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ECOLOGICAL APPLE CULTURE IN ROMANIA - CULTIVATION AND CULTIVARS

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Abstract

In the last decade, European consumer demand for organic or ecological products has increased. Ecological agriculture has the potential to reduce negative impacts on humans and ecosystems, but its productivity compared to conventional agriculture remains a controversial issue. Consumers began to look for safer and better controlled fruits, produced in a more ecological environment. Organically produced fruits are considered to satisfy consumer demands while having a favorable impact on the environment and human health. European Union guidelines on organic production prohibit the use of synthetic products (fertilizers and plant protection methods). The principles for organic farming are similar in different European countries and the permitted inputs are regulated by law. In this paper, we proposed to present principles and rules in ecological fruit growing sector, as well as fertilizers and varieties recommended for apple culture in an ecological system in Romania.

Key words*: apple, ecological system, rules, cultivars, fertilizers.*

INTRODUCTION

The definition and state of ecological agriculture

"Ecological agriculture" is a term protected and assigned to Romania by the EU to define this agricultural system and is similar to the terms "organic agriculture" or "biological agriculture" used in other member states. For example, the term organic is used in Great Britain, Cyprus, Ireland, Malta, the term biological in France, Italy, Belgium, Greece, Luxembourg, Austria, the Netherlands, Portugal, and the term ecological in Denmark, Sweden, Lithuania, Poland, Spain, Romania, Slovenia, Hungary, Germany, etc. (Butac et al., 2021).

The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) define organic agriculture as an "integrated system of managing the agricultural production process, which contributes to supporting and strengthening the resilience of the agro-ecosystem, including biodiversity, biological cycles and soil biological activity" (Butac et al., 2021).

According to the most recent Research Institute of Organic Agriculture (FiBL) data (2019), organic agriculture is practised in 187 countries, and 72.3 million hectares of agricultural land were managed organically by at least 3.1 million farmers. The regions with the organic agricultural land areas are Oceania (35.5 million hectares, 50% of the world's organic agricultural land), Europe (16.5 million hectares, 23%), Latin America (8.3 million hectares, 11%), Asia (5.9 million hectares, 8%), North America (3.6 million hectares, 5%) and Africa (2 million hectares, 3%) (Figure 1) (Willer et al., 2021).

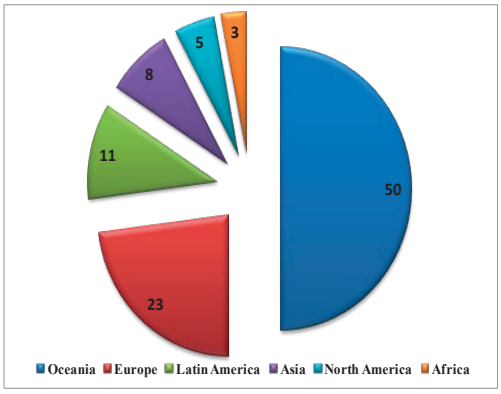

Figure 1. Distribution of organic agfricultural land by region, 2019 (surce: FiBl survey, 2021)

Worldwide, in 2016, fruit tree species from the seed and stone fruit group in the ecological system occupied an area of 254,600 hectares, berries 56,443 hectares (Butac et al., 2021), and nut crops occupied an area of 574,069 hectares.

In Europe, Spain, France, Italy, Germany and Switzerland are the countries with the largest orchard area in the ecological system.

Thus, Germany is the country with the oldest tradition in organic agriculture, at the level of 2017, 15% of the total production of fruits (apple, pear, plum, sweet and sour cherry, apricot, peach, quince, walnut) being produced in an organic system.

In Italy, in the South Tyrol region, 41,000 tons of apples are produced annually, of which 10% are organically grown. Under the slogan "in harmony with nature", the farmers of this region formed an association of apple producers in an integrated system, AGRIOS, since 1988.

In Switzerland, the pioneer of organic farming in the world, apples are the most sold fruits. At the level of 1999, there were 366 farmers, who owned 213 ha of apple orchards, of which 70-80% produced organically.

