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SOCIOECONOMIC PREREQUISITES FOR THE USE OF GENETICALLY MODIFIED CROPS IN UKRAINE

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We have performed sociological surveys of different strata of the population of Ukraine to determine their attitude towards GMOs. Total of 1842 respondents have been interviewed. A majority of respondents are not supportive of the use of raw materials from GMOs in food products, although at the same time 75 per cent are actually out of touch with methods of creation of GMOs and genetic engineering in general. Another interesting point to note here is the fact that there is a clearly defined opinion amongst the general public that the use of GMOs needs to be regulated by the state and products produced with the use of GMO should be labeled. At the same time, however, more than 70 per cent of those interviewed are supportive of the idea of a possibility to use GM crops in the bioenergy industry. We have made an attempt to calculate a possible economic benefit from the use of GM agricultural crops in Ukraine on the basis of the prognosis analysis. The level of yield and the selling price increase if the intensive or innovative technology is used, whereas expenditures decrease and the possible profit grows. Thus, the change in a total amount of the possible profit is obvious, especially in the case when the innovative technology is used.

Key words: *GM crops, interview, economic profits, technology of production of GM crops, agriculture, prognosis analysis.*

Introduction. Ukraine belongs to countries in which the use of genetically modified organisms (GMOs) in general and, in particular, genetically modified agricultural crops is not regulated at the official level. Along with other spheres, it is not regulated in the practice of agricultural production, although according to unofficial data significant parts of areas sown with corn, soybean, and rape have been based on the use of genetically modified (GM) seeds [1, 2]. In the process of the present study, we have performed sociological surveys of different strata of the population of Ukraine to determine their attitude towards GMOs.

According to data of the study, a total of 1842 respondents have been interviewed. We have chosen youth people aged less than 25 years to be the main target audience, with a breakdown of the survey data by the following factors: gender, regions of Ukraine, place of residence and type of employment or occupation.

As the data of our interviews show, a predominant majority of citizens (68 per cent) have a positive attitude towards the scientific and technological advance.

The sources of information, as of today, are mass media outlets – TV, paper press and the Internet. 70 per cent of respondents have received information about GMOs from these sources, and we can consider these sources such that shape the public opinion. A majority of respondents are not supportive of the use of raw materials from GMOs in food products, although at the same time 75 per cent are actually out of touch with methods of creation of GMOs and genetic engineering in general. In this case, absence of knowledge and information gives rise to suspicions and fears.

Another interesting point to note here is the fact that there is a clearly defined opinion amongst the general public that the use of GMOs needs to be regulated by the state and products produced with the use of GMO should be labeled. At the same time, however, more than 70 per cent of those interviewed are supportive of the idea of a possibility to use GM crops in the bioenergy industry.

The purpose of work was analysis of socio-economic preconditions of using the new technologies with GM crops in Ukrainian agriculture practice.

Materials and methods

Object of research are the results of using GM crops in the world practice of agriculture production. Methods of research – monographic, analytical-synthetic, statistical, methods of economic analysis, sociological.

We have made an attempt to calculate a possible economic benefit from the use of GM agricultural crops in Ukraine on the basis of the prognosis analysis. The calculations have been based on data from official statistical reports, which have been adjusted to take into account advantages of the use of the new technologies [3–6]. The study performed herein included a description of the level of production of agricultural crops in Ukraine, the comparative analysis of technologies that were used and the prognosis of results of a possible use of GM agricultural crops in those technologies [7].

Based on results of the analysis of economic activities of agricultural enterprises (farms) of the different forms of ownership in Ukraine, we have identified the following three technologies of the production of agricultural crops [8]:

- extensive – in farms that have insufficient provision with means of production and employ traditional methods of cultivation;
- extensive – in farms that both have a high level of financial and technological provision and employ modern technologies, highly productive machinery and equipment, progressive methods for organizational management of farm works etc.;
- innovative – the technology being predicted, with the possible employment of cultivation of GM agricultural crops.

An averaged index has been determined from results of this analysis, and on the basis of the index, the presently used technologies have been compared with the innovative technology. Specifically, the comparative analysis of the cost of inputs into production in the case of growing grain corn, in accordance with the technologies used in Ukraine, shows that the level of expenses is higher under the intensive technology.

