	1	20-25	28-36
12.	Garlic	3	5-6	350-430
13.	Early cabbage	2	25-30	47-57
14.	Autumn cabbage	2	35-40	36-41
15.	Eggplants	2	35-40	36-41

Regarding the *weed control*, the use of the herbicides is an indispensable link in the conventional system technology. The weeds are not considered "bad plants" but "accompanying wild plants" in organic agriculture's theory (Bankels, cited by Petrescu, 1997).However, there are four main factors that must be taken into account when it comes to applying herbicides: choosing the most effective herbicide, establishing the most effective dose of application, timing and technique of application and the factors influencing the implementation (Stan and Stan, 2010).

Concerning the weed control in ecological agriculture, there are two groups of measures: preventive and curative.

Some of the preventive measures are considered: plant quarantine, crop rotation organization, practicing long crop rotations, soil working depth rotation, sowing at optimum time, ensuring the plant density, continuous occupation of land by introducing successive crops, the adjustment of soil reaction and ensuring optimal ratio between nutrients, removal of excess water, using of fermented compost to fertilize in organic system, elimination of weed outbreaks from uncultivated land, cleaning of farm machinery, the use of seeds free irrigation water and timely performance of agricultural works (Munteanu N. et al. 2008).

Curative measures can be: physical-mechanical kind (manual, mechanical or thermal control), biotechnical kind (mulching, soil tillage in the dark, forcing the seed germination), biological kind (allelopathic, parasite and fungal control), genetic kind (based on competition for environmental factors between crop plants and weeds), biochemical and biodynamic kind.

Pests and diseases control. Stan and Stan, 2010, considers that damage caused by the effect of crop diseases and pests are, on average, 18% and can reach

up to 100% when they encounter the best conditions for development. In conventional agriculture there are preventive treatments against diseases (using contact products) and curative treatments (using systemic products). Usually, pests are controlled only by curative treatments when their appearance is seen.

The principles of integrated control are applying in ecological system, with the specification that most chemicals are prohibited. Therefore, rather than the conventional system, the ecological system focuses on preventive measures.

Tables 2 and 3 presents some plants with pathogen and insecticide action successfully used in organic farming.

Table 2

Species of plants acting against pathogens at vegetable crops
(Munteanu N. et al. 2008)

Species	Pathogen	Disease	Partea de plantă folosită
Anethum graveolens (Dill)	*Fusarium oxysporum* *Rhizoctonia solani*	fusariosis rhizoctoniasis	Volatile oil
Chelidonium majus(Wormwood)	*Botrytis cinerea* *Fusarium oxisporum*	gray rot fusariosis	All plant
Lycopersicon esculentum (Tomatoes)	*Fusarium oxisporum*	fusariosis	leaves, leafjuice
Mentha piperita (Peppermint)	*Cladosparium fulvum* *Botrytis alii*	Brownstaining of leaves garlic rot	Leaves, volatile oil

Table 3

Native plant with insecticide action (Munteanu N. et al., 2008)

Species	Contained pest
Achillea millefolium (Yarrow)	aphids, mites, psilide, thrips
Allium cepa (Onion)	mites, ants, deposit pests
Artemisa absintium (Wormwood)	nematodes, caterpillars, fleas
Conum maculatum (Hemlock)	Beetle larvae
Coriandrum sativum (Coriander)	aphids, spiders, Colorado beetle (repellent effect)
Solanum nigrum (black nightshade)	aphids, mites, cabbage white butterfly

Ecological agriculture system can use a series of entomophagous predators for pest control: *Coccinella septempunctata* against grey lice, *Encarsia formosa* (parasitic wasp) against *Trialeurodes vaporariorum, Trichogramma spp* (parasitic wasp) against *Mamestra brassicae* to mention the most known.

CONCLUSIONS

1. Technological factors represent the main element of vegetable growing, regardless of the system of culture, because they provide the quantitative growth (conventional system) and the quality growth (organic systems) of vegetable production.

2. Sustainability of vegetable growing, either conventional or organic, is closely related to ensuring optimized technological factors in accordance with the latest developments in the vegetable growing area and economic efficiency conditions.

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