L. VOLOSCIUC, doctor habilitat

The Institute of Genetics, Physiology and Plant Protection of Republic of Moldova

THE BIOLOGICAL PREPARATIONS FOR PLANT PROTECTION IN ORGANIC FARMING

Consider new directions for biotechnology, creating conditions for the development of chemical and biological plant protection, their rational levels and proportions. The article aimed to present the problems of plant protection in ecological agriculture, using the possibilities of modern biotechnology. Application traditional technologies demonstrate indispensable contradiction between the plant protection requirements condition and the need to preserve environment. The systemic approach of relations between crop and pests opens new possibilities in researching biocenotic relationships within ecosystems and halting spending growth trends directed to plant protection. Parting from the aggravation of ecological situation and taking into account the achievements in the field of biological plant protection, in the Republic of Moldova consistent measures have been undertaken in the direction of ecological agriculture promotion. For solving of plant protection problems were developed biotechnological processes of production and application of an impressive range of biological means, which is used for conventional and organic agriculture. The main legislative documents (Law No 115 from 2005 concerning the ecological agriculture, Government decision No 149 from 2006 concerning its implementation, a series of regulations) have been adopted. The results relative to production organization, processing and marketing of ecological products are being registered, but a series of the technological problems remains which are waiting their solution.

biotechnology, conventional agriculture, organic farming, ecology, biological preparations

The pesticide, as a chemical compound, used to control weeds, plant diseases or insects. Since pesticides may be harmful to humans, animals, or the environment, it is important to understand the fate of pesticides after application. In connection with the adverse impacts of pesticides people throughout the world are interested in organic or “naturally produced” foods. However, although similar in principle, growing crops or producing animal food or without use of pesticides is different from “organic” farm production. Legally, there are steps that growers must follow before the word “organic” can appear on the label. Conventional growers use pesticides, fertilizers, genetically engineered organisms and growth enhancers to

stimulate their soil and crops. Typically, the health of the soil is of secondary importance compared to gaining strong short-term crop yields. If the soil is found to be lacking or depleted in nutrients, synthetic fertilizers are added. Crops may be grown from genetically engineered seeds and pesticide usage is allowed to control crop pests. Conventional farmers can also use manure without restrictions and are not required to keep records of their production practices [1, 2, 3, 4, 5, 6].

Organic farming (ecological agriculture) is a completely different system from conventional farming. Over the years, organic farming has become defined very simply as a practice that does not use synthetic pesticides or conventional chemical fertilizers, but organic farming involves much more than this [7, 8, 9, 10, 11, 12]. Now, organic farming is more popularly known for what it is not. Conventional agriculture is far more widespread, so let's first take a look at the conventional process in order to better understand the differences that distinguish organic farming from other agricultural systems [8, 13, 14, 15, 16].

Ecological agriculture is a system which avoids or largely excludes the use of synthetic inputs (pesticides, fertilizers, hormones, feed additives etc.) and to the maximum extent feasible relies upon biological protection, crop rotations, animal manures, mineral grade rock additives and biological system of nutrient mobilization. Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones [17, 18, 19, 20, 21].

Taking into account the negative phenomena of conventional agriculture and to ensure permanent progress and lengthy agriculture, which must remain in harmony with nature, the world has consolidated the International Federation of Organic Agriculture Movement (IFOAM). Over the past few years have been crystallized and the main requirements for organic products, which are currently classified in EU Regulation No 2092/91 of 24.06.1991 [1, 7, 22, 23]. To improve process improvement activities in organic agriculture since 1 January 2009 new regulations were approved (No 834/2007 and No 889/2008), which references to Directive 2092/91 were automatically taken over by No 834/2007 [5, 11, 23]. Although serious premises are known to promote green technologies, however, the results have been modest, which requires further research to ensure scientific and technological strategy for implementing this kind of activity [5, 11].

Material and methods. Isolation, identification and determination of biological strains of baculovirus, bacteria, fungi, and actinomycetes were performed by applying optical and electronic microscopy, production and application of biological means of plant protection. The efficiency of biologic preparations was determined by Abbot formula, which provides natural insect mortality [21, 23, 24].

The establishment of biological protection systems applying bacterial preparations, baculoviral and fungal entomopathogens, biologically active substances, including sex pheromones has been carried out on the systems of pest forecasting development [8, 25, 26].

Testing in laboratory and experimental group means, methods and conventional and organic farming systems was conducted in four randomized repetitions in accordance with the general requirements of experiences of this kind [7, 27, 23].

