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STRATEGY OF DEVELOPMENT AND IMPLEMENTATION OF CROP ROTATIONS IN UKRAINE (Part 2)

Today in world agriculture several directions of alternative agriculture are simultaneously developed, studied and implemented. The combination of agronomic, environmental and economic characteristics of the branch creates conditions for the development and implementation of zonal and adaptive systems with different levels of intensification. Such farming systems can be implemented in farm formations depending on the specialization, environmental conditions of agrolandscapes and technical capabilities.

The priority of ecological farming system is the use of biological agents as a source of natural resources, widely use of organic fertilizers by introducing “green manure” cultures use to fertilize the soil with stubble after-harvest residues and non-tradable harvest, microbiological processes along with the fertilizer application for regulations in soil fertility.

Since independence, Ukraine (as of 01.01.2009) number of animals in agriculture fell by more than fivefold. Plant by-products (straw, maize stalks) were not widely used; technically it was impossible to wrap it into soil quickly with few economic costs. Producers in Ukraine annually burn 30-40% of crop by-products (15-20 million tons), which means the soil does not obtain 45-50 mln tons of manure. The direction of further intensification of agriculture as a way to improve industry productivity is largely exhausted, and because of its negative effects finding of alternative farming systems is required aimed at obtaining high-quality and safe products for human users.

The basis of proper crop alternation in rotation should be placing each culture after her better predecessor in compliance with the standards of interchanging (duration of return periods for each crop in the previous field). On the basis of crop rotation systems there are provided the systems of fertilization, mechanical tillage and crop

protection from weeds, pests and pathogens. Irregular conducting these activities, without considering what was grown in recent years and what will be sown on the next year, would result in low efficiency of fields. In regular rotation the objective laws of agriculture realize better and their compliance enables to adjust nutrients cycles of plants in agriculture.

Crop rotations for ecological farming systems determine the impact on quantitative parameters of the cycle of nutrients in agrocenoses by alternation of crops in time and space, the use of non-tradable crop stubble, after-harvest and root remains, green manure. The introduction of long (7-8 fields) or short (3-5 fields) rotations or their parts must necessarily provide planting legume crops (legumes and grasses).

For ecological farming system the most effective measures are introduction and development crop-interchange rotation with perennial legumes. An example of such rotation is as follows: 1 - perennial legumes, 2 - winter wheat plus stubble on green manure, 3 - sugar beets, 4 - buckwheat, 5 - maize, 6 - peas, soybeans, 7 - winter wheat plus stubble on green manure, 8 - barley and sowing of perennial legumes; or 1 - peas, 2 - winter wheat, 3 - rape, 4 - winter wheat + green manure legumes, 5 - maize, 6 - soy, 7 - barley+ buckwheat in green manure.

In households with low livestock density or without them circumstances encouraged to focus on the production of grain. Cereal crops can be up to 70% of arable land. Wheat, corn and barley dominate in the structure of grains. Crop rotation is as follows: 1 - always green manure fallow (lupine, mustard, rape, oil radish, etc.) 2 - winter wheat, 3 - sugar beets, 4 - barley, 5 - peas, 6 - winter wheat, 7 - maize grain, 8 - barley. As can be seen there are 75% of cereals in crop rotation and ear-forming cultures are not sown after stubble of ear-forming predecessors. As the fertilizer, in addition to green manure, including sugar beet tops, straw, all post-harvest remains, are used and provide a yield increase of 1 ton of barley per hectare.

Green manure fallow cultures in rotation help to improve the phytosanitary status of fields, the main indicators of soil fertility and are a good precursor for winter crops. A strong root system of rape, oil radish, white mustard, penetrating to a depth of more than 1.5 m, well drain soil enriched with organic matter; root and stubble slow down the development of diseases, pathogens which are stored in the soil.

Growing of basic and intermediate green manure crop as fertilizer is particularly important in light sandy low humus soils for putting

abandoned land in agricultural use or as replacement of farmyard manure under row tilled crops.

