PESTICIDES AND FOOD PRODUCTION

PESTICIDI I PROIZVODNJA HRANE

Bojana BEKIĆ, M. JELOČNIK, B. KATIĆ

Institute of Agricultural Economics,Belgrade, Serbia
Corresponding author: Marko JELOČNIK, e-mail: marko_j@mail.iep.bg.ac.yu

***Abstract**: Providing enough amounts of food, for fast growing world population, is one of the largest problem of modern society. The data from Food and Agriculture Organization of the United Nations (FAO, 2006), are showing us minatory number of people on the planet today (approximately 7 billion). Due to intensive development of science and technology during the last decades, a large number of very effective and inexpensive pesticides were synthesized, which is with increase of arable land areas, influenced on total agricultural production growth in the world. However, production of enough quantity of food (as well as food surplus, whose storage is very expensive) is a characteristic of developed countries, while so called third world countries still have hunger problems. The period of highly chemicalized intensive modern agriculture, in which pesticides are having main role, enabled triple of yield per sowed hectare, and on the first sight gave positive solution of hunger problem. However, excessive and unreasonable use of pesticides and other chemical preparations brought us to the extreme degradation of all environment's elements (soil, water, air, flora and fauna). Destruction of natural resources with permanent pollution, in the end, lead to decrease of yield per hectare and production of food contaminated with pesticides and other materials dangerous for human health. The philosophy of unlimited growth and development must be changed with new philosophy of sustainable development, which considers development balanced with needing of nature protection. One of the solutions, can be agricultural orientation toward organic production, which exclude use of synthetic pesticides in agriculture. Organic agriculture, as an ideal harmony of environment and agriculture production, can actively help the process of sustainable management of natural resources. Healthy food, produced by methods of organic agriculture, in balance with biologic and ecologic regularity, enables the sustain of human population viability. Therefore, the future of next generation and survive of human species largely depends on activities we take today.*

***Abstract**: Obezbeđivanje dovoljne količine hrane, za sve mnogobrojniju svetsku populaciju, jedan je od najvećih problema savremenog društva. Podaci Svetske organizacije za ishranu i poljoprivredu (FAO, 2006), ukazuju na veoma veliki broj stanovnika na planeti danas (oko 7 milijardi). Zahvaljujući intenzivnom razvoju nauke i tehnologije, tokom prethodnih decenija, sintetisan je veliki broj veoma efikasnih i jeftinih pesticida, što je uz povećanje korišćenih obradivih površina uticalo na rast ukupne poljoprivredne proizvodnje u svetu. Međutim, proizvodnja dovoljne količine hrane (kao i višak hrane koji se skladišti uz ogromne troškove) karakteristika je razvijenih država, dok se zemlje trećeg sveta i dalje suočavaju sa problemom gladi. Period visoko hemizovane, intenzivne moderne poljoprivrede, u kojoj veliku ulogu igraju pesticidi, omogućio je utrostručavanje prinosa po zasejanom hektaru, i na prvi pogled dao pozitivno rešenje problema gladi. Međutim, prekomerna i neracionalna upotreba pesticida i ostalih hemijskih preparata dovela je do alarmantne degradacije svih elemenata životne sredine (zemlje, vode, vazduha, flore i faune). Uništavanje prirodnih resursa, permanentnim zagađivanjem, u krajnjoj liniji vodi ka opadanju prinosa po hektaru i prozvodnji hrane kontaminirane pesticidima i drugim materijama opasnim po zdravlje ljudi. Navedeno dovodi do zamene filozofije rasta i razvoja bez ograničenja, novom filozofijom održivog razvoja, koja podrazumeva razvoj usklađen sa zahtevima zaštite prirode. Jedno od rešenja ovog problema, može biti orijentisanje poljoprivrede ka organskoj proizvodnji, koja isključuje upotrebu sintetičkih pesticida u poljoprivredi. Organska poljoprivreda, kao idealni sklad životne sredine i poljoprivredne proizvodnje, aktivno bi pomogla u procesu održivog upravljanja prirodnim resursima. Zdrava hrana, proizvedena primenom metoda organske poljoprivrede, a u skladu sa biološkim i ekološkim zakonitostima, omogućila bi održavanje vijabilnosti ljudske populacije. Stoga budućnost narednih generacija i opstanak čoveka uveliko zavisi od aktivnosti preduzetih danas.*

***Key words:** organic agriculture, food production, environmental protection, sustainable development*
***Ključne reči**: poljoprivreda, organska poljoprivreda, zaštita životne sredine, održivi razvoj*