Results. The Biological Protection — foundation and part of organic farming. Many different definitions of biological control have been proposed. According to Cook and Baker (1983) “Biological control is the reduction of the amount of inoculum or disease producing activity of a pathogen accomplished by or through one or more organisms other than man”. Based on this broad definition of biological control, organisms and procedures involved include: avirulent or hypo-virulent individuals or populations within the pathogenic species, antagonistic microorganisms, and manipulation of the host plant to resist the pathogen more effectively.

Biological plant protection utilizes nature’s own methods in the prevention and combatting of plant diseases and pests. It is based on ecological balance, where each and every living thing has a place of its very own in nature, its own biological niche. In biological plant protection pathogens are controlled by their natural enemies — microbes isolated from nature. From new methods of pest control are the most effective biological that the current concept would be more correct to name as their density routing methods through biological agents and comprise a broad spectrum of processes. These include the introduction and acclimatization of new areas of biological entities, mass production and launch seasonal agrocenosis protected [5, 12, 23]. This is a system for regulating population density of pests, taking into account the specific environment and their dynamics, using natural mechanisms and entities useful adapted to maintain the populations of pests and pathogens below the economic damage, ensuring economic efficiency and environmental.

Enhancing the efficiency of biological protection can be achieved in the phytosanitary situation of the protected-culture knowledge, biology capabilities pest and biological agent. Addressing Plant Protection and Development of the production of organic products can be achieved when applying main groups of biological agents: entomophages, biological products (viruses, fungi and bacteria) and biologically active substances, first sex pheromones [5, 9, 10, 23].

Given the fact that the mechanisms regulating natural ecosystem is determined by complex relationships between components lower levels of organization of living matter (the consortial systems and food chains), which can be searched in accordance with existing methods, it is obvious

that investigations natural ecosystem in order to determine mechanisms of adjustment can be made only in the food web. It is necessary to research the relationships that are falling species enlightening plant and phytophagous specialized as species polyphagous and oligophagous pests do not determine the status circuits of substances, but only serve as elements of doubling the mechanisms of transformation of matter and energy. Therefore in order to develop models and plant protection systems necessary to detect natural ecosystem regulation naturally mechanisms or less modified under the influence of anthropogenic factors.

As an indication main selection means of plant protection do not have to use the degree of destruction of the pest, but the elimination phytophagous during the whole ontogenetic and taking into account the phenomenon of post action over several years. The persistence of biological agents within agroecocenosis demonstrates that these is extracted from natural conditions, and then apply in order to protect plants become artificial analogues of natural compounds regulating density populations of harmful organisms.

The aim of natural control is to restore a natural balance between pest and predator and to keep pests and diseases down to an acceptable level. The aim is not to eradicate them altogether. Pesticides do not solve the pest problem. In the past 50 years, insecticide use has increased tenfold, while crop losses from pest damage have doubled. Here are three important reasons why natural control is preferable to pesticide use [28, 29, 30]. Pesticides can quickly find their way into food chains and water courses. This can create health hazards for humans. Human health can also be harmed by people eating foods (especially fruit and vegetables) which still contain residues of pesticides that were sprayed on the crop.

There are a number of harmful effects that chemical pesticides can have on the environment. Pesticides can kill useful insects which eat pests. Just one spray can upset the balance between pests and the useful predators which eat them. Artificial chemicals can stay in the environment and in the bodies of animals causing problems for many years. Insect pests can very quickly, over a few breeding cycles, become resistant to artificial products and are no longer controlled. This means that increased amounts or stronger chemicals are then needed creating further economic, health and environmental problems.

Development of Ecologic Agriculture in the World and Republic of Moldova. In response to environmental actions, in 1972, in Versailles was established IFOAM who managed to promote organic farming and currently meets approximately 1.000 members in 170 countries. The main results of the latest survey on certified organic agriculture world-wide show that 43.1 million hectares of agricultural land are managed organically by 2 million producers. The regions with the largest areas of organically managed agricultural land are Oceania (17.3 million hectares or 40 % of the global organic

farmland), Europe (11.5 million hectares or 27 % of the global organic farmland) and Latin America (6.6 million hectares or 18 %).

On a global level, the organic agricultural land area increased by 6 percent or almost 6 million hectares compared with 2012; mainly due to a major increase of organic land in Australia. The countries with the most organic agricultural land are Australia (17.1 million hectares), Argentina (3.2 million hectares) and the United States (2.2 million hectares). The highest shares of organic agricultural land are in the Falkland Islands (36.3 percent), Liechtenstein (31.0 percent), and Austria (19.5 percent). The countries with the highest numbers of producers are India, Uganda and Mexico [31, 32, 33].