Recently rotation process failure becomes threatening, there is chaos in economic management. However, there are many large and small-scale farms that introduce rational crop rotations and the latest developed technologies, achieve high yields growing crops and raise livestock sector productivity.

In the production introduction of crop rotations is decided by the proper organization of the economy, which provides rational relationship between the different branches of agricultural production. The more developed some industries, the more varied composition by type of crop plants. Depending on their structure and economic purpose field, fodder and specialized rotations are distinguished.

In field crop rotations placing cereals and technical field crops are placed, forage crop is allocating in limited area. Food crop rotation is rich for forage crops, and cereals and technical crops occupy a small area. Farm specialization often determines the need for saturation of rotation with special crops. Hence the name - specialized rotation. They can be saturated only with such cultures, which are not affected by their frequent sowing at one and the same field. The specialized rotation includes some grain or vegetable crop rotation. In all cases, they should take into account the scientific basis of crop rotation.

Based on the experimental results of scientific research institutes the recommendations were worked out for rational crop rotations for large farms, where possible introduction of many-field crop rotations, and for farmers with a limited acreage of land under cultivation, which requires the use of a small set of crops and short rotation. In view of the present indicative most common crop rotation schemes with different duration for various soil and climatic zones of Ukraine.

Steppe. I. 1 - clean or ordinary fallow; 2 - winter wheat, 3 - rape or soy, 4 - maize, 5 - barley, 6 - maize for silage and green fodder, 7 - winter wheat or winter barley, 8 - soybeans, 9 - winter wheat or winter barley, 10 - sunflower; II.1 - black fallow, legumes, 2 - winter wheat, 3 - sugar beets, maize for grain or silage, 4 - spring cereals, sunflower; III. 1 - black fallow, 2 - winter wheat, 3 - rape, 4 - winter wheat; IV. 1 - legumes, 2 - winter wheat, 3 - maize, 4 - maize and spring crops.

For sunflower we can allocate half of the field in the rotation: 1 - black fallow, 2 - winter wheat, 3 - barley, 4 - 0.5 of field sunflower plus 0.5 of field maize.

Changing of one rotation of sunflower and corn should be interchanged to keep the return period to the previous field.

Rice crop rotation: 1,2 alfalfa; 3, 4, 5 - rice; 6 - land improvement field; 7, 8 - rice.

Forest-steppe. I. 1 - perennial legumes grasses, 2 - winter wheat + after harvest crops for green manure, 3 - sugar beets, 4 - maize for silage, 5 - winter wheat + after harvest crops for green manure, 6 - maize, 7 - peas or soybeans, 8 - winter wheat + after harvest crops for green manure, 9 - sugar beets and sunflowers, 10 - barley + overseeding with perennial legumes grasses; II. 1 - perennial and annual grasses, 2 - winter wheat, 3 - sugar beets, 4 - maize for grain and silage, buckwheat or barley, oats; III. 1 - legumes, 2 - winter wheat, 3 - sugar beets, 4 - maize, soybean, 5 - spring cereals (barley, oats, cereals); V. 1 - black or full fallow, 2 - winter wheat, 3 - rape, 4 - winter wheat+ after harvest crops for green manure, 5 - maize, buckwheat, millet or barley; V. 1 - legumes, 2 - winter wheat, 3 - maize, 4 - barley and oats.

Polyssya. I. 1 - clover, 2 - winter wheat+ after harvest crops for green manure, 3 - potatoes, 4 - flax, 5 - winter rye, 6 - maize for silage and green fodder, 7 - peas, lupines, 8 - winter wheat, 9 - winter or spring rape, 10 - barley + sowing clover; II. 1 - legumes, 2 - winter wheat, 3 - winter rape, 4 - winter wheat, 5 - potatoes; III. 1 - legumes, 2 - winter wheat, 3 - early potatoes, flax, 4 - winter wheat, 5 - spring cereals; on sandy soils: 1 - lupine for grain, 2 - winter rye, 3 - potatoes, oats, 4 - winter rye, 5 - oats.

