

ECO-FRIENDLY PEST CONTROL ALTERNATIVES TO SYNTHETIC/CHEMICAL PESTICIDES

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Abstract

Public health has always been a widely debated issue, especially when it comes to nutrition, which in the last decade tends to evolve towards the consumption of nutritionally high quality products often raised in protected environments with attractive labels where the chemical residues from the use of plant protection products in the agricultural production phase are not always inscribed. Thus, in recent years the population begins to consume increasing quantities of organic products, which most often use eco-friendly alternative solutions to chemical pesticides that pollute the soil, feed animals and the finished product. These alternatives not only promise to improve the quality of food, but also to reduce environmental problems related to greenhouse gas emissions or pollution. The present work is carried out along a comparison between the agriculture of the past and the one of the future and wants to determine ways and possibilities of replacing synthetic chemicals with eco-friendly alternatives.

Keywords

Eco-friendly, pest control, PPP, pesticide, organic agriculture

JEL Classification

Q10, I1, Q50, L66

Introduction

As the main branch of the national economy, agriculture plays a significant role in providing food, raw material for the processing industry, representing a sector on which the natural, technical and social economies depend. The importance of the sector is emphasized by the fact that the problems of the world economy cannot be solved if agriculture is excluded. Environmental protection factors influence the degree of generation of a branch of material products. Climate can influence the structuring of crops as well as the spread of products in the context of the chemical composition of moisture, light and soil, so that each sector of

agriculture depends and is a direct condition of these factors of natural care that determines growing conditions and makes possible the addition of a particular species of plant or animal depending on the area and its characteristics. The modern society, from industrialization to the presentation of the use of technical processes and of the visualization of agriculture as the main branch of economic sector, depends directly on the degree of mechanization, on chemical substances used in agriculture as inputs on the purpose of protecting plants and potentially organoleptic characteristics of final products. Even though agriculture is the main source of food and environmental protection and has a special role to play in the sustainable growth of the economy, it is strongly influenced by changes in the economy, crises and various changes in agriculture modified over time. Thus, agriculture undergoes major changes that affect food security. This crisis generates decentralization of the agri-food sector, the privatization of the land and the lack of some programs designed to create new agri-food chains. The problem of agricultural exploitation, a global feature of the situation in order to increase the state's static concerns to the world for finding foreign exchange and bilateral cooperation, some modalities and ways of intensifying the multilateral cooperation, establishing some collaborations. One of its main ways is the organic farming sector is alternative organic care, to protect crops and provide them with fewer chemicals as happens in conventional agriculture, thus helping to improve the quality of life worldwide and protect the environment.

Organic farming involves the responsible use of inputs, reducing this number as much as possible, and prohibiting artificially synthesized chemicals such as fertilizers and pesticides but also the use of genetically modified material or the administration of antibiotics and hormones in the zootechnical sector. Currently, conventional agriculture requires a large contribution of plant protection products that increase their resistance to external factors, and that can correct structural problems in farm management such as insufficient crop rotation, sensitive varieties, and high nitrogen intake that can be associated with a complex environmental, agronomic and ecological problems. In response to these problems, the European Union is bringing a new vision to the integrated systems of agriculture that have been developed around a coherent approach, along with other concepts such as organic farming. The last decade has been marked by the integration of seemingly conflicting objectives that, developed in farms throughout Europe, have delimited the elaboration of a concentration action that involves the improvement of these conflicts between environment, agronomy, and economy (Vereijken and Royle, 1989; Vereijken, 1990), actions that it also implies increasing the degree of cooperation especially in the last five years. (Vereijken 1995, 1997). The design of multifunctional crop rotation and efficient nutrient management strategies followed by the economic foundation of some projects that take into account the responsible cultivation of the soil and the development of the ecological infrastructure in the farms are the main methods oriented to support the high-quality production, with a minimum contribution of resources. In the last 20 years, the organic farming sector has registered one of the biggest increases being considered an economically viable alternative to traditional production practices.