As of the end of 2013, 11.5 million hectares in Europe were managed organically by more than 330000 farms. 2.4 % of the European agricultural area is organic. Twentyseven percent of the world's organic land is in Europe. The countries with the largest organic agricultural area are Spain, Italy, France, and Germany. There are eight, countries in Europe with more than ten percent organic agricultural land: Liechtenstein, Austria, Sweden, Switzerland, Estonia, the Czech Republic, Latvia, and Italy. Compared to 2012, organic land increased by 0.4 million hectares and the European market size was 24.3 billion euro.

As organic moves beyond a niche, the organic movement needs to take stocks of what organic has become and what the future holds for us all. The movement needs to be prepared to cope with future political developments, environmental challenges and market trends. IFOAM EU initiated a participatory vision process to prepare the movement to proactively face the future [IFOAM, 2015] [34, 35, 36].

In Republic of Moldova to achieve these goals were taken some measures sparse, which did not allow this movement to grow. It should be mentioned that it is known for some favorable conditions. Besides the achievements already made towards the development and application of biological methods of plant protection, the primary basis for obtaining organic products were taken a series of measures aimed at obtaining, processing and marketing of organic products [5, 7, 11].

It is worth mentioning that in terms of production achieved, organic agriculture and responding to the objects particularly important for Moldova, as for example:

- Meet the growing domestic and foreign natural products, which clearly demonstrated the contribution to maintaining and improving the health of humans and animals;
- Considerably diversified range of product categories in the market is in a state of overproduction and increasing the volume of crop production values appreciated at the moment we value;
- Facilitates the production activity of native farm out the lack of

competition on the foreign market for some vegetables and fruits that have optimal conditions for the application of technologies for organic products;

- Material interests prices farmers through organic products exceeding 1.5—3 times the conventional prices, although there has been a 15—20 percent decrease in production volume;
- Enhances the quality of biological, biochemical and nutritional organic products. Given the fact that organic products are not a result of industrial processes, the consumer chooses the criteria morphometric but after their biological value;
- Strengthen opportunities for agricultural producers to enter the western market for agricultural products, which is highly conventional and competing products show particularly high requirements for organic products.

Namely in this way can we hope to stop the processes of ecological crisis and maintain the natural dynamic balance. Application technologies for organic farming are resulting in products with high biological value, healthy, pesticide-free and high-quality content.

The new paradigm of sustainable development in agriculture is based on respecting the following principles:

- minimization purchased artificial inputs from outside of the farm and avoiding them completely in organic agriculture;
- intensive use of renewable sources of energy mainly of local provenience, and a more complete energy and nutrient recycling;
- minimization of the negative impact on the environment, and utilization of local, more adapted varieties and hybrids of crops, a higher biodiversity of crops;
- restoration of soil fertility, which is determining the vitality and the health of soil, crops, animals and people;
- equity in relationships between producers, processors, distributors, sellers and buyers;

Republic of Moldova has the legislation in this aspect, harmonized with the European and international requirements which includes:

- the national concept on ecological agriculture and the action plan for the implementation of this concept, adopted by the Governmental Decision no 863 from 21.02.2000;
- the Law no 115-XVI from 09.06.2005 regarding the ecological production;
- the Governmental Decision no 149 from 10.02.2006 regarding the implementation of the law on ecological production;
- the Government Decision no. 1078 of 13.10.2008 «Technical regulations for the implementation of Regulation EC 834/2007 on organic food production, labeling and control».

In order to respect these principles we should return to holistic (system) researches instead of reductionist ones. Improvement of technologies isn't enough for achieving a more sustainable development and especially for organic farming systems. Changes for the whole farming system are necessary which show the multifunctional role of agriculture. We need to develop self-sufficient and self-regulating production systems, which are less dependent from artificial, industrial inputs, can use more efficiently local resources and are friendly to the environment.

Researches have to be undertaken for the whole food chain — from crop breeding, primary production by farmers, processing, marketing up to consumers. By saying this we mean to take in consideration not only the production sector, but also the environment and social sectors. In other words, the whole link should be in the attention of researches — from the fork up to the table of consumers.

