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PROBLEMS AND WAYS OF MODERN AGRICULTURAL PRODUCTION

Досліджено інтенсивні технології вирощування сільськогосподарських культур, перспективи та шляхи їх удосконалення, зниження антропогенного тиску на довкілля. Обгрунтовано шляхи компенсації негативних змін на орних землях: застосування систем накопичення, збереження і раціонального використання прісної води, формування сприятливого мікроклімату в регіонах, досягнення балансу органічних речовин в орному шарі, розширення видової різноманітності культурних рослин і формування багатовидових агроценозів, впровадження систем уникнення індукування у культурних рослин дисстресів різної природи, підвищення рівня екологічної безпеки систем захисту посівів від шкідливих організмів, збереження видової різноманітності довкілля.

Ключові слова: аграрне виробництво, інтенсивні технології вирощування, екологія, фактори життя рослин.

Technological progress is changing all aspects of life and production activities of man. Improvement of energy-intensive and labor intensive and polluting technologies in metallurgy, chemical industry and power engineering allows to reduce labor costs and anthropic pressure on the environment.

Agricultural production is a unique sphere of material production. The uniqueness lies in the fact that it cannot be replaced by any other activity. The population of the planet has already exceeded 7.4 billion people every day requires food. Without food security in any country is dependent on the sources of its receipt. At the same time, the profitability of the agricultural production has traditionally been inferior to other spheres of activity and is little attractive for investment. Agricultural production is not a classic manufacturing, where quick turnover of capital and high profitability, based on agricultural production the natural biological cycles of plant life, which created the wise nature [1].

The second uniqueness of agricultural production is the need to use large areas of land and grow crops under the open sky. Agricultural production is inextricably linked to climate and weather features of each year during the growing season of crops [2]. Every year, the need for food increase. This can be explained by population growth and the desire to improve the level of nutrition of people.

The basis of crop production is the production of grain. Weevil combines all that is necessary for human nutrition: high energy concentration and balance of nutrients, small volume, convenience and long shelf life [3].

Most grain is grown in three countries: USA, China, India. Their aggregate share in world production is 50 %. From 2.3 to 3.4 % of the world's total grain production provide fields of France, Germany, Russia, Canada, Brazil, Ukraine, Australia and Argentina [4].

Among the crops on the first place in gross collections is wheat is the main food crop of the planet. Very similar results in maize and rice. Per capita all grow wheat in Canada, Australia, France and Argentina [5].

However, not only the grain is the purpose of agricultural production. Fruit, berry, vegetable, technical, fodder, ornamental, medicinal and other crops grown on their fields and plantations of modern farmers.

The progress of science in the areas of molecular genetics, biotechnology, plant breeding, biochemistry, physiology of plants, all agronomy majors allows you to give to farmers new and better and more productive hybrids and varieties and technologies of their cultivation [6]. Modern agricultural production makes extensive use of intensive technology of cultivation of crops, providing the 15-17 t/ha of maize, 10-12 t/ha of wheat, 10-11 t/ha of rice and other [7].

It seems we are on the right direction in the future. However, even is not a complete objective analysis of the situation reveals a number of disturbing trends, which after a certain period of time turn into difficult problems that will be very difficult to solve.

Intensive growing techniques involve extensive use of modern hybrids, fertilizers and means of chemical protection [8].

Without creating a high level of effective fertility is not possible to realize the high potential of biological productivity of the modern seed crops. For example, to get 10 tons of wheat absorption by plants must be at least 350 kg of nitrogen compounds, phosphorus compounds 135 kg, 260 kg of potassium compounds. If we consider the coefficients of the assimilation by plants of mineral compounds from the soil, these values should be considerably higher, especially compounds of phosphorus [9].

At the same time, it is known that in intensive technology, the cost of mineral fertilizers is about 40 % of the cost of the whole technology of growing crops. The effectiveness of mineral fertilizers in different countries speak such facts. The increase of grain yield per 1 kg of nitrogen compounds (according to FAO) is: in Germany is 20.3 kg, France – 21.2 kg, UK – 24.3 kg, Ukraine – 11.1 kg [10]. Figures indicate the level of effectiveness of the agrochemical activities of farmers in our country.

The last decade almost every year is marked by processes of "flowering" of water in the river, ponds and small rivers. Eutrophic eutrophication is a consequence of excessive and irrational use of mineral fertilizers on arable lands [11]. This is all the visible part of the problem. Invisible requires a more detailed analysis that is beyond the scope of a review article.