Undoubtedly, crop rotation schemes are to be regarded as fundamental in their construction. They can not cover the whole variety of schemes and set rotation, which occurs in theory and in practice of modern agriculture. The need for implementation of short crop rotation caused by the emergence of new forms of land ownership, land sharing, increasing of number of households with a small area of land, crops and limited set of crops and narrow economy specialization. After all, modern agriculture with rational parameters rejects practice only when grown grains and oilseeds, which is widely practiced across the state. None other than the desire of today's rapid gain prevents many farmers to realize and to object the brutal violations of rotation.

In Ukraine there is a strategy of crop rotation development in nearby and distant future. The owners of farms must pay more attention to the advices of scientists to keep rotation structure to maintain soil fertility. It is necessary to restore classic crop rotation, which would provide in its structure optimal set, ratio and location of field crops.

In 2014 in Ukraine sunflower acreage held 22% in the structure while at the normative rate it must not exceed 11%. Infringement occurs

because various forms of management and of the pricing policy on the products, the lack of livestock and the need for growing fodder agrophytocenoses. Set and the ratio of crops have passed a rational limit. Two groups of crops – cereal and oil crops – are mainly planted in large farms. As a result of unilateral depletion of the soil, strengthening by it's exhausting, negative results would be observed through decades as heavy losses of fertility. That fertility can then be returned at least in 50 years with large additional costs. Therefore, in each farm should not be allowed permanent crops, to be followed established standards alternation. One field is allowed to grow maize, ear-forming cereals, legumes, rape - once in three years, sunflower - once every 6 years.

In justifying crop alternation in rotation reasons of lowering of yield and quality in repeated and permanent crops is not considered, also biological characteristics of plants, their allelopathic activity and effect on phytosanitary condition of the soil and crops. Based on years of comprehensive research we found soil and environmental factors of soil exhausting under various field crops impact. It is necessary to take into account their allelopathic activity, phytonematodes and pathogenic states of soil. In different farming systems, including biological (organic) agriculture, there is no alternative for crop rotation as a powerful source of effective land use in Ukraine.

The strategic objective of the study of crop rotation is caused by rotation realization that it would be a mistake to assume that modern agriculture in market conditions should only go to innovation with rotations of short duration. At least that fact must be considered that Ukrainian Forest-steppe and Steppe are large-scale grain production regions, sugar beets, sunflowers and more, and here, too, the main producers of large agricultural enterprises. Such diversified enterprises, of course, should introduce and develop rotations with long duration (7-10 fields). So, have a right to exist both types of rotations – with long and short durations too. But which one to implement - the owner decides.

It should also be remembered that the basic unit of technology growing crops is correct placing them in rotation, to the same crop rotation are the basis of all farming systems. Therefore stationary experiments to study the rotation of research institutions were conducted for a long time since the 20s of last century. The main objective of these experiments was to determine the role of perennial grasses and legume-grass mixtures grass to improve soil fertility, increase yields. In the 1961-1962 experiments' schemes were replaced

towards expanding areas of high productive cultures, their optimal alternation in rotation. Results of researches are widely used in agriculture, as evidenced by the experience of the development of crop rotations production workers.

However, with increasing intensification of agricultural production, introduction of new technologies, high-performance varieties and hybrids of crops that have high demands on soil fertility, crop allocation issues arise anew. In addition, until recently, not enough attention was paid to overcome incompatibilities and self-incompatibility of some cultures, the term of their return to the previous field that limits the ability to design reasonably rotation of varying duration for farms of different ownership forms and areas of specialization.

In view of these challenges for the future research are:

- Conducting experiments in the field of stationary lyzimetre researches to solve such issues: environmental safety of agriculture, crop rotation and environment (agricultural landscapes); reconstruction of existing experiments with the requirements of the time;

- Developing ways of dealing with allelopathic soil exhausting when saturation at specialized crop rotations with cultures those are close in biological characteristics. For crops with long return period of the previous growing place in the rotation– agricultural methods development for its reduction are needed. Learning of means to overcome incompatibility and self incompatibility of some main crops of rotation (ear-forming cereals, pulses, oilseeds, etc.) in recurrent crops. Specialization of rotations with short duration due to crops sensitive for this factor requires the development and application of countervailing measures to improve the phytosanitary condition of the soil and crops;