Vigorous actions taken in Moldova have allowed the institutionalization of this field of activity, increase activities within the agricultural producers interested in promoting organic agriculture, approval of the National Label «Organic-Moldova» and the recording of significant indicators (Figures 1—3).

The biotechnology of production of biologic preparations for organic farming. Plant biotechnology scientists working to maintain healthy plants, optimize crop yields, and minimize pesticide usage. Applying modern technologies of genetic and gene engineering, become more consistent achievements aimed at controlling pests and enhancing plant protection in the next directions: enhancing a plant's resistance with genes from the plant

kingdom, genetic engineering, as a powerful tool to combat plant virus diseases, using antimicrobial proteins to enhance plant resistance (Volosciuc L., 2015).

Given the experience in the production of biological species and the need to combat harmful organisms that cannot be countered by other means biological, bio developed a special role of local scientists. With their competition they have been implemented and approved a lot of biological means,

which is a powerful tool to combat harmful organisms and improving environmental conditions (Voloşciuc L., 2009a, 2012; Volosciuc L., Voyniak V., 2012). Among these are the following:

Trichodermin BL is constituted under the fungus *Trichoderma lignorum* and used to combat white rot, gray and root vegetable crops, ornamental, vegetable and tobacco seedlings and vegetable crops, reducing crop attack by pathogens 2–3 times stimulating growth, plant growth by 25–30%.

Trichodermin F7 — based preparation is the fungus *Trichoderma harzianum* granular and liquid. It is used to combat agricultural crops root rots, root rots reducing 1.5–2 times.

Nematofagin-BL is constituted under *Arthrobotrys oligospora* fungus and used for combat nematodes in protect technical and vegetable crops.

Verticilin — the base of preparation is the fungus *Verticillium lecanii* in the form of a wettable powder. It is recommended for the control greenhouse whitefly to the efficacy of 95%.

Rizoplan is constituted under the bacterium *Pseudomonas fluorescens* AP-33 and is used to combat the root rots of crops.

Pentafag is designed to combat bacterial diseases at crops. The preparation is based on 5 strains of bacteriophages effective in controlling plant diseases caused by bacteria of the genus *Pseudomonas*.

A lot of viral preparations were developed for pest that cannot be combatted by other biological means.

Virin-ABB-3 — to combat *Hyphantria cunea* in orchards, forests and parks. The preparation is based on nuclear polyhedrosis viruses and cumulative and synergistic action granulosis, showing of the epidemic and post-action effects.

Virin-MB — to combat Cabbage worm and is based on *Mamestra brassicae* nuclear polyhedrosis virus.

Virin-OS — to combat insects of genus *Agrotis* and is based on granulosis viruses and nuclear polyhedrosis synergistic action.

Virin-HS-2 — to combat rootworm by cotton and insects of genus *Heliothis* and is based on nuclear polyhedrosis virus.

Virin-CP is intended to combat codling moth and is based on *Carpocapsa pomonella* granulosis virus.

As more and more plant biotechnology products become available, studies to evaluate the ecologic and economic effectiveness, as well as risks associated with biotechnology must be researched. A successful program biological control requires comprehensive cultivation management and good cultivation hygiene, which contributed for effectively prevents of pests and plant diseases. The right plant management guarantee optimum conditions for effective activation of beneficial organisms.

CONCLUSIONS

Application traditional technologies demonstrate indispensable contradiction between the plant protection requirements condition and the need to preserve environment. The systemic approach of relations between crop and pests opens new possibilities in researching biocenotic relationships within ecosystems and halting spending growth trends directed to plant protection.

Integrated plant protection systems, as an element applied conventional and organic farming, is not only a mechanical alternation of chemical methods of pest combating, but a complex of actions aimed at using natural mechanisms regulating the density of populations of organisms harmful and only in critical conditions, implementation of minimum quantities of pesticides.

Ensure effective non-chemical plant protection systems is becoming reality in the deployment of integrated plant protection with predominant application of biological methods of protection.

Biological plant protection — as an efficient method of avoiding the conflict between environmental protection and quality of the plant is based on continuous use of information related to monitoring populations of harmful and useful organisms, and the use of compensation measures and combat application entomophages, bio preparations and biological active substances.

Republic of Moldova has prerequisites and conditions for the extension and deepening of activities sufficient to obtain organic products. Promoting organic agriculture requires improving the legal framework, developing national strategy on organic food production, monitoring compliance of normative acts, strengthening national body for evaluation, inspection and accreditation of operators, supporting farmers to shift conversion period.