A logical question arises: how to get larger crops without significant adverse environmental impact. On the formation of the crop requires a significant amount of available connections of mineral nutrition, but how can you keep them in an accessible form in the arable layer of soil without the risk of denitrification and leaching? The technocratic solution offered by modern intensive technologies clearly leads in environmental impasse. In the pursuit of yield and food of mankind unconsciously, destroys the environment, including itself [12]. It turns out that the pragmatic and applied understanding of the problem is false? Then which way we need to move and how to combine large gross harvest and preservation of a healthy environment, including the health and future of ourselves?

The problem is complex and multifaceted. Let's try to summarize them and to approach the main points of their solution.

The elements of the problem. *Climate.* Climate change today is a fact requiring no proof. According to the calculations of William Kellogg National center for the study of the atmosphere (USA) temperature at the poles will increase in the coming decades is 3-5 times faster compared to other territories in the world. Significant climate change will be a reality for raising the temperature by only 1.5°. The temperature increase of even 1.0 OS can lead to significant economic losses. For example, a reduction of 11 % of grain production in the United States. The warming process will most likely take more than 1000 years [13].

George Voguel – head of the research Center for ecosystems Buchalski laboratory of marine biology (USA) proves: "Since 1850, as a result of human activities, carbon dioxide (CO^2) in the atmosphere has increased from 270 particles/million to 330 particles per million Of which 25 % is the growth of the last decade. Exploring gas out of ice samples in the Laboratory of glaciology and Geophysics (France) scientists convincingly proved that 15 thousand years ago (a glacial period), the CO^2 content in the atmosphere was 0,016 %, in a modern atmosphere already – 0,033% [14].

Soil. By the mid-21 st century humanity will complete the development of all suitable for cultivation of agricultural plants territories. More than half of the potentially usable space is situated in Africa. At the same time every year as a result of human activity: erosion, salination, the construction of cities and industrial objects, etc. from agricultural use is withdrawn from 14.0 to 16.0 million hectares of land. That is, over the next decades, expansion of arable land on the planet will be completely exhausted. The conversion of all the world's land area into arable land is impossible because of the danger of the complete loss of ability to maintain the biological balance of the biosphere.

Greater danger is posed by various forms of erosion. How such processes threat, says such a fact. Proven in the past to arable land in Central America (e.g. Guatemala), even in 1000 years stay in as the fallow (the people left devastated their territory) and have not restored your fertility [15]. Accordingly, we need to host on arable land and intensively and at the same time environmentally and carefully.

More than 120 million years ago (Jurassic period of the Mesozoic era) appeared first plants angiosperms division – Angiospermae. The modern fauna includes more than 240 thousand species of angiosperms. Of these, more than 80 thousand species are edible [16]. As modern man uses this vegetable wealth? The reader can make an assessment.

Almost 90 % of the total food that it consumes humanity, provides a total of 20 species of plants. Intense technology of cultivation and breeding work is carried out with 100 species of plants. All other edible plants man uses only partially, mainly at the local level. Most of them don't even comprehensively investigated [17]. That is, species richness of edible plants on the planet you can imagine in the form of an inverted pyramid standing on its top. This situation is very unstable. Any planetary apphoto one of the 20 most important agricultural plant species is potentially dangerous to humanity, it will be wheat, rice, corn, soybeans, sugar cane, peanuts.

Accordingly, the introduction into practical use of new food crops will not only reduce the risks of food security of the population, but will more fully and comprehensively use of arable land and the flow of the energy of the Sun Lights to grow food. Temperate zone contains many potentially suitable for the process of domestification promising edible species of plants [18]. Just such an important issue today, we have no one develops.

A particularly promising increase in species diversity of agricultural plants may be issues that will be discussed further.

Modern agriculture in our country, unfortunately, still far from perfect. Understandable is the desire of farmers annually to obtain maximum possible profit from each hectare of arable land. However, from a purely pragmatic perspective leads to a dead end. The laws of agricultural science are objective and do not depend on market or profit margin. Fortunately, they operate independently from the desires of the landowners, the mountain tenants. Recall one of these laws – the "law of return". In 1840 Eustace.

Liebig formulated: "Give the soil what you took from him with the harvest, or don't count in the future to get the same as before".

Unfortunately, the balance of nutrients arable land of our country can not speak. There is a disturbing fact, over the past 20 years the content of humus in arable lands in the national average decreased from 3.55 % to 3.0 %, i.e. 0.55 %. Soils are not only poorer, significantly worsening their agronomic characteristics. This process will be accelerated for the preservation of the acute shortage of organic matter, energy and organic carbon that should regularly do in the arable layer of soil. Adequate return made with the harvest of organic compounds and mineralized humus in the soil is not [19, 20].

