

INNOVATIVE NO-TILL TECHNOLOGIES IN AGRICULTURE AS A BASIS FOR INCREASING THE EFFICIENCY OF AGRARIAN PRODUCTION

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The article considers the issues of increasing the economic efficiency of introducing innovative technologies at agro-industrial enterprises under the conditions of market economy. The opportunities of modernization of technical equipment of agricultural production are studied.

The development of modern civilized social production is carried out on the basis of achievements of scientific-technological progress. This is proved by the results of close connection of science and production which are realized according to the scheme: "Science – Technics – Technology – Production". The essence of scientific-technical-technological progress is in constant combination of the development of science, engineering, technology, material production. This is a complex process of developing and improving production tools, technologies and organization of production. It covers all spheres of social activity and is aimed at increasing its efficiency [3].

In this situation the problems of identifying the efficiency of introducing innovative production in agriculture are actual. These problems are important because the efficiency of introducing innovative products and their methodological grounds are not properly investigated under the conditions of formation of national innovative system.

Theoretical and practical aspects of innovative activity in agriculture on macro- and micro levels are described in research works by foreign and Ukrainian scientists: B. Santo, B. Twiss, Yi. Shumpeter, P.T. Sabluk, O.H. Shpykulyak, M.Y. Malik, L.M. Malik and others.

The results of their researches make it possible to consider the problem from different points, evaluate its present state and make conclusions concerning defining the efficiency of introducing innovative products in agriculture and perspectives of their use.

The purpose of the article is the development of scientifically grounded suggestions regarding the introduction, development and optimization of zero tillage system (No-till) in Ukraine and in the world, substantiation of the opportunity of modernization of technical equipment of Ukrainian agricultural production; investigation of the influence of innovations on the increase of productivity in crop production sphere.

Methods of the research. Methodological basis of the conducted researches includes the provisions of economic theory, scientific works by national and foreign scientists on the issues of introduction, development and optimization of zero tillage system (No-till) in Ukraine and in the world. The information base for the research is the laws of Ukraine and other countries of the world, literary sources, author's personal observations.

Results of the research. In recent years a lot of farm producers have been trying to introduce the technologies which have firmly established themselves abroad. Western countries have a well developed infrastructure of specialized livestock production. There are different meat associations in Europe and studbooks on all breeds of beef cattle have been kept for more than 100 years. For example in France the leading structural element of the branch is the “studbook” of cattle of Limousin, Charolais and other breeds. Together with the Association of breeding certain cattle breeds, it carries out all selective work in the whole country. Similar self-governed structures exist in England, Canada, the USA, Australia and other countries.

During recent years a lot of Ukrainian farms have been trying to cultivate fields according to minimal technology hoping to change on No-till in several years. Zero tillage system, also known as No-till, is a modern system of farming which means refusal from soil plowing, direct sowing, using cover crops and competent application of crop rotation. All work is done by a special stubble seeder which cuts post-harvest residues, spreads them on the soil, makes a furrow of necessary depth in it, precisely sows the seeds and covers the seed bed.

The main principle of No-till system consists in using the natural processes which take place in the soil. Experts who support this system regard the traditional plowing as useless or even harmful. They explain that billions of capillaries, which remain after the roots of annual plants or are formed as a result of life activity of earthworms and other organisms, penetrate the soil 1-2 meters deep in an uncultivated field. Moisture saturates the soil through these thin but very deep capillaries and in winter it freezes and breaks the canals. In this way loosening of soil takes place.

Soil protection is the basis of No-till: the seeds are sown into after-harvest residues with the minimum disturbance of their structure and without mechanical effect on the soil. These residues form a mulch layer. It saves moisture, protects the field from the sun, water or air erosion and dust storms meanwhile the upper layer of the soil is not damaged. Nutrient residues help to manage the soil carbon. Carbon is the basis of humus and catalytic agent of the processes which control soil erosion while under application of traditional technology carbon is released into the air.

For this reason experts actively discuss whether the western experience is useful for Ukrainian farmers. Before changing on No-till, experts advise first to try minimal technology and control weeds. From the point of view of traditional technology the best method of controlling the weeds is deep moldboard plowing. With No-till technology the weeds are overtopped with nutrient residues which are spread in the field, and cover crops or green manure and perennial “green fallows” stop weeds growing. After autumn plowing the soil stays uninhabited and this creates favorable conditions for weeds growing. Whereas a mulch layer reduces weeds germination[6].