Results and discussion

The level of the total cost of inputs into production of grain corn, based on a rate per unit of area – a hectare (with 1 hectare (ha) being equivalent to 10,000 square meters or 2.471 acres), under the extensive technology is equal to 2493.7 UAH, whereas that under the intensive technology is 2601.6 UAH. That difference, in the main, is caused by an increase in the total cost of

material inputs into this production from 2153.8 UAH per ha to 2327.6 UAH per ha, including an increase of expenditures for seeds and planting stock from 420.8 UAH per ha to 466.6 UAH per ha and those for mineral fertilizers from 560.0 UAH per ha to 680.0 UAH per ha. At the same time, the expenditures for remuneration of labor, fuels and lubricants, depreciation of material assets and other expenditures have decreased.

A similar situation is traced in the analysis of cost of inputs into production of soybean [9]. More specifically, the total cost of inputs increases from 2103.2 UAH per ha to 2128.4 UAH per ha respectively, including the total cost of all material inputs – from 1749.9 UAH per ha to 1790.1 UAH per ha. This growth has been caused by the increase in such components of expenditures as planting stock – from 240.2 UAH per ha to 266.9 UAH per ha, and crop protection agents (weed and pest killers) – from 520.0 UAH per ha to 616.0 UAH per ha. At the same time, the expenditures for fuels and lubricants, repairs, depreciation and other expenditures have decreased.

Based on the averaged index of the net cost of production under the technology presently used in Ukraine and the expected net cost of production under the innovative technology, we have compared the cost of inputs into production per unit area of land during production of grain corn and soybean. Specifically, it is possible to decrease the expenditures during production of grain corn from 2547.7 UAH per ha to 2527.3 UAH per ha, whereas those during production of soybean – from 2115.8 UAH per ha to 2050.3 UAH per ha. Such savings can be achieved at the expense of decrease in expenditures for remuneration of labor, crop protection agents, and fuels and lubricants.

Since the saving of material and monetary inputs has been determined per 1 hectare, the total saving amount will depend on the areas under crops. Using the same methodology, every agricultural enterprise can calculate the economic feasibility of the use of GM crops depending on its technological facilities, areas sown with particular crops, phytosanitary state of fields etc.

We have performed the calculations of economic benefits from the introduction of GM crops into the agriculture at the scale of Ukraine for the following four variants of possible development of events:

variant 1 – when 10 per cent of the sown area would be under GM crops (202.1 thous. ha for GM grain corn and 61.2 thous. ha for GM soybean);

variant 2 – 15 per cent (303.2 thous. ha and 91.8 thous. ha, respectively);

variant 3 – 20 per cent (404.2 thous. ha and 122.4 thous. ha, respectively);

variant 4 – 30 per cent (606.3 thous. ha and 183.6 thous. ha, respectively).

The level of our target index (the possible profit) is influenced by the yield of the crops, the selling price and expenditures. We have found that the yield of the crops under study is subject to significant variations, depending on the natural and meteorological conditions and technologies used in farms. Therefore we have set the following three levels of yield, which have been typical for most of farms that were studied: minimal, maximal and average. This differentiation by the level of yield has also been taken into consideration in the different technologies of growing the crops. In doing so, we have assumed the use of highly productive seeds with strict compliance with the technology of growing. The compliance with these requirements influences the quality of products, which, in turn, is a significant factor in the formation of the selling price.

More specifically, in production of the corns under study, the level of yield and the selling price increase if the intensive or innovative technology is used, whereas ex-

penditures decrease and the possible profit grows. Thus, the change in a total amount of the possible profit is obvious, especially in the case when the innovative technology is used.

However, the analysis of technologies of growing GM crops demonstrate some advantages in comparison with technologies of growing conventional crops in terms of a decrease in the burden of crop protection agents per unit area of land. Regarding the system of protection of GM glyphosate-tolerant soybean the technology is significantly simplified in this case as compared to the traditional one from the point of view of protection against crop pests [10]. Specifically, spraying of sown areas with herbicides to control crop pests needs to be carried out two times instead of the five times. If GM corn would be grown with the two resistance factors (those against herbicides and European corn borer), it would be possible to discontinue the use of 11 herbicides and one insecticide. If the resistance would be provided against one factor only (namely, European corn borer), there would be no further need to use insecticides on sown areas.

The growing of GM crops contributes to a reduction in the level of greenhouse gases emissions at the expense of a lower consumption of fuels and application of rational schemes of land use controls (with no-tillage or minimum tillage). More specifically, the saving of fuels is a result of a lesser number of necessary trips to fields to apply pesticides (as compared to conventional crops) and switching to agricultural technology with no-tillage or minimum tillage. In turn, this makes a contribution to a reduction in the level of carbon emissions.