Comparative study between conventional and organic farming

Without a doubt, agriculture is one of the greatest discoveries of the human race, and it has allowed for 10,000 years now that different communities can live in one area and produce enough food to meet primary needs even for a growing population. Over time, farmers have found effective solutions for plant protection, increasing their resistance to various diseases and pests, but also to the environmental conditions that are not always conducive to crop development and the production of average crops to cover the demand for food. Whether it is agriculture or animal husbandry, the human footprint on agriculture leaves traces even today and with technological innovations and a deeper understanding of the functioning of

ecosystems and even plant biology, studies have begun to show that products from conventional agriculture in which chemicals are used contain residues of substances used to protect plants and animals that produce negative effects on the human body once ingested. The detailed analysis of chemical risks on food safety, but also of biological risks concluded the need to use methods that protect plants from diseases and pests or must improve their quality, but without being harmful to human consumption and the environment. Thus, all methods used in conventional agriculture had to be replaced by eco-friendly alternatives which, on the one hand, minimize the risk of chemical residues occurring in the final product and are safe for consumption and, on the other hand, protect crops from all external factors that have negatively influenced production. The comparative study between the two types of agriculture can make an overview of the advantages and disadvantages of using inputs in agriculture from an ecological and conventional perspective as shown in Fig. no. 1. When it comes to the differences between conventional and organic farming, things are pretty simple: Conventional farming uses artificially synthesized inputs while organic farming uses naturally created inputs. For a better understanding of this comparative study, an approach in 3 directions is considered necessary:

1. Management of PPP use (plant protection products)
2. Management of the use of fertilizers and flavor enhancers
3. Soil ecology management

Insect & Plant Pest Management

The plant protection products are used in conventional agriculture in order to increase the productivity and quality of the crops as raw materials for the processing industries but also for the wide consumption, to provide the necessary food for the population in a continuous growth, to contribute to lower global prices correlated with the increase of the supply of agricultural products, to protect the public health of some communicable diseases caused by the presence of pests and to allow a better conservation of the organic matter in the soil while eliminating the invasive weeds dangerous to maintain the production at an acceptable level. The main purpose of using PPP in conventional agriculture is to produce more food and higher quality and this main objective determines positive effects on the environment such as: reducing the expansion of agricultural land to forests or forest lands, thus preserving biodiversity in the respective ecosystems, reducing erosion of soils and the conservation of natural resources. Also, the use of PPP over time has been considered indispensable, preventing the population even from the appearance of malaria that in some areas was combated by using insecticides and protecting some areas covered with vegetation from invasions of locusts or other harmful insects. The major importance of PPP utilization is materialized in percentages so that the average productions increased by 20% -50%, which allowed to maximize the benefits of other types of inputs such as fertilizers, seeds, and water for irrigation, with positive effects on the ease of work. Farmers who in less developed countries represent less than 3%, being replaced by the mechanization of agriculture, while in poorly developed countries, persons engaged in agricultural activities exceed 50% of the total active population. This correlation is supported by the reverse proportional relationship between the degree of development of a country and the share of agriculture in GDP. Researches from the last decade bring to the fore that the European Union effectively regulates the use of plant protection products in conventional agriculture and that it prohibits the use of high-risk substances for human health, concluding that their use under the LMA (maximum permissible limit) is totally safe. Of course, the irresponsible use of these substances or medicines for veterinary use can have adverse effects and are unsafe for human consumption including substances such as methyl parathion, chlorpyrifos, dimethoate, and diazinon), acetylcholine esterase inhibitors (metham sodium is the most used), GABA-gated chloride channel antagonists (endosulfan), pyrethroids and pyrethrins. To minimize the risks

of chemical residue depletion in finished products, organic farming uses natural measures to prevent diseases and pests and to manage outbreaks. The use of the physical and biological control agents is materialized by the following actions: biodynamic measures, mineral and biological balance in the soil, rotary and animal grazing programs, planting companions, harvesting traps solarising the soil - where an appropriate rotation can not take place. Biological control and protection of predatory habitats, mechanical controls, such as traps, barriers, light, and sound, mulching and slash, - Stings with flames and steam.