At present in Ukraine No-till systems are successfully applied in “Agro-Soyuz” corporation in Dnepropetrovsk region. However, there must be certain preconditions for the wide spread of this technology in the country. The main prerequisites of its spread are both soil-climatic and social-economic conditions. Till recent time during discussions concerning minimal tillage the main attention was concentrated on its physical parameters, fertility conservation, increase of anti-erosion resistance,

reduction of power expenditure. Nevertheless, the progress in a number of countries was caused by the necessity of increasing the labor productivity which is connected with the availability of huge areas of arable lands with limited labor resources. Other factors, though being important, are minor.

Thus, No-till technology makes it possible to increase labor productivity in 3-5 times, reduce spending money for remuneration of labor in 2,6 times, machinery – 1,5, fuel – 2,2 times. The reduction of aggregate expenditure for production in Western countries can reach 12%. The introduction of No-till technology is even necessary in terms of increasing labor productivity as rural population is becoming older and young people are not willing to come back to the village that is labor resources become scarce. But speaking about technological aspects of No-till technology it has both advantages and disadvantages. Those, who are in favor of it, mention only its pluses. Those, who do not support it, speak only about its minuses. Is it possible to consider the problem keeping the balance?

Farmers in different countries have their own reasons for introducing this technology. In the USA it is increasing labor productivity and controlling the erosion caused by the wind, in Canada the main aim is conserving moisture in the soil, in Brazil they are concerned with the extensive use of the upper soil layer, due to destruction of rainforests. Thanks to this technology, the water erosion, when both chemicals and substances, causing rapid algae growth, are thrown into the water, has reduced. Due to the fact that postharvest residues are left in the fields, gradual increase of organic matters and humus is achieved. Under the conditions of sufficient moisture content in the soil, the consumption of nutrients, first of all phosphorus, increases considerably. Organic residues protect soil moisture from evaporation. The soil becomes enriched with micro- and mesofauna including earthworms which play a very important role in increasing soil fertility.

The role of people who take the lead in introducing innovative technologies has always been of great importance. But in foreign countries they are encouraged by the state though the land is mainly privately owned. In recent years Europe has been actively introducing zero technology. Kazakhstan has started No-till enthusiastically. The whole Kustanay Research Institute of Agriculture deals with studying the technology. They even design new machinery for No-till. For example, their plowshares for seeders have received several patents.

Ukraine has one of the most power-intensive productions in the world: 0,89 kg. of notional fuel is spent for producing one dollar unit [2]. That is why the main advantage of No-till is in reducing fuel consumption. Machines carry out three operations in one passage: till the soil, sow seeds and bring in fertilizers. They use 4-5 liters per hectare. Meanwhile under minimal tillage it is necessary to disk and till the soil, sow the seeds, which takes 30 liters per hectare. Such savings in fuel expenditures and human labor are annually observed at farm enterprises “Victoria Agro” in Novomyrhorod district of Kirovohrad region, “Bardin” in Ochakiv district of Mykolaiv region, “Sonyachne” in Solonyansk district of Dnipropetrovsk region, “Vira” in Oleksandriya district of Kirovohrad region, LLC “Veda” in Pidvolochysk district of Ternopil region and many others, where No-till technology is applied [5].

The application of No-till technology results in smaller amounts of carbon

dioxides released into the atmosphere as it facilitates reducing fuel consumption. At the same time organic matters created due to carbon dioxides recovered from the atmosphere are fixed in postharvest residues.

A lot of things depend on machinery which a farmer may choose for introducing the new technology. That is why before buying it, it is necessary to learn more exactly the fields area, the information about the relief and types of soil. It is also advisable to work out a skillful crop rotation system to apply a minimal quantity of machines but managing to sow the crops in necessary terms. The choice of machinery should be done only after these considerations.

The world's arable land area comprises 1317 million hectares. In 2004-2009, 95,480 million hectares or 6,8% of these lands were cultivated with the application of No-till technology. Of this area 94,7% are located in six countries: the USA, Canada, Brazil, Argentina, Australia and Paraguay. The whole Europe, both Eastern and Western, has only 3%. Nevertheless it should be noted that this technology is used more and more often for cultivating additional 1 million hectares every year [8].

Some experts consider the use of powerful power-consuming tractors with broad grip combined units, which fulfill several operations in one passage, to be an advantage of zero technology. A lot of producers offer farmers to use GPS-equipment which helps to make maps of field productivity and fertility. Its application can help to make structural analysis of the soil state and inform about differentiated application of mineral fertilizers [7].

