

Conventional, biotechnological and organic agriculture?

Science and technology are changing just as fast as today's world does. Most people are used to thinking of agriculture as an old-fashioned way of living – static and constant, not knowing that agriculture in itself combines science and technology, developed and used every day.

More and more researches are done to find out which methods of growing crops are best paid off. And good results from agricultural point of view are high yield, easy and cheap cultivation, and resistance to diseases and pests and especially a quality ignored by most – non-toxicity towards the environment.

In general we could point three different directions in agricultural science and technology - conventional, biotechnological and organic agriculture. There's a lot of common ground between the three of them and there're a lot of differences. More informatively we could call the organic agriculture – the one of past; the conventional – the one of the present; and the biotechnological agriculture – the agriculture of the future and this would be correct and at the same time completely wrong. The organic agriculture is generally connected to growing crops with minimum use of fertilizers and pesticides, method not used for centuries, is the reason why it is partially correct to term it the agriculture of ancient times. The conventional agriculture the one that mankind has been using since the discovery that fertilizers accelerate the growth and pesticides reduce the influence of pests. In today's world most farmers rely on usage of organic and synthetic fertilizers, pests and soil improvers and that is why I call it agriculture of the present. As always – there are progressive people who dare apply the novelty in science and technology in practice. That's how in some countries a number of farmers develop the techniques of biotechnological agriculture working on genetic level to improve the properties of crops. Flatly denied by some and accepted by others – biotechnological agriculture is still the farming of future.

Number of schemes has been developed to evaluate the achievements in the all three directions because knowing the best one would help to solve number of problems. Maximum yield from crops would help fighting world hunger – according to www.worldhunger global agriculture produces at least 2 720 kcal per human daily – enough to feed the population on Earth but the problem comes from the uneven allocation and properties of the farmland around the world. The minimum usage of fertilizers and pests would decrease dramatically the release in the environment of toxins that harm the wild plants and animals, along with the emissions of CO₂, CH₄, N₂O that have great contribution to the global warming effect. Lower energetic input in growing and sustaining a culture would rapidly reduce the consumption of fuels which would reflect in cost reduce.

Popular scheme for comparison used in Germany (Federal Ministry for Food, Agriculture and Forestry, Bonn) is a frame to evaluate the pros and cons for 4 conventional (KTNO, KRED, KTE1-3, RS), and one organic agricultural method – ÖKO. According to the results from its use the energetic input per unit farmland is higher with conventional farming compared to the organic. This higher need of energy comes from the necessity of using inorganic nitrogen fertilizers. Respectively the emissions of CO₂, CH₄, N₂O from conventional farming are three times the ones from the same size organically farmed land. Yet the yield from organic farming is 66% the yield of wheat and 40% the yield of rape compared to the yields of the conventionally farmed land.

Other experiments made by the University of Michigan prove that yields of organic crops could be higher than those of conventional – up to 4 381 kcal per person a day compared to 2 786 kcal per person a day gained with conventional crops. The experts have in

mind one other very important aspect – mineral fertilizers that increase in higher grade the conventional crop's growth are a rare and expensive product in the developing countries (including Bulgaria). The same project points that the nitrogen delivered to the crops through organic farming covers the minimum need of nitrogen, which cuts the expenses for indigested fertilizers, along with decreasing the risk of releasing of toxic chemicals in the surrounding ecosystem.

Countries that also find organic agriculture economically suitable are Uganda and Ukraine. Uganda is Africa's most organically developed country and is 13th in the World at part of the farmland devoted to organic agriculture. 40% of the organically farmed land in Africa is in Uganda. The World Organic Market is evaluated to be 30 billion US\$. Using that Ugandan export rose from the year 2000 until 2003 with 67%. Bigger savings have been made possible using only 1kg fertilizers per hectare land compared to the 9 kg used in East Africa. In Ukraine in the year 2002 the organic farms used to count 31, and in 2006 – 80. There is a great variety of organic crops too – barley, wheat, maize, peas, millet, oats, mustard, sunflower, coriander, soy and some ethereal plants. Recently the government approved a plan for "Organic development" which provides for 10% of the organic farmlands by the year of 2015.

All these data confirm that organic agriculture has its advantages – not only the yield isn't lower but the effect on the environment is mild. Having in mind the growing market for organic products we could disprove my thesis that organic agriculture is the agriculture of past.

For centuries humans tried to increase the yield from crops and to improve their qualities by crossbreeding them. This is pure biotechnological farming, even classified as such much later in human history. Today we separate biotechnological agriculture into two directions differing only in the amount of genetic material manipulated. Combining genes from close varieties of plants yielding new qualities is less invasive method to combine desirable properties. Even the great variety of qualities in one crop genus this method gives only limited number of combinations. Radical, new and yet not widely accepted method is using genetically modified crops. In theory the combinations are unlimited. There are number of techniques to produce GM crop – the MAS method gives us the ability to check if a desired gene is present in the plant or not and select the ones we need; the GM trait allows us to insert gene for immunity from pests and herbicides. It is now scientifically proved that GM crops do increase yield compared to conventional ones. Closely are studied crops modified with *Bacillus thuringiensis* – part of them modified to be resistant to insects (named Bt) and other part to be resistant both to insects and herbicides (named BtHr). Both cases show higher yield compared to conventional crop:

- In Mexico – increase with 9% using BtHr soybean;
- In Romania – increase with 31% using again BtHr soybean;
- In the Philipines – 15% using BtHr corn and 24% using only Bt corn;
- In India – 50% using Bt cotton.

Apart from the obviously higher yields GM crops have other advantages over the conventional crops – pest and herbicide resistant crops are cheaper to grow. Smaller amounts of pesticides used for GM crops reduce the amount of gases released in the environment. According to some sources GM crops reduce the gas emissions with rates compared to cutting 500 000 cars. In South America using GM soybean allowed double growth of the crop for one year.

All these made GM crops well preferred in some countries: 95% of the soybean and 75% of corn in USA are GM; 95% and 50% of corn in GM in Argentina and Brazil respectively. 100 million ha have been planted with GM crops in year 2006 in the world.

Study of Bt cotton, grown in Arizona and resistant to *P. Gossypiella*, shows that it does no more harm on the environment than the non-GM cotton but growing the non-GM requires usage of pesticides which dramatically harm the populations of nontarget insects. In India cotton resistant to 3 different pests is used and they can destroy up to 60% of the yield per year.

According to Prof. David Zilberman "Understanding how to use pesticides properly is difficult, but replacing the type of seed used is easy and thus more desirable," Zilberman added. "The bottom line is biotechnology has the potential to positively impact the lives of small, poor farmers in developing nations. It would be a shame if anti-GMO (genetically modified organism) fears kept important technology away from those who stand to benefit the most from it." (http://www.eurekaalert.org/pub_releases/2003-02/uoc--gmc020303.php)

The US Company Monsanto predicts that until 2017th the need of food, fodder and fuels produced from GM crops will have been raised with 200 million tons per year. This can only be accomplished by expanding farm land and the yield from it. Expanding the farm land planted with conventional crops even more would lead us to environmental disaster so the answer is to devote more land to biotech and organic crops which are both proved to have higher yield and less aggressive to the local environment.

The conclusion from all is that what we have in Bulgaria and big part of the world today is the worst that we could achieve – conventional agriculture yields less and harms the environment more. This could only mean that faster and yet well controlled mankind should develop the organic and biotech agricultural methods if we want to reduce world famine, ease the developing economics and protect the world from giant environmental disaster caused by global warming and ecosystems' pollution.

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