Fertilizer Inputs

Modern agriculture is a feature of developed countries, with a high degree of industrialization and has a more commercial character. In this sector, considerable quantities of fertilizers are used in relation to relatively small areas and modern techniques. Zootechnics has a weight that far exceeds that of phytotechnics and is practiced in farms specialized in market crops. The inspection activity (IF) ensures compliance with the provisions of Regulation (EC) no. 2003/2003 regarding the circulation of chemical fertilizers, but also of the national legislation in the field, both by all economic operators and by end-users (farmers). The production branch of fertilizers is carefully monitored and managed by the large monopolies, and the number of the employed population is low, although productivity is imposing. Regardless of whether the plants are grown for general consumption, the production of raw materials for the processing industries or agricultural lands cultivated for the production of fodder, in conventional agriculture fertilizers are used which have a number of undesirable side effects such as: increase of risk appearance of chemical residues arising from the use of synthetic fertilizers, the proliferation of parasites from vegetable crops and from the zootechnical sector, eutrophication of watercourses. The most commonly used chemical fertilizers in conventional agriculture are: urea, diammonium phosphate, urea ammonium nitrate, mono ammonium phosphate, anhydrous ammonia, sulfate of ammonia, etc.

In organic farming, the concept of fertilizer is delimited around the main role that fertilizers play, namely the supply of nutrients for plants but also a secondary role linked in particular to sustainable development and environmental protection - to enrich the cultivated land. Organic or mineral fertilizers in which nutrients, hardly soluble are mobilized with the help of microorganisms in the soil, moistening the soil and providing a microfibrillar film to reduce the risk of soil and deep water pollution are the most effective alternatives to using artificial fertilizers. Fertilizers used in organic farming are: compost, composted manures, rock specks of dust, seaweed, calcium carbonates, beneficial organisms, mined dolomite, magnesium carbonate, etc.

Soil Ecology Management

The anthropic interventions from conventional energy-intensive agriculture determine negative trends in the forecast of soil evolution worldwide, the negative effects being manifested on several environmental resources: water, air, flora and fauna. The intensification of the mechanization regarding the soil works, remains an important aspect that the agrotechnical link being recognized the most efficient technology of cultivation of agricultural plants but it also brings the degradation of the soil that can be approached from the point of view of the nutrients present in the chemical composition of soil (fertility), physical degradation including destruction, erosion, crustification and secondary compaction, agrochemical degradation and surface and deep water. In highly industrialized and developed countries such as Belgium, the Netherlands, Germany, Switzerland, agricultural consulting centers, guide the farmers towards a new strategy for using different types of fertilizers, severe reduction of application quantities in the following years, but under the conditions of maintaining the balance of different nutrients in the soil (Oenema and Jansen, 2005).

In the ecological agriculture actions of protection against the acceleration and the extension of the processes of degradation of the soils and the resources of the natural environment are practiced and the main emphasis is placed on maintaining and improving the chemical composition of the soil that preserves the nutrients and the biodiversity. An ecologically cultivated soil will continue to have more humus, having a higher nutritional structure than the chemically fertilized soil, which reduces their susceptibility to erosion and clogging, thus being able to better absorb rainwater and to withstand longer periods of drought or with low rainfall. The contribution of biomass activates the soils and increases the natural biodiversity. Eco-friendly pest control alternatives to synthetic/chemical pesticides