INTRODUCTION

Production enough amounts of food, that would satisfy basic needs in modern man alimentation, today is one of the most important question. Periodic or constant presence of famine phenomenon, because of insufficient amounts of produced agricultural products in some world regions, occurred in the history of humanity, mostly from the following reasons:

a) In the past, food production was, because of knowledge imperfection of reliable agro-technical and science solutions, on a relatively low level and could not satisfy the needs of people in the world. Agriculture and produced quantity of agricultural products largely depended on climate, pests, plant diseases and natural disasters, as well as on unruliness of conquerors during often wars and devastations.
b) With development of science, technological and technical solutions in agriculture, modern history succeed in a large extent to adjust agricultural production to environmental conditions, reducing to a minimum possible risks of yields short coming (practical application of agrotechnic and mechanization; usage of genetic and selection; agrochemical solutions in production, protection, processing and preservation of crops, etc.). Today, the demographic explosion (uncontrolled increase of world population) is the main cause of famine presence in the world, i.e. insufficient quantity of agrofood products.

The period for achieving the one billion people on earth lasted from the emergence of human species till mid of XIX century. In the subsequent few decades, until the year of 1880, the number of people is doubled. The FAO estimation from the year of 2003 shows, that in the beginning of XIX century there were 6.5 billions of people on the planet, while the present estimation of the same organization for the beginning of 2007 is that in the world live 7 billions of people. According to the same study the average increase in population, during the period 1980.-2000, was approximately 100 millions of people per year. Assumption that the number of people on earth duplicate on every 50 years imposes the need of total food production increase, proportionally to the same extent per year. The influence of demographic explosion on world hunger is best pictured by FAO slogan from 2004.: *„Instantly, there are more hungry people in the world now, than in any period of world's history, and the prognosis are that their number will constantly increase"*.

According to executed analysis of FAO, the conclusion is that today all developed countries in the world largely surpass diurnal energetic needs of population, necessary for normal development and function (in the USA approximately 3,600 Kcal, France 3,550 Kcal, Germany 3,300 Kcal, Canada 3,050 Kcal, etc.). In these countries by the assessment of experts, only 3% of population is hungry. Inversely, in other parts of the planet, the diurnal meal of the people often contains far less energy than established day-to-day needs (the FAO recommendation from the 1995. for diurnal energetic value of used meal is 1,600-2,800 Kcal), i.e. there are more starving people (at the Far East 30% of population is imperilled by hunger, and 15% already starve; every 4th inhabitant of Africa is undernourished and about 12% of inhabitants of Latin America are starving). The estimations are that today approximately 850 millions of people suffer from chronic undernourished, while every year in average 80 million of people die from malnutrition, or 100 people per minute. Present world food crisis started at the beginning of the seventies of the XX century, and because of increase of basic food prices, mostly cereals, it was influenced mainly on deterioration of the poorest population alimentation.

Differentiation in the world on those that have enough amounts of food (about 30% of the total population) and those which don't have enough and live on the edge of famine, is also a problem of the modern society. The search for solution of this problem on a global level must be intensified, before all, through strategies for overcoming the general poorness (faster development of non-agricultural activities in non-developed, mostly agrarian, countries) and

politics of agricultural production development.

Approximately 10% of active population, engaged by agriculture, is characteristic of countries with developed industry. Based on intensive hyper-production and food surpluses, these countries have capability to feed, with respect of high nutrition standards, the rest of its own population (one farmer can feed more than 50 people). Inversely, in non-developed mainly agrarian regions of the world, more than 60% of total population are in agriculture (in Africa 75% of employed people work in agriculture, so extensively and risk of agriculture in this region is best pictured by the fact that one farmer often cannot feed its own family), with constant food shortage and insufficient population alimentation.

Only about 11.5% of total soil areas in the world is in the function of agricultural production (the world at present has approximately one billion hectares of a cultivated land and on each inhabitant there is about 0.14 ha of cultivated soil). Australia uses its own soil resources in the smallest extent, about 6.4%, Africa around 6.6% and South America around 6.7% ha of their potentials. Inversely, the largest part of cultivated soil areas are in use in Europe (more than 28.6 %) and Asia (about 18%). Extension of agricultural areas, which will be in function of intensive agriculture, especially in non-developed regions, is one of the possible steps in overcoming the famine problem. It is interesting, that there is no country that can in a long-term feed its own population, using a all present food stock in it. Constant variation of food supply and requirement, in the context of global population increase and satisfaction of basic alimentary needs, issues out all of those resources and activities that contribute to potential increase of total agricultural production.