Strengthening technology strategy and research functionality to meet needs for technological processes aimed at providing means for obtaining and processing of organic products is the key position in the intensification and extension of educational activities in the taking and processing of organic products.

Organic farming can be a viable alternative production method for farmers, but there are many challenges. One key to success is being open to alternative organic approaches to solving production problems. Determine the cause of the problem, and assess strategies to avoid or reduce the long term problem rather than a short term fix for it. As a result, the wish for better synergy between biotechnologies, ecology and plant protection for the benefit of sustainable exploitation of the biosphere could thus be granted.

REFERENCES

1. Голдштайн В., Боинчан Б. Ведение хозяйств на экологической основе в лесостепной и степной зонах Молдовы, Украины и России. М.: ЭкоНива. 2000. 267 с.

2. Altman A., Hasegawa P.M. Plant Biotechnology and Agriculture. Prospects for the 21st Century. Academic Press, London. 2012. 286 p.
3. Crop Production and Plant Protection in Organic Farming by Sundararaman S.R., Conference on “Outstanding Organic Agriculture Techniques” Bengaluru, India. 2009. p. 1—15.
4. International assessment of agricultural knowledge, science and technology for development (IAASTD): global report / edited by Beverly D. McIntyre et al. Washington, 2009. 606 p.
5. Volosciuc L.T. Probleme ecologice on agricultură. Chişinău. Bons Offices. 2009. 264 p.
6. Zadoks J.E., Waibeu H. From pesticides to genetically modified plants: history, economics and politics. Netherlands Journal of Agricultural Science. Vol. 48. 2000. P. 125—149.
7. Волощук Л.Ф., Войняк В.И. Биологические методы защиты растений — основа получения экологической виноградной продукции. *Mediul ambient. 1(61)*. 2012. С. 31—37.
8. Кирюшин В.И. Проблема экологизации земледелия в России. *Достижения науки и техники АПК*. М. 12. 2012. С. 1—7.
9. Crop Protection, edited by Harry Brook and Mark Cutts. Edmonton, Alberta. 2016. 585 p.
10. Chris Maser, Carol A. Pollio. Resolving Environmental Conflicts, Second Edition. 2011. 286 p.
11. Volosciuc L., Josu V. Ecological Agriculture to Mitigate Soil Fatigue. Soil as Rural Heritage (Editor David Dent). Springer. 2014. P. 431—435.
12. Volosciuc L., Panzaru B. Recent achievements in microbiological plant protection. *Journal of ASM. Life Sciences. Plant and Animal Biotechnology*. 2(326). 2015. P. 178—183.
13. Crop Protection Products for Organic Agriculture: Environmental, Health, and Efficacy Assessment, eds. Allan S. Felsot, Kenneth D. Racke., 2007. Vol. 947. 258 p.
14. Ferron Pierre, Beguine Jean-Philippe. Crop protection, biological control, habitat management and integrated farming. A review. *Agron. Sustain. Dev.* 25. 2005. P. 17—24.
15. Rex Dufour. “Conventional” and “Biointensive” IPM. Aproprate Technology Transfer for Rural Areas. Pennsylvania. 2011. 52 p.
16. Scialabba N. Organic Agriculture. FAO, Roma. 2015. 105 p.
17. Фокин А.В. Биологизация защиты растений — процесс циклический? Защита и карантин растений. 3. 2010. 25 с.
18. Хлопяников А.М., Наумкин А.В., Стебаков В.А. и др. Агротехнические и эколого-экономические основы биологизации земледелия. *Вестник Брянского государственного университета*. 4(2). 2012. С. 1—5.
19. El-Hage Scialabba N. Organic Agriculture and Food Security. FAO, Rome, 2007. 22 p.