In Romania, ecological agriculture included, at the level of 2019, an area of approximately 395,228 ha, respectively 2.9% of the agricultural area. Fruit trees occupy only 15,905 ha, i.e. a share of 4.0% of the total organic agriculture at national level (Butac et al., 2021).

Principles of ecological agriculture (EA) (Kienzle and Kelderer, 2017; Butac et al., 2021):

1. The principle of health: EA must ensure and improve the health of the soil, plants, animals and people. Ecological farming is intended to produce healthy food with superior nutritional quality that prevent disease and maintain well-being.
2. The principle of ecological: EA must achieve an ecological balance by organizing agricultural production systems, managing habitats and maintaining genetic and agricultural diversity.
3. The principle of fairness regarding the environment and living conditions. Fairness is expressed through respect, justice and consideration.
4. The principle of management that EA must be managed in a prudent and responsible manner to protect the health and well-being of current and future generations, as well as the environment. EA must prevent the occurrence of major risks by adopting appropriate technologies.

The main rules of ecological farming (Kienzle and Kelderer, 2017; Butac et al., 2021):

1. Environmental protection. EA must reduce or eliminate the use of synthetic or natural products that destroy useful organisms in the soil, diminish non-renewable resources and diminish the quality of water, air and agricultural products.
2. Maintaining and increasing soil fertility. EA through specific practices aims to intensify the activity of microorganisms in the soil, in order to increase its fertility.
3. Respect for consumers' health. By practicing EA, the aim is to obtain quality agricultural products, without pesticide residues, with a balanced content of proteins, carbohydrates, lipids, vitamins, organic acids and mineral salts.
4. The ecological farm must be a balanced unit being a component of the ecosystem.
5. Recycling of materials and resources inside the farm.
6. Maintaining the biodiversity of the agricultural ecosystem.
7. Cultivating plants in harmony with natural laws.
8. Obtaining optimal and not maximum productions. Maximum productions are achieved in most cases with an abusive use of resources and environmental degradation. Ecological agricultural systems aim to obtain optimal productions, under the conditions of environmental protection, agricultural products and conservation of non-renewable resources.
9. The use of technologies suitable for the ecological farming system.
10. Preserving the integrity of ecological agricultural products, from their production to marketing.

The legal framework and normative acts regarding ecological fruit growing

The European Commission has established rules for each type of activity through Regulation (EU) 848/2018 regarding production and labeling of organic products, Regulation (EC) no. 834/2007 and Regulation (EC) 889/2008 which provide application of appropriate management of biological processes based on ecological systems using natural resources (Kienzle and Kelderer, 2017).

In Romania, the ecological farming system is regulated by the following normative acts:

- Order 464/2019 regarding the import of ecological products from other countries;
- MADR Order 181/2012 and 954/2016 regarding the organization of the inspection and certification system in ecological agriculture;
- MADR Order 737/2014 regarding the registration of operators in ecological agriculture;
- Decision 131/2013 regarding the labeling of ecological products;
- Order 51/2010 regarding the authorization of imports of ecological agri-food products from other countries;
- Regulation 889/2008 regarding production and labeling of ecological products;
- Regulation 852/2004 regarding the hygiene of food products.
- Order no. 417/110/2002 regarding the labeling of ecological food products;
- Emergency Government Ordinance 34/2000 regarding ecological agri-food products.

Even if ecological agriculture has developed in many countries, there is a need for research activities, as follows:

• Creation of cultivars and rootstocks suited to ecological systems;

• Using of fertilizers and pesticides suited to ecological agriculture to improve soil fertility and maintain the health of plants, people and the environment.

Creation of cultivars and rootstocks suited to ecological systems

Appropriate cultivars and rootstocks are a key factor in development an orchard system (conventional and ecological).

Apple cultivars should show resistance to diseases, pests and abiotic factors such as frost or sunburn.

After the 1990s, many new cultivars from breeding programs around the world were tested and promoted as tolerant or resistant to one or more diseases.

In the last years, in the ecological fruit-growing sector and also in the market was introduce new scab-resistant cultivars with higher fruit quality, such as 'Topaz', 'Red Topaz', 'Dalinred', 'Santana', 'Ariwa' and 'Natyra' due to collaboration between breeder, growers and marketing organizations (Kienzle et al., 2016; Kienzle and Kelderer, 2017). These cultivars have the Vf scab resistance gene.