In the food production, in different world regions, there is often disproportion between number of people and volume of agricultural production (Table 1.). These regions and countries are forced to import food from other parts of the world that they often cannot do, before all because of the problem with balance of payment. The countries in these regions (Asia, Africa, and Latin America) are potential centres of famine epidemic.

Table 1

Population and world agricultural production in 2002

Region	% of population of the region out of total world population	% of agricultural production of the region out of total agricultural production in the world
Western Europe	8.3	16.2
Eastern Europe	8.4	16.9
Asia (without Japan)	56.9	33.6
Africa	8.6	4.8
Australia and Oceania	0.1	1.6
Northern America	5.6	15.1
Latin America	8.3	8.0

Source: The role and importance of pesticides applying in increase of agricultural production, Janjic (2006.).

MATERIAL AND METHOD

Pesticides. Large number of different living organisms can be featured as harmful in agricultural production. Those are certain species of insects, rodents, nematodes, pathogens (viruses, bacteria, phytoplasm and fungi), as well as parasitic plants and weeds. They are the cause of large damages during the process of plant agricultural production. According to Pimental, in 1991 loses before harvest under their action were about 35% on global level, until the losses during a stocking of agricultural products were about additional 20%. It is considered that pests every year, lessen the production in the world in amounts that are sufficient to feed half of a billion people.

Table 2

Damages from pests, plant disease and weeds in the world (%)

Region	pests	diseases	weeds	total
Northern and Central America	9.4	11.3	8.0	28.7
South America	10.0	15.2	7.8	33.0
Europe	5.1	13.1	6.8	25.0
Africa	13.0	12.9	15.7	41.6
Asia	20.7	11.3	11.3	43.3
Oceania	7.0	12.6	8.3	27.9

Source: The role and importance of pesticides applying in increase of agricultural production, Janjic (2006.).

In spite of all measures taken in today's agriculture, pests continue to be the main factor that limits potential food production. The solution for production of enough food quantity for fast growing population can be in increase of agricultural areas in use, as well as limitation of demographic growth and in increase of crop yield per used ha.

Present world agriculture is a highly chemicalised production, in which for the past few decades, yield per sowed unit of production capacity was tripled. In it besides modern agro-technology and mineral fertilizers (their usage increase approximately six times), pesticides are very important factor of agricultural production that can influence at the extent and quality of present plant production (their usage increase about twelve times).

Characteristic effects of pests that can decrease the potential yields are:

- *Weeds and parasitic plants* – with aboveground and underground organs they complicated soil cultivation, crop treatment and harvesting, that influence on quality of planed agrotechnic measures; they contribute to reproduction and dispersion of insects population and vectors of plant diseases; they also influence on quality of organoleptic characteristics of crop; for their own growth and normal function they use large amounts of water and nutrients out of soil, which make them a great competitor to sawed crop (they often output from soil equal quantity of nutrients that farmers input in soil through fertilizers);
- *Pathogenic organisms, cause of plant diseases* - during cultivation and stocking of agricultural plants, they influence on change of basic plant features, and also they can contribute to total degeneration of crop plants or stimulate its transition to category of products useless for human and livestock nutrition;
- *Pests* – among them, first of all insects, display their bad features by feeding with cultivated plants and their products in the field or storage, or by damaging plants. It is interesting that maize, in its different development stages, is being attacked by 400 species of pests, on a world level.

These reasons direct us toward applying of pesticides in plant agricultural production, so that plants can manifest their genetic potential undisturbed and with that provide enough amounts of natural food resources for global population. Based on experiences in the world, maximum effects in plant production with minimum investments can be achieved only by reduction of present pests.

Modern method of agro-eco-systems protection in agriculture, consider applying of products that have chemical or biological origin in the process of reduction, extermination or rejection of pests. The collectively name of these products is pesticides.

From the appearance of the first modern pesticide DDT (without doubt the most efficient organochloric insecticide of all time, which is because of its negative effects on people and domestic animals forbidden in agriculture of developed countries during seventies of XX century), until today, when are produced more than 1,000 of active materials formulated

in few thousand registered pesticides, chemical reduction of pests is still efficient method of pest population control.

For the last few decades, production and consumption of pesticides on a world level is in constant increase (from the nineties annual trend of consumption increasing is about 2%). With level of consumption around 2,500,000 tonnes, every year about 30 new preparations with increased effect of active substance are introduced that considerably decreases spent quantity of new preparations per treated hectare, according to amounts of preparations with equal indications used in the former years. From the utilized amounts of pesticides, the largest consumption is in USA, about 34%, and Western and Eastern Europe, about 45%.