Visual driving systems which are equipped with digital cameras and have 3-5 cm. accuracy should also be mentioned. They are especially efficient in vegetable production. For example, in potatoes growing the system equipped with cameras will never cut the row as it perceives the row visually on the contrary to satellite systems which physically are not able to find the configuration of the row if it is not straight. Let us consider the opportunity of introducing the technology at the typical for Cherkasy region farm enterprise. Calculations concerning the substantiation of the opportunity to apply the system of parallel driving are presented in table 1.

1. Average expected economic effect of application of parallel driving system

Crop	Saving per 1 hectare, UAH	Area, hectares	Total savings, UAH
Winter wheat	160	1100	176000
Winter barley	120	400	48000
Sunflower	70	900	63000

According to these calculations the measure is efficient as the economic effect is 287000 UAH per year. The cost of buying and introducing the parallel driving system differs depending on the producer and ranges from 14 to 23 thousand UAH.

The given examples prove the opportunity of intensification of crop production by means of wider application of innovations which facilitate the improvement of the efficiency of the sector greatly. The advantages of introducing the suggested systems are as follows:

- increase of labor productivity in 3-4 times and reduction of spendings for crop production in 2-3 times;
- reduction of spendings for buying fuel, fertilizers, means of plant protection, other material costs;
- sowing seeds and harvesting are carried out in the best farm terms, being reduced in 1,5-2 times;
- increase of crop productivity;
- minimal erosion processes and considerable increase of organic matters and humus in the soil;
- protection of soil moisture from evaporation and other advantages.

At the same time the disadvantages of No-till technology can also be considerable. With postharvest residues on the soil surface the soil temperature in spring is on 3-5 ° lower due to which the crops' organogenesis stages change for later terms which causes the delay in sowing spring crops (with corresponding consequences).

If the soil is not properly drained, the danger of excessive moisture in the plowed soil layer arises and therefore its biological activity decreases. This issue should be kept in mind regarding the introduction of No-till technology.

Under the saturation of the plowed soil layer with postharvest residues the need for increasing the sowing rates by 15-25% may appear. It may become more difficult to control the weeds in the areas under crops and the expenditures for buying herbicides may grow by 15-100% depending on the crop and crop rotation type.

With the application of No-till technology the effect of herbicides decreases as some part of preparations stays on postharvest residues and is detoxified in biologically active upper layer. The availability of postharvest residues creates favorable conditions for appearance and keeping the sources of infestation, infection, survival of pests in winter period, and controlling the rodents becomes more difficult.

With a great number of postharvest residues the efficiency of nitrogen fertilizing by spreading it on the surface decreases, the loss of one third of carbamides may be possible. As for organic and ecologically friendly production, it is impossible to receive high yields without the application of fertilizers and herbicides in Ukraine as well as in the whole world. Thus, Ukraine has the best soils in the world but even this soil will not give a high yield if the means of pest and disease control and fertilizers are not applied. For example, wheat fusarium blight is more harmful than chemicals used to control it [4]. No-till technology requires exceptionally high skills of farm and technical personnel.

To change on No-till technology it is necessary first of all to buy foreign machinery (tractors, seeders, sprinklers, fertilizer spreaders, soil tilling complexes and combine harvesters). Why foreign machines? Because mechanism complexes for No-till technology are not produced in Ukraine and they should be bought from abroad which is problematic under the conditions of great UAH depreciation and financial crisis. The disadvantage of No-till technology is a high price of main technical means – direct seeding machines. Their price may reach dozens and hundreds of dollars [1].

Conclusions. The results of the conducted research make it possible to make

conclusions that Ukrainian economy is still depressed and the only way for the state is to encourage more active innovative activity of Ukrainian enterprises.

Taking into account the importance of introducing zero technology in our country the state has to motivate and support those who are involved in No-till technology application. To provide subsidies for buying non-selective herbicides and necessary for this technology machinery, provide scientific support, arrange workshops with foreign experts and researches taking part in them, study the experience of leading farms and, which is most important, create the atmosphere of understanding the state importance and practical significance of starting the new technology.

Annual state subsidies for farm producers comprise 2,4 billion USD. Using these funds for introducing new and effective technologies, Ukraine could stop granting any subsidies for agriculture in the future. At the same time we can not say that No-till technology will solve all the problems. It is a complex system which requires following all the details in technological operations. If at least one of these elements is disregarded, the system will not give the wanted results. Therefore, the future belongs to zero technology. The earlier we start its introduction, the earlier we will achieve stability, spendings reduction and profitable farming of the country.

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