

THE DEVELOPMENT AND INTRODUCTION OF HIGHLY ADAPTIVE AND WATER-RESOURCE-SAVING TECHNOLOGIES OF CULTIVATION OF AGRICULTURAL CROPS IN EXTREME DROUGHT CONDITIONS

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Abstract: *The method of crop cultivation by moisture-accumulating, water saving and energy-saving technology in the areas of insufficient humidity and wind erosion, includes the basis of zero tillage technology - direct seeding on crop residues with minimal disturbance to the soil structure. The proposed method starts with harvesting of the grain yield by stripping, where straw standing is used as a crop residue, which will contribute to the accumulation of more snow on fields compared with traditional methods; sowing is carried out with the simultaneous application of fertilizers through drills with turbo-drive or any other seeders.*

KEYWORDS: *CULTIVATION METHOD, HARVESTING BY STRIPPING, SOWING WITH FERTILIZERS.*

INTRODUCTION

Kazakhstan's climatic and soil conditions are characterized by significant diversity. Existing farming systems, applied to crops mainly include agriculture on non-irrigated land with predominant cultivation of spring crops. The overwhelming majority of the area of cultivation of major cereals, especially of wheat falls to the unfavorable conditions of sharply continental climate in Kazakhstan, whose territory is exposed to wind and water erosion. Drought and salinity problems are becoming more acute. Throughout the region, there was a significant decrease in soil fertility. The content of humus in topsoil decreased significantly, infestation of grain crops was increased. Moisture deficit in the soil has been and remains one of the most urgent problems of the country's agriculture. It becomes obvious that under these circumstances improvement in crop sector is to be achieved primarily through the use of moisture-, soil-, energy-, resource -saving and Environmentally-friendly farming systems. This system of conservation agriculture is currently the key lever for the survival of farmers engaged in crop production and, above all, the main export crop of Kazakhstan - wheat.

Under the conditions of rain fed agriculture, this technology will significantly increase the fertility of the soil, due to the higher control of wind and water erosion, improve soil's ability to hold water and increase its organic matter content. Reserves of high stubble in fields delay and accumulate more snow; pulverized and scattered chaff through biological degradation improves the structure and quality of soil. All these processes contribute to the accumulation of moisture in the soil, which is essential for sustainable wheat production in rain fed regions.

The developed method significantly reduces the number of processing operations on soil, reduces manufacturing costs. This method fits well in a low-cost system of agriculture. Besides, these technologies allow farmers timely perform the sowing and harvesting campaigns, the timing of which depends significantly on the grain harvest in the region.

Worldwide, only 4% of the land is suitable for tillage [1]. These lands are located in a relatively small number of countries, and Kazakhstan appears to be one of them. Possession of these lands does not only increase their importance and increase people's income working there. It is also a great responsibility in front of the humanity for its food security. Food and Agriculture Organization of the United Nations also pays much attention to the development of agriculture in Kazakhstan. Given that the world's population is increasing, there is only one way to feed more people - an increase in agricultural productivity. This, along with the export of oil, is one of the most practical ways of the Kazakhstan's economy growth. In order to ensure food security in extreme drought conditions, we propose the introduction of highly adaptive and water-resource-saving technologies of cultivation of agricultural crops, which includes the principal elements of zero tillage technology.

PREREQUISITES AND MEANS FOR SOLVING THE PROBLEM

Application of zero technology can and should increase productivity in harsh climatic conditions of Kazakhstan. There are several climatic zones in Kazakhstan, so application of this technology will be different in different oblasts, and even different rayons. The concept of zero-technology states that constant plowing and soil cultivation disrupt its natural structure and turning layers accelerates evaporation. At the same time, preserving the land untouched keeps in safety the channels for transportation of nutrients, moisture and living organisms. Zero technology welcomes the abandonment of high stubble in the field. In winter, it helps apprehend more snow, which permeates the soil in spring. In spring and especially in the summer it covers young shoots from the scorching sun and limits evaporation.

Under conditions where the amount of moisture in the soil is limited and rainfall is unpredictable or predicted with difficulty, it is important to make the most of that moisture that remains in the ground after the snow melts. The same applies to the nutrients - their number is limited. If the seeding rate is too low, we lose in crop yield. If it's too high - we lose in grain condition. There are no unique recommended numbers of seeding rates, this figure is individual for each farm and each individual field - empirical [2].