In the structure of a total quantity of applied pesticides in the world, herbicides are dominant with over 40%. They are followed by insecticides with over 30%, fungicides with about 20%, while other groups (rodenticides, growth regulators, limacides, etc.) have only a few percents.

Organic agriculture. Strong role of chemical technology in modern agriculture actualized the question of risk, which that kind of technology in food production carries on. Retrospect is, before all, on possible consequences from high use of chemically produced food for population alimentary and influence of very chemicalized agriculture on the rate of environmental pollution in which people live. Excessive and non-rational usage of pesticides and other chemicals led to extreme degradation of all environmental elements (soil, water, air, flora, and fauna). Destruction of natural resources, eventually, leads to decrease of total yields per hectare and production of food contaminated with pesticides and other material dangerous for human health.

Progressive part of society is increasingly focused on production and consumption of agrofood products produced according to biological and ecological principles, in other words products of organic agriculture, which are safer for the final consumer (with higher per capita income, increases the demand for quality agricultural products, produced in natural conditions and which bring label of health food).

Among numerous reasons that direct on search for alternatives of modern pesticides, the following are the most important: the influence of used preparations remnant on human health and environment; high price of pesticides, synthesis of new active materials and licences for their usage, enlarged the total costs of agricultural production; often manifestation of pesticides non-selectivity and their effects on non-targeted organisms; the development of pests resistance; dangers during production, transportation and application of preparations; the increasing price and demand for non-treated agricultural products; activity of green movement and anti-pesticides legislation, etc.

By the law of organic production and organic products from 2006, in Serbia were regulated the rules of behaviour in this area of agricultural production, because of their accession to the current world trends. The law precisely defines concepts and production procedures for potential producers. Some of them are:

- Organic agriculture is the system of ecological production management which improves biodiversity, matter cycling, biological activity of soil and environmental protection;
- Organic product is every product produced, labelled and certified according to this law and legal acts based on it;
- By the methods of organic plant production, is established the choice and type of plant species, crop rotation, soil cultivation, means and methods of fertilizing, system for sustainability of soil productivity and ways of plant disease, weeds and pests reduction. Methods are legislated by the portfolio minister;
- Organic agriculture is based on natural processes and usage of organic and natural mineral materials;
- It is forbidden a usage of synthetic origin preparations, as well as genetically modified

organisms or their derivatives, except in the cases indicated by this law,

- Reproduction materials which are in use must be produced by the organic production methods;

The above-mentioned remarks lead us to conclusion that modern society is turning toward philosophy of sustainable development, i.e. development in harmony with demands of available natural resources protection, inversely to, so far, philosophy of growth and development without clearly defined limits.

CONCLUSIONS

Nowadays, famine threatens the humanity more than ever before, especially in non-developed countries, therefore the question of finding out the strategies and tactics for faster development of agricultural production in the entire world must be primary. During the extermination of this phenomenon, the development of modern and applied science, technical and technology should be utmost exploited.

According to precious role of soil as a factor of agricultural production, it can be a base of agricultural production enlargement, by the expansion of cultivated areas in use and their correct exploitation in the regions where it is a limiting factor of production.

Besides that, the applying of all modern chemicals for crop protection (pesticides) is unavoidable. They are alongside agrotechnic and fertilizing methods in use, enabled in the last few decades intensively of production process, tripling yields per hectare of sowed agricultural area.

In meantime, the anxiety of worldwide population is appeared because of founding a toxic effect of pesticides on a mammal (human) DNK, as well as contamination of water, soil and air. In focus of modern agricultural trends are production of healthy food i.e. organic agriculture, in which is the usage of synthetic pesticides forbidden. Abandoning of conventional agriculture postulates and introduction of ecological principles, will be contributed to human health improvement and environmental protection.

LITERATURE

KOJIĆ M., ŠINŽAR B. *Korovi*, Naučna knjiga, Beograd, 1985.

RANĐELOVIĆ, V., *Ekonomika poljoprivrede i zadrugarstvo,* Poljoprivredni fakultet, Beograd, 2001.

JANJIĆ, V., *Uloga i značaj primene pesticida u cilju povećanja poljoprivredne proizvodnje*, Ekonomika poljoprivrede, Beograd, 2006.

KATIĆ, B., *Životna sredina i kvalitet hrane u Srbiji,* Environment for Europe, Beograd, 2006.