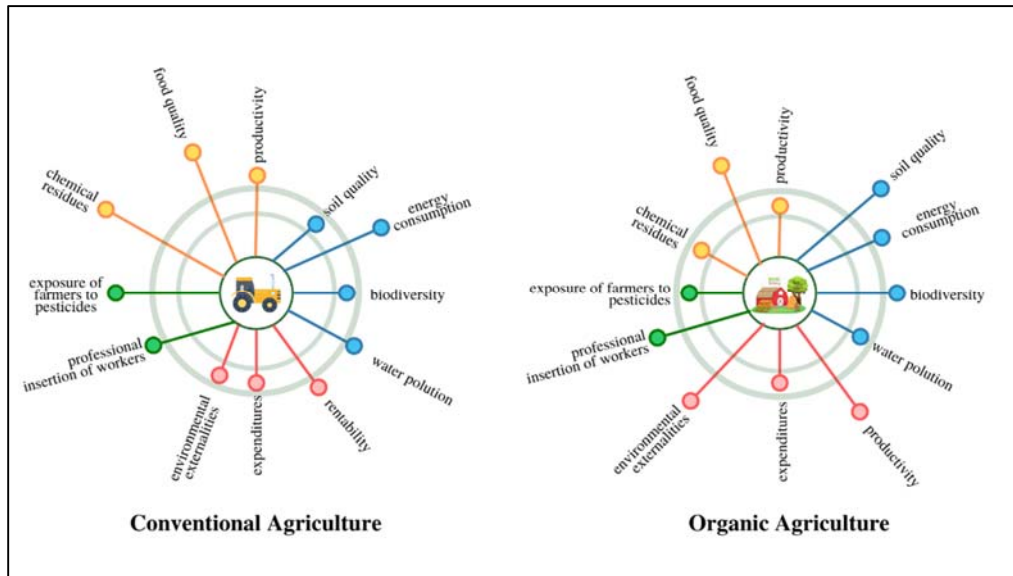


Fig. no. 1 Comparative analysis between conventional and organic farming

Source: Personal processing based on present research

Organic farming represents an efficient global system of agricultural management and food production that combines best environmental practices, conservation of natural resources, a high level of biodiversity, the application of high standards for animal welfare and a production method that respects the preferences of certain consumers for the products obtained with the help of natural substances and processes. The role of this agricultural management system is to produce cleaner food, more suited to human metabolism, in full correlation with the conservation and development of the environment. One of the main goals of organic farming is the production of fresh and authentic agri-food products, respecting the natural and environmental factors. In the first stage of the agri-food chain, the use of synthetic fertilizers and pesticides, genetically modified organisms (GMOs and their derivatives), growth stimulators and regulators, hormones, antibiotics, etc. is prohibited on the farm (production stage). During the processing stage, the use of synthetic chemicals, food additives and their complementary substances for the preparation of organic foods is prohibited. Organic farming has a major contribution to the growth of economic activities with an important added value and to increase the interest for the development of the rural area, and to the sustainable development of the agriculture, The objectives, principles and norms applicable to organic production are included in the Community and national legislation in this field. These norms, together with the definition of the production method in the sector of vegetable, animal and aquaculture production, also regulate the following aspects related to the organic farming system: processing, labeling, trade, import, inspection and certification.

The European provisions regarding the labeling of products obtained from organic farming, established in Regulation (EC) no. 834/2007 of the Council on organic production and labeling of organic products and in Regulation (EC) no. 889/2008 of the Commission establishing the rules for applying Regulation (EC) no. 834/2007 are very precise and consider giving the consumers complete confidence in the organic products, as products obtained and certified according to strict rules of production, processing, inspection and certification. One of the essential conditions for the extension of organic farming at the European Union level is the promotion of the concept of organic agriculture in order to make consumers aware of the advantages of consuming organic products so that they offer a higher price for clean products whose quality is guaranteed by a system. Inspection and certification. Education in organic farming, in order to train specialists in this field, is a concern of the higher education institutions. The various actions of informing the producers, training and promoting the concept of organic farming are carried out by state and private organizations. The problem of crop destruction due to diseases and pests that most often have a devastating effect on the economy. Rodents, mosquitoes and cockroaches are carriers of bacteria and germs that can cause diseases that are very dangerous to human health and can even lead to death if not treated properly. In this case, the safest method of combating diseases and pests has always been the use of PPPs (plant protection products), which, used within limits set by the European Commission, do not harm human consumption. But the irresponsible use of this and the zootechnical sector in which antibiotics and growth agents are usually used negatively influence public health. Organic farming tends to find the most efficient solution to replace artificial chemicals with eco-friendly ways of protecting plants and animals against diseases and pests. The ecological methods of pest control that are safe for public health and the environment are:

Insectary Plants

The use of aromatic plants such as rosemary, peppermint, marigold and thyme can have beneficial effects on crops because this type of plants produce nectar that attract honey bees and keep pests away by their strong odour and the substances they secrete. At the same time, bees attracted by the smell of these plants pollinate the plants, thus ensuring the continuity of the crop.

Diatomaceous Earth

Diatomaceous Earth is the name of a powder resulting from the combination of microscopic particles of shells, algae and silica and can reduce the number of insects that are harmful to crops by their physical destruction, with high efficiency against insects with soft bodies such as fleas, ants, snails, caterpillars, thrips, roachers and root maggots. This powder is safe for the environment and for consumption and its action is determined by the sharp particles which inflict physical damage to the cuticle of an insect and determine leaks vital body fluids resulting in dehydration and eventually death. However, this control method can also wreak havoc on good insects that help plants grow and multiply.