According to sources, when 1 liter of diesel is burnt, about 2.75 kg of carbon dioxide is emitted into the atmosphere. The adoption of the no-tillage farming system enables farmers to reduce use of fuels through the elimination of tillage and seedbed preparation by approximately 35.52 liters per ha as compared to the traditional tillage system and by 14.7 liters per ha as compared to the reduced tillage cultivation. In turn, this results in reductions of carbon dioxide emissions of 89.44 kg/ha and 40.43 kg/ha, respectively. In addition, the use of no-tillage and reduced-till farming systems that utilize less plowing enhances the quality of soil, decreases intensity of erosion, increases the amount of organic carbon in the form of crop residue that is stored or sequestered in the soil. This carbon sequestration reduces carbon dioxide emissions into the environment.

Conclusions

According to information provided to us by economic entities that have been interviewed within the framework of the present study, the agriculture of Ukraine is not free from GMOs; the latter already find their ways to enter food products in Ukraine, in the main, through imported products that contain GMOs. This results in GM crops being grown in Ukraine and food products that contain food raw materials with GMO being consumed in the country. Ukrainian agricultural producers are open enough for biotechnologies and see advantages from them.

In our opinion, the time comes for Ukraine to work out the state policy on GMO issues and keep developing regulatory bases for the use of them in accordance with the chosen principles.

Science (including biotechnology) develops in the conditions of scientifically sound legislation and falls into decay in the conditions of «preventive principles». The studies performed herein can be concluded in the following recommendations:

Restrictions on GMOs should be scientifically sound.

Fear, incompetence and public opinion should not be a basis for making any decisions regarding to GMOs.

Restrictions on GMOs should be realistic to implement and should be *continuously* implemented.

Both transparency of studies on genetic engineering and constant awareness of the general public regarding their effectiveness and biosafety are needed.

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СОЦІОЕКОНОМІЧНІ ПЕРЕДУМОВИ ВИКОРИСТАННЯ ГЕНЕТИЧНО МОДИФІКОВАНИХ КУЛЬТУР В УКРАЇНІ

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Було проведено соціологічне опитування різних груп населення України для визначення їх ставлення до ГМО. Всього було опитано 1842 респонденти. Більшість респондентів не підтримують використання сировини з ГМ-складовими у продуктах харчування, хоча в той же час 75% фактично не мають поняття про методи створення ГМО та генетичної інженерії загалом. Зацікавлює також той факт, що існує чітко виражена думка серед населення, що використання ГМО слід регулювати та продукти, що виробляються з використанням ГМО, слід маркувати. Хоча в той же час більш ніж 70 відсотків опитаних за ідею використання ГМ культур у галузі біоенергетики. Було зроблено спробу розрахунку економічної ефективності від використання ГМ сільськогосподарських культур в Україні на основі аналізу прогнозування. Рівень врожаю та ціна збільшуються, якщо використовується інтенсивна чи інноваційна технологія, в той час як витрати зменшуються і можливий прибуток зростає. Отже, зміна загальної кількості можливого прибутку очевидна, особливо у випадку, коли використовується інноваційна технологія.

Ключові слова: ГМ культури, опитування, економічні прибутки, технологія виробництва ГМ культур, сільське господарство.

СОЦИОЭКОНОМИЧЕСКИЕ ПРЕДУСЛОВИЯ ИСПОЛЬЗОВАНИЯ ГЕННОМОДИФИЦИРОВАННЫХ КУЛЬТУР В УКРАИНЕ

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Был проведен социологический опрос разных групп населения Украины для определения их отношения к ГМО. Всего было опрошено 1842 респондента. Большинство респонден-

тов не поддерживают использования сырья с ГМ компонентами в продуктах питания, хотя в то же время 75% фактически не имеют понятия о методах создания ГМО и генетической инженерии вообще. Вызывает интерес также тот факт, что среди населения существует мнение, что использование ГМО нужно регулировать и продукты, которые производятся с их использованием, подлежат обязательной маркировке. В то же время более чем 70 процентов опрошенных за использование ГМ культур в отрасли биоэнергетики. Была сделана попытка расчета экономической прибыли от использования ГМ сельскохозяйственных культур в Украине на основе анализа прогнозирования. Уровень урожайности и цена увеличиваются, если используется интенсивная или инновационная технология, в то время как расходы сокращаются, а возможная прибыль возрастает. Так, изменение общего количества возможной прибыли очевидна, особенно в случае использования инновационной технологии.

Ключевые слова: ГМ культуры, опрос, экономическая прибыль, технология производства ГМ культур, сельское хозяйство.