On what basis will build their plans for revenue growth economists and managers of agricultural holdings, if they ignore the basis of agricultural production, the fertility of arable land?

Water. One of the essential factors in the successful management of agricultural production is a normal provision of crops with moisture. Increasing the level of productivity and requires adequate increase of water consumption by plants of agricultural crops. However, according to the changes of climate and of fluctuations in weather every year water balance on arable lands is becoming more intense.

The increase in annual precipitation across the country ranges from 50 to 100 mm. However, there is an increase in the quantity of heat that enters and is generated on site. Indicators albedo areas, which are deprived of well developed vegetation (especially in the first half of the warm period) is always less compared to meadows, pastures or forest. That is, it is human activity that contributes to the generation of heat (infrared radiation transformed solar energy) in regions with a high degree of tilled soil. The increased amount of heat leads to increased evaporation of water from the topsoil. In combination with the increase in periods between rainfall, mostly torrential character, the situation with the provision of water on crops is complicated [21].

To mitigate the situation, it is desirable to have large reserves of moisture in the soil, but they are only possible subject to the availability of significant quantities of humus. The decrease of humus content, the ability to retain moisture decreases, accordingly, even in the zone of sufficient moisture, the crops of cultivated plants in recent years are experiencing periodic moisture deficit during the growing season. Such conditions negatively impact their productivity. So, the circle closes. Even the increasing application of mineral fertilizers does not ensure adequate growth level of yield for water deficit.

Without solving the problem of optimization of the water regime of crops to plan for higher and more stable yields no sense. To compensate for a shortage of replacement hybrids on new inefficient. The concentration of commercially attractive crops: sunflower, corn, soy and other without considering the water balance in the soil does not provide financial expectations. Plants are called crops require substantial amounts of available moisture and have a high transpiration factors and require a lot of moisture in the middle and second half of the growing season, when traditionally the least amount of precipitation [22].

The water problem is complex and solving it a quick-time event is impossible. Modern farmers overwhelmingly psychologically and economically ready for long-term work on arable land to improve their water regime.

Air. It seems what problems can be at the farmers air, because we all live on the bottom of the ocean air called the atmosphere. However, the problem is real. First question is about the compliance of the air parameters for successful vegetation in crops of cultivated plants. Most plants that people grow for their own needs is mesopotami. Accordingly, the parameters of temperature, relative humidity, and force of air flow must be optimal for vegetation of cultural plants. For most crops the optimum air speed in the surface layer should be in the range of 1.5-2.0 m/sec. A more rapid flow of air significantly increases the performance of transpiration of plants and evaporation of moisture x soil.

Loss of moisture from the topsoil at a temperature of 28…30 ^{o}C and relative humidity of 35-50 % and a wind speed about 4-6m/sec. be 6-9 mm per day [21]. For how many days the water agronomically valuable rain in 30 mm will be completely lost by the soil and planting the reader can calculate independently.

What is real today in our country over the past quarter century done to ensure that violent winds blew the top layer of soil with sown seeds (a form of erosion – deflation) and did not take scarce water from arable land in an area of nearly 32 million hectares? Such a simple question, the majority of owners, tenants and large and small state chiefs reasoned answer is no.

Windbreaks, which actually remained without a master, the locals doubout for firewood. On boarding of new plantings and care of existing of the question. It's not fashionable, because it brings quick money into private pockets. Our country, unfortunately, not China, which at the time was under forest, with 5.2 % of the territory, and today is 13.8 %, and in the future will be not less than 30 %.

But only domestic forestry, the only one in Europe selling on the export of timber. This is assuming that in Europe the level of afforestation 30-33 % of the territory and more (they protect it, planted and cared for), and we have about 16 % and it is mainly young forest (Mature barely 4 %). The woods and meadows not know drought is a well – known agronomic axiom. How we protect arable land from dry hot winds and the negative impact of water deficit for crops without a clear and reasonable state policy in the forestry reclamation?

There is another way. This is the way of irrigation. However, the situation globally and in the domestic is not easy. Traditional irrigation in most countries is limited primarily by the shortage of quality fresh water. Irrigation apresentou sea water with the use of traditional energy sources (gas, oil, coal, nuclear fuel, etc.) is very expensive. The use of solar energy has not yet reached such a level of perfection to be competitive.