Birds and Mammals

Creating a pleasant and conducive environment in open field crops can attract birds and small friendly mammals that feed on the insect pests of the respective culture, so using PPP is no longer essential as these species can ingest large amounts of pests including: snails, slugs and caterpillars

Mulching

This essential agricultural practice widely used in open field crops simply allows a protective layer of a material that is spread on top of the soil being an ecological method of pest control and helps reduce the harmful effects of sunlight and rain, reducing soil damage, prevents weeds growth and creates an environment that changes plant growth and development

Neem Oil

The substance derived from neem trees can poison insects and stop their growth and development. Neem oil can be applied as foliar or soil spray and has negative effects on insects such as: white flies, aphids, loopers and mealy bugs. The use of neem oil is dangerous for beneficial insects but has no adverse effects on mammals.

Insecticidal Oils

This control method is efficient on the insects that these substances choke, leaving them without oxygen, so the eggs of insects and the complete undeveloped insects are very sensitive and die. Insecticidal oils can be used to control spider mites, mealy bugs, aphids and psylla.

Conclusions

For a long time, crop protection was largely based on the use of chemical insecticides. However, these can be harmful to humans and pets, while there is a risk of groundwater contamination. Chemical insecticides also cause harmful changes to beneficial organisms. As a result of the toxicity caused and the evolution of the resistance of the insect populations, alternative pest control tactics are needed, which will contribute to an effective and sustainable crop protection. Organic insecticides are insect management agents that have shown a high potential in protecting fruit trees, vines or other agricultural crops, without being aggressive at the time and after application. Moreover, they have a high selectivity for beneficial insects and a reduced impact on the existing fauna. Being composed of natural extracts, they will reduce the amount of chemicals used previously and do not require waiting time between application and harvest. They can also be used in organic farming, the products being manufactured in strict compliance with the high quality standards. They have a biostimulatory effect, thus favoring the rapid and healthy growth of plants. Non-toxic and with rapid decomposition, biological insecticides are the best solutions for farmers who want rich crops with more resistant plants and rapid growth. As can be seen in Fig. no. 2, organic agriculture brings many benefits to the environment and the sustainable development of the economy.

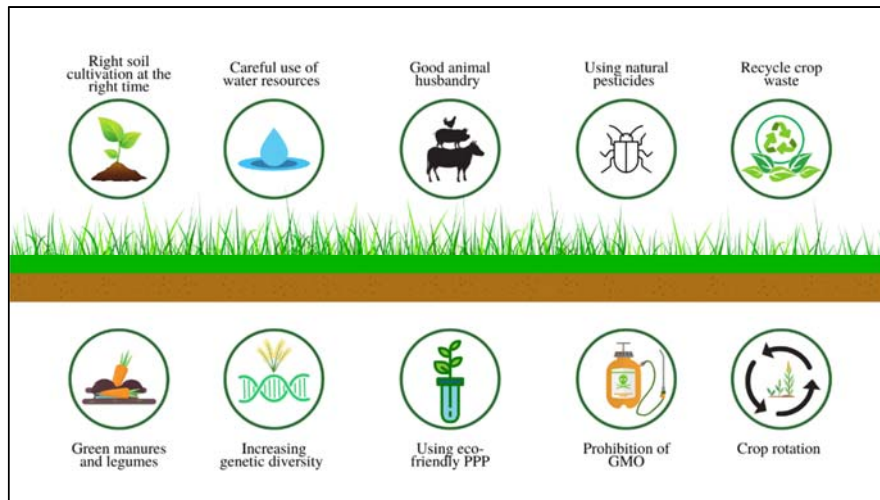


Fig. no. 2 Advantages of eco-friendly plant control methods

Source: Personal processing based on present research

But despite the benefits listed in Fig. no. 2, eco-friendly alternatives used in organic farming cannot destroy all pests. One of the major problems in horticultural plantations and crops, including vegetables, is nematodes. Scientific studies report about 20,000 types of soil nematodes identified. They nourish the roots of the plant and reduce the absorption of water

and nutrients, which reduces the yield. In addition, the infested plant becomes more vulnerable to other stressors, such as heat and other microorganisms that cause disease. Nematodes are difficult to control with common chemical pesticides. An alternative to these is Marigold extract and seaweed, which reduce the development of nematodes and ultimately destroy their population.

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