The breeding strategies for creation of new cultivars are based on two new approaches:

1. Combining of scab resistances with powdery mildew (*Podosphaera leucotricha*) resistance and fire blight (*Erwinia amylovora*) tolerance (Kellerhals et al., 2016).
2. Using in artificial hybridization of genetically distant cultivars. Avoidance of inbreeding is also an important issue (Ristel et al., 2016).

The evaluation of varieties from pomological collections for susceptibility to different diseases is crucial for both approaches (Kellerhals et al., 2016; Lateur et al., 1994.

In Romania, during the last 20 years, breeding objectives have mainly focused on fruit quality and disease resistance. The apple breeding programs for resistance to scab (*Venturia inaequalis* Cke.) have mostly concentrated on Vf gene originated from *Malus floribunda* 821 (Militaru et al., 2019).

Thus, from the breeding program carried out in Romania, a number of 65 new apple cultivars resulted, the great majority being resistant or tolerant to specific diseases.

Many of these cultivars have been propagated and spread in commercial plantations in our country, being highly appreciated by growers and consumers, such as 'Romus 3', 'Romus 4', 'Rebra', 'Rustic', 'Valery', 'Remar', 'Luca', etc. (Table 1).

Table 1. Apple cultivars recommended for organic farming

No.	Cultivars	Short description
1	Romus 3	Resistant to scab; summer cultivar; fruit: red color, ovoid, very good taste, highly appreciated by consumers and growers.
2	Romus 4	Resistant to scab; autumn cultivar; fruit: red color, flattened spherical, good taste.
3	Rebra	Resistant to scab; winter cultivar; fruit: red color, spherical, good taste.
4	Rustic	Resistant to scab; winter cultivar; fruit: red color, spherical, good taste.
5	Rumina	Resistant to scab; winter cultivar; fruit covered with rust on the surface, with good storage.
6	Topaz and Red Topaz	Autumn varieties; resistant to scab; fruit: yellow color with red stripes in the Topaz cv., and red color in the Red Topaz cv.; sweet-sour taste.

No.	Cultivars	Short description
7	Choupette® Dalinette	Winter cultivar; resistant to scab; fruit: red color; sweet taste; good storage capacity.
8	Natyra	Winter cultivar; resistant to scab, but sensitive to powdery mildew and bacterial cancer; fruit: dark red epidermis, crispy pulp; good storage capacity.

Using of fertilizers suited to ecological agriculture to improve soil fertility

In ecological orchards, two categories of fertilizers are allowed - organic fertilizers (manure, urine, compost, green fertilizers and plant residues) and mineral natural fertilizers (rocks and mineral products) (Toncea et al., 2016) (Table 2).

Table 2. Fertilizers used in ecological fruit growing

No.	Fertilizers tip	Short description and your role
1	Manure	Mixture of solid and liquid manure from animals; it contains many nutrients necessary to restore soil fertility and plant nutrition.
2	Urine and manure wort	Liquid which are used both as basic and foliar fertilizer.
3	Poultry manure	Fast-acting fertilizer with almost double the N, P and K content comparative with manure.
4	Compost	Organic fertilizer resulting from the controlled fermentation of a mixture of organic waste, such as vegetable waste, and urban sludge, etc.
5	Green fertilizers	The plants used are peas, lupine, clover; when the plants are in full growth; they are chopped and inserted under the soil.
6	Natural mineral fertilizers	In organic agriculture, only natural products are used as mineral fertilizers, not industrial ones; these materials (natural rocks, ores) in addition to a dominant nutritional element (phosphorus, potassium) also contain other elements necessary for plant nutrition.

CONCLUSIONS

Considering the fact that the agro-food market is dominated by fruits from conventional orchards, heavily chemical, by food additives used to improve the color, flavor and structure of food and their preservation, the organic products market can contribute to the protection of the environment and the health of generations current and future.

Researchers should develop a set of measures such as: breeding and introduction into culture and market of cultivars with durable resistance to pathogens; improving technological sequences for soil and vegetation management with the aim of increasing yielding capacity and fruit quality; improving technological sequences to ensure plant health.

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