Our country occupies the last place in Europe in terms of providing water to the population. Domestic surface water we have all been contaminated by the activities of man himself. We have no clean high-quality surface drinking water. Have the chance to expand the areas of irrigated lands, especially the use of rational methods of irrigation (especially drip). However, it is not so simple. Domestic production of machinery and equipment for drip irrigation is practically destroyed. Foreign cars are very high speculative prices. However, to ensure irrigation of the entire area of the Steppe (that is, more than 16 million hectares of arable land) is unrealistic. Restored the irrigation of an area of less than 1 million/ha. For irrigation only in the Steppe we just don't have as much good quality water. Therefore, the main attention is rational to focus on improving the water regime of arable land without irrigation.

Energy. The largest source of energy on the planet is the Sun. Therefore, it is the ability to collect and efficiently use the energy of sunlight is the main task of physicists – engineers and agronomists – Agrar.

Modern crops of cultivated plants subsist thanks to the implementation of space role: absorption of incident flux energy Lamps (sunlight spectrum with a wavelength from 380 to 710 н.m).and use it for the needs of photosynthesis. Analysis of the efficiency of modern crops falling stream of energy of Headlights the Sun proves their imperfection. For example, the sowing of peas absorb the falling stream of energy of Headlights full enough (60-80 %) only in the 34-36 % of the time your growing season. The rest of the period, the losses incident flux of solar energy by crops ranges from 40 to 97 %. The crops of corn or sugar beets the period of a complete absorption of the incident energy flow of the Headlights of up to 60-65 % of the period of their vegetation. However, energy loss, particularly in the initial period of growth, is also very high. Skipped by plants of far energy reaches the soil surface and is the source of life of the weed competitors.

The logical question is: how to ensure maximum use of the energy flow of the world cultural plants and not weeds? In mono-species crops such a result is impossible to achieve. Nature, unlike man, does not form the same species of plant. Natural multi-species plant communities, species in the process of joint vegetation mutually adjusted their biology and vegetate in accordance with the requirements of the biological stage. This allows you to maximize the use of available factors of life in the first place the falling stream of energy of Headlights during the whole warm period of the year and to ensure maximum biological productivity per unit land area. The fundamental scientific objection to the formation of a multi-view agrocenosis of cultivated plants on arable land no. Except for certain complications of the process of harvest, and other biological issues can be successfully addressed in the research process.

Ancient systems of farming in the tropics and prove the feasibility of high biological productivity such as the multiple combinations of cultivated plants in some crops. Their development for moderate climatic zones – the question of the future. In more detail the methodology for the formation of such multi-view systems are disclosed in the monograph by A. A. Ivashchenko "energy from the Sun and weeds" [23].

Modern intensive technology of cultivation of agricultural crops required element include the use of a reliable chemical protection from pests. Chemical load on arable land for intensive technologies of cultivation of agricultural crops is traditionally high. For example, the sugar beet herbicides only contribute 5 to 12 l/ha. And there is application of fungicides, insecticides. A total of hectares of crops during the growing season goes from 15 to 19 kg/ha of pesticides [24].

The control of other types". However, this biological approach to the protection of crops requires deep research and development of each of the harmful object. There is another way. The main method of application of pesticides on crops there are different versions of the application. In addition to appropriate advantages of this application method is very inefficient. For example, as a result of spraying the seedlings of sugar beet (cotyledon plants) insecticides against beet weevil (at a high number – more than 3-4 beetles/m^2) the targets of the plant culture will be applied only 0.02 % of the volume of the working fluid. The rest of the working fluid with insecticide – 99,98 % of the volume applied to the soil surface, i.e. in addition to the destruction of useful fauna entomo insecticide only pollute the environment.

Development of ecological methods of applying pesticides on targets of the plant will allow dozens of times to reduce chemical load and to provide the necessary level of protection of crops. That is, new methods of applying chemical method of protecting crops of pests may get a new "breath" and environmental application.

Modern science is now a very large volume of facts and results of studies of crop rotation, systems of basic soil treatment, fertilizer application, evaluation of different varieties and hybrids, and more. However, how such information may be used for the process of optimization of technologies of cultivation of agricultural crops? The question is not rhetorical. Because such research is not considered primary subject – crops and the nature of its requirements to the factors of life.