- Deepening the study of systems of crop rotation and farming in multifactor experiments determining influence of the intensification of crop rotation (the use of different methods of cultivation, doses of fertilizers, growth regulators, herbicides, pesticides, fungicides) on the productivity of certain crops and crop rotation as a whole;

- Increasing researches to develop rotations for alternative agriculture based on the principles of biologization (use of organic fertilizers and non-tradables production on fertilizer efficiency green manure, legumes and role of intermediate crops due to the increasing requirements for organic farming under different fertilization systems and cultivation in crop rotation);

- Deepening the study of energy-saving environmental crop rotations with different saturation of individual crops on soils of ecological and

technological groups of lands at Polyssya, Forest-steppe and Steppe to the development of this direction of rotation;

- Continuation of the study of a new type of crop rotations with different duration – maize-legumes, including maize-soybean and maize-alfalfa rotations;

- Summarizing the results of research to develop models and automated management by structures of sown areas, the basic principles of set and crop interchanging and their technological processes in the rotations, to create computerized data banks;

- Initiating a problem to the Ministry of Agriculture and Food of Ukraine to restore the state of development of statistical accounting rotation of all categories (Form 17) and recovery “Books fields of history.”

Conclusions.

1. In modern agriculture the leading factor in high productivity is the rotation of crops. High-effective crop rotations are those with different duration – 3-4-5-fields and with long rotation – 6-10 fields rotations their types and crop properly structured acreage and scientifically grounded ratio and placement. Theoretically and practically proved is the fact that with a decrease in the length of rotation, especially at simplified the 2-3 fields crop rotation, productivity of arable land use reduced.

2. Given the scientific potential problems with crop rotation, which has been preserved as a result of years of research in different soil-ecological zones of Ukraine, there is an opportunity to expand and deepen the scientific rationale and methodology for optimizing the structure of crop rotations with different duration to increase their productivity, conservation and restoration of soil fertility, improving its phytosanitary state and agrophytocenoses in agricultural landscapes. Strengthening of innovation into industrial production plays an important role and contribute to obtaining competitive agricultural and livestock farming production through a combination of crop and livestock sectors.

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Розглянуто стратегію розроблення й інновації різноротаційних сівозмін, обґрунтовано відповідну структуру посівних площ з урахуванням ґрунтово-кліматичних умов та спеціалізації господарств України. Наведено окремі ефективні принципові схеми сівозмін різної ротації, що відповідають сучасним системам землеробства і запроваджуються в господарствах, які стали найефективнішими за показниками виробництва. Визначено перспективи подальших досліджень у напрямі поглиблення основ розроблення сівозмін.

Ключові слова: сучасні системи землеробства, різноротаційні сівозміни, структура посівних площ, чергування культур, різне насичення, інновації, форми господарювання.

Рассмотрено стратегию разработки и инновации разноротационных севооборотов, обосновано соответствующую структуру посевных площадей с учетом почвенно-климатических условий и специализации хозяйств Украины. Приведены некоторые эффективные принципиальные схемы севооборотов различных ротаций, соответствующих современным системам земледелия и внедряемых в хозяйствах, которые стали наиболее эффективными по всем производственным показателям. Определено перспективы дальнейших исследований, дано предложение по улучшению форм хозяйственной деятельности.

Ключевые слова: современные системы земледелия, разноротационные севообороты, структура посевных площадей, чередование культур, разное насыщение, инновации, формы хозяйствования.

The strategy of development and innovation of crop rotations with different durations, the satisfying structure of sown areas regarding soil and climatic conditions and farms specialization in Ukraine are examined. There are shown some effective principle crop rotation schemes of different duration met the modern agricultural systems and introduced in the farms which had achieved the most effective productive parameters. The prospects of further studies are determined on the direction of deepening the researches of crop rotations development.

Keywords: modern farming systems, crop rotations with different durations, structure acreage, crop rotation, different saturation, innovation, forms of management.

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