20. *Letourneau D., Van Bruggen A.* Crop protection in organic agriculture, eds. Kristiansen P., Taji A., Reganold J. Organic agriculture: a global perspective. 2006. P. 93—121.
21. *Neil Helyer, Nigel D. Cattlin, Kevin C. Brown.* Biological Control in Plant Protection. CRC Press. 2014. 568 p.
22. *Vincent, M. S. Goettel, G. Lazarovits.* Biological Control: A Global Perspective. CABI, 2007, 464 p.
23. Volosciuc L.T. Biotehnologia producerii și aplicării preparatelor bacteriovirale on agricultura ecologică. Chișinău. Mediul ambiant. 2009. 262 p.
24. Biopesticides: Pest management and regulation, by *D.Chandler et al.* CABI. 2010. 256 p.
25. *Bellon Stùphane, Penvern Servane.* Organic Farming, Prototype for Sustainable Agricultures. Springer. 2014. 382 p.
26. *S.B. Vinson, S.M. Greenberg.* Biological control of pest using trichogramma: current status and perspectives, edited by. Northwest A&F University Press, China. 2016. 496 p.
27. *Доснехов Б.А.* Методика полевого опыта. М.: Агропромиздат. 1989. 313 с.
28. Global Organic Statistics 2014 and *Organic 3.0.* Growing Organic Agriculture Sector Explores its Future. FIBL and IFOAM. 2014. P. 1—8.
29. Future IPM in Europe., 2013. Book of abstracts. Pala Congressi. Italy. 335 p.
30. IFOAM training manual for *Organic Agriculture in the Tropics*, edited by Frank Eyhorn, Marlene Heeb, Gilles Weidmann. FiBL. 2014. 243 p.
31. Organic Farming. Prototype for Sustainable Agricultures, eds. Stephane Bellon, Servane Penvern. Springer. 2014. 489 p.
32. *Paull, John & Hennig, Benjamin.* Atlas of Organics: Four Maps of the World of Organic Agriculture Journal of Organics. 3(1). 2016. P. 25—32.
33. *Runduf M., Bengtsson J., Smith H.* Local and landscape effects of organic farming on butterfly species richness and abundance. J. Appl. Ecol. 45 (3). 2008. P. 813—820.
34. Research in Organic Farming, edited by Raumjit Nokkoul, InTechOpen. 2016. 198 p.
35. Transforming food & farming: an organic vision for Europe in 2030. IFOAM, 2015. Brussels. 38 p.
36. *Willer Helga, Lernoud Julia.* The World of Organic Agriculture. Statistics and Emerging Trends. FiBL, IFOAM. 2015. 309 p.

Волощук Л.Т. Біологічні препарати для захисту рослин в органічному сільськогосподарському виробництві

Розглянуто нові напрями у біотехнології, створенні умов для розвитку хімічного та біологічного захисту рослин, їх раціональний рівень і пропорції. Представлено проблему захисту рослин в екологічному сільському

господарстві, можливості сучасної біотехнології. Застосування традиційних технологій демонструє протиріччя між умовами захисту рослин і необхідністю збереження навколишнього середовища. Системний підхід до взаємодії між культурою і шкідниками відкриває нові можливості в дослідженні біоценотичних взаємовідносин в екосистемах і зупинки тенденцій зростання витрат, спрямованих на захист рослин. На основі досягнень в галузі біологічного захисту рослин, в Республіці Молдова були проведені послідовні заходи щодо розвитку екологічного сільського господарства. Для розв'язання проблем захисту рослин були розроблені біотехнологічні процеси виробництва та застосування значної кількості біологічних засобів, які використовуються для традиційного та органічного землеробства. Основні законодавчі документи (Закон № 115 від 2005 р. щодо екологічного сільського господарства, рішення Уряду № 149 від 2006 р. щодо його виконання, низка нормативних актів) прийняті. Є результати щодо організації виробництва, переробки та збуту екологічної продукції, проте залишається низка технологічних проблем, які очікують вирішення.

Волошук Л.Т. Биологические препараты для защиты растений в органическом хозяйстве

Рассмотрены новые направления в биотехнологии, создании условий для развития химической и биологической защиты растений, их рациональные уровни и пропорции. Представлены проблемы защиты растений в экологическом сельском хозяйстве, возможности современной биотехнологии. Применение традиционных технологий демонстрирует противоречие между состоянием требований к защите растений и необходимостью сохранения окружающей среды. Системный подход к взаимоотношениям между культурами и вредителями открывает новые возможности для изучения биоценологических связей в экосистемах и прекращения тенденций роста расходов, направленных на защиту растений. С учетом достижений в области биологической защиты растений, в Республике Молдова предпринимаются последовательные меры в направлении развития экологического сельского хозяйства. Для решения проблем защиты растений были разработаны биотехнологические процессы производства и применения широкого ассортимента биологических средств, которые используются для традиционного и органического земледелия. Основные законодательные документы (Закон № 115 от 2005 г. об экологическом сельском хозяйстве, Постановление Правительства № 149 от 2006 г. о его реализации, ряд нормативных актов) приняты. Результаты, касающиеся организации производства, переработки и сбыта экологически чистых продуктов, есть, но остается ряд технологических проблем, которые ждут своего решения.