At the time, Professor K. A. Timiryazev said: "The Scientific basis for the rational management of agricultural production is plant physiology". In our country, the physiology of plants is no longer a priority area of research, as the subtleties of the evaluation of the specificity of the needs of plants in mineral compounds, food or water consumption at various stages of organogenesis hard tomorrow to turn in the money. The research is fundamental. Who today, the country is deeply and comprehensively examines problems for example, the specific water consumption of different types of cultivated plants at the stages of ontogenesis and develops a rational way to compensate for water stress? Unfortunately, such scientific works of domestic authors are unknown. This is assuming increasing relevance of the scarcity of fresh water in the country.

Climate change today is a global phenomenon. Only in the last Quaternary period (about a million years ago), Europe has experienced six of cooling and warming which were named in order of occurrence: barske, the Danube, guntsche, mendelski, Riske, and wormlike. If after the end of the last glaciation was held 15-18 thousand years, the period of warming between Riskin and wurmskin sladen lasted 60 thousand years, and between Mendelson and Riskin almost 150 thousand years. Warming periods were significantly longer compared with those in which we live. Only 8500 years ago, Scandinavia was freed from the glacier.

Significant warming has occurred 5800-5500 B. E. Serenic temperature in Europe was in the 2.5…4.0 ^{o}C higher than at present. Late warm cycle lasted from 3 thousand to n. e to the 500r. B. E. comparison of the current warming period indicates that the phase of development of natural vegetation on the continent currently is a late part of the cycle. Time to change the direction of the cycle the cold take a few thousand years [13].

Mankind has survived in the past era, survive today. New conditions put before a science task to correctly navigate the tendencies of climate change and to have the appropriate scientific techniques and reasoned, specific responses to changing environmental conditions.

On the agenda today are issues of adaptation of agricultural production to increase the amount of heat and increasing water scarcity in the fields, to the ability to mitigate natural fluctuations and determine a more optimal climate in the regions, to receive the guaranteed high yields of the required products now and in the distant future.

For this we all need good will, public policy, the leading role of science in society, intellect, creative approach to problem solving, the ability and desire to benefit their land and people.

Conclusions. 1. Modern intensive technology of cultivation of agricultural crops provide high yields and at the same time showing a strong negative impact on the environment and the person.

2. Intensive growing technology enhance the process of soil erosion, the inhibition of the microbiological activity of arable layer, mineralization of humus, decreased species diversity of nature and the loss of the ability of the environment to maintain balance and compensate for the destructive human activities.

3. Global climate change hinder the management of agricultural production as a result of growth of the shortage of quality fresh water, the growing influence of dry winds, high temperatures, degradation of arable land, depletion of species diversity of the environment.

4. Compensation of negative changes is possible by applying the system of accumulation, conservation and sustainable use of fresh water, creating a favorable microclimate in the regions of balance of organic substances in the topsoil, the expansion of the species diversity of cultivated plants and the formation of multi-species agriculture, the implementation of systems to avoid induction of the cultivated plants of the dis – stress of different nature, raising the level of environmental security systems to protect crops from pests, preserve species diversity of the environment.

5. Agricultural production is an indispensable form of human activity, so the future of the person depends primarily on its level of knowledge, understanding and skills of a person to predict and to adjust their relations and needs with the capabilities of mother nature.

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Проблемы и пути современного аграрного производства

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Исследованы интенсивные технологии выращивания сельскохозяйственных культур, перспективы и пути их усовершенствования, снижение антропогенного давления на окружающую среду. Обоснованы пути компенсации негативных изменений на пахотных землях: применение систем накопления, хранения и рационального использования пресной воды, формирование благоприятного микроклимата в регионах, достижение баланса органических веществ в пахотном слое, расширение видового разнообразия культурных растений и формирования многовидовых агроценозов, внедрение систем предотвращения индуцирования у культурных растений дисстреса различной природы, повышение уровня экологической безопасности систем защиты посевов от вредных организмов, сохранение видового разнообразия окружающей среды.

Ключевые слова: аграрное производство, интенсивные технологии возделывания, экология, факторы жизни растений.

Problems and ways of modern agricultural production

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It was to evaluate the modern intensive technologies of cultivation of agricultural crops and the prospects and ways of their improvement, the reduction of the anthropic pressure on the environment. This is shown ways of compensation of negative changes on arable land: is possible by applying the system of accumulation, conservation and sustainable use of fresh water, creating a favorable microclimate in the regions of balance of organic substances in the topsoil, the expansion of the species diversity of cultivated plants and the formation of multi-species agriculture, the implementation of systems to avoid induction of the cultivated plants of the disstress of different nature, raising the level of environmental security systems to protect crops from pests, preserve species diversity of the environment.

Key words: agricultural production, intensive cultivation technology, environment, factors of life of plants.

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