SOLUTION OF THE EXAMINED PROBLEM

The technical result of the proposed innovative technology with the patent number KZ №28388 consists in cultivating crops in a new way, better seen in arid and wind erosion zones [3,4]. Crop cultivation by moisture-accumulating, water saving and energy-saving technology includes elements of zero tillage technology - that is direct sowing of crop residues with minimal disturbance to the soil structure. Our proposed method starts with harvesting of the grain yield by stripping, where straw standing is used as a crop residue, which will contribute to the accumulation of more snow on fields compared with traditional methods. Spring sowing is carried out with the simultaneous application of fertilizers through drills with turbo-drive or any other seeders. Pre-sowing or post-emergence treatment of herbicides or pesticides is carried out by any sprayers.

RESULTS AND DISCUSSION

The method of crop cultivation is implemented in the following sequence:

1. Harvesting of crops by reaper "OZONE" leaving the standing tailings of the harvest in full growth to accumulate and retain moisture;
2. Pre-sowing herbicide treatment of the field;
3. Planting seeds simultaneously with fertilizers by disc seeders or by any other sowing machines, soil compaction and fertilizer application;

4. If necessary, especially in wet years, post-emergence herbicide (pesticide) treatment of fields.

Abandoned standing stems form a soil protection coating, resist wind and water erosion, provide greater accumulation and retention of moisture, prevent weed growth, contribute to enhanced soil micro flora, and are the basis for the resumption of the fertile layer and crop improvement. Application of the proposed method of cultivation of agricultural crops can increase soil moisture reserves, increase grain yield and quality.

Production of food crops in Kazakhstan is carried out mainly by traditional technologies, but by using the proposed method of cultivation there may be a significant cost reduction that will lead to competitive grain production in Kazakhstan.

The proposed technology is necessary not only to stop the destruction of the environment, but also is fully capable to provide an opportunity to strengthen, due to lower prices of products, the competitive position in the export market. Using the proposed method allows to reduce significantly the number of agro-technical works in the technology of crop cultivation, which significantly affects the agro-physical properties of soil and farm economy. The method provides for one hectare of arable land: labor savings, cost savings of machine exploitation, saving fuel and reducing the time of fieldwork. Consequently, the application of the proposed method can provide a significant increase in the household income.

The innovative technology of grain harvesting standing plants using the reaper "Ozone" has been tested in the harvesting campaign in 2012 in an area of 93 hectares on the farm "Terekty" of Kokpektinsky district in the East Kazakhstan region during harvesting of spring wheat varieties of "Omsk-18" (figure 1).



In the winter, on a monthly basis, on the 10-12th day of each month, the height of the accumulated snow was measured in two fields (93 ha and 101 ha) of the same array, where the 93 ha field was harvested with the innovative technology and the 101 ha field was harvested by traditional method. Measurements were taken along the diagonal of fields every 50 meters in 20 points of each field.

Thus, harvesting by stripping method allowed accumulating on the 93 ha field 49% more snow throughout the winter than on the 101 ha field in the traditional way. Additional 64-43 = 21 cm of snow is equivalent to an increase annual precipitation to 10-17%. Accumulated snow, which was then transferred into water, provided better germination in 2013 on the 92 ha field (with a yield being 3-4 centners per ha more and equaling to 18 centners per ha) compared to the 101 ha field.

Calculations that were done after the trials on the Farm "Terekty" showed that a simultaneous transition to water-saving technologies of soil management and harvesting of grain crops significantly improves the economic indices of crop production in farms. Thus, the need for a tractor power can be reduced by 34%, and combine harvesters - by 40%. At the same time, the need for machine operators can be reduced by almost 30%, while reducing total labor costs for the full range of mechanized operations - by

15%. Reducing energy intensity of basic fieldwork on crop management and harvesting of grain will reduce overall fuel consumption by 20% (32 kg / ha). The total cost of machinery stock required for the full range of mechanized operations in field can be reduced by more than 20%, and the amount of direct operating costs (without deductions for renovation) – by 13%.

The transition to stripping technology can significantly reduce the cost of grain production in the region. The revenue from the implemented technology per 1 hectare of sown area is predicted to be equal to 8 475 tenge per hectare. According to the Regional Statistics of the East Kazakhstan, there are around **543 120 hectares** of planted crops, thus, the economic impact from implementing the stripping technology will be around **4 602 874 thousand tenges**.

Currently, the share of direct operating costs in the cost of crop production is unreasonably high and varies for different crops from 49 to 72%. The most resource-intensive work is mechanized tillage and harvesting of grain crops. In the overall complexity of labor expenditure tillage accounts for 16 to 37%, depending on the type of grain, fuel consumption - 32 to 54%; cleaning accounts to 42% of the cost of living labor, and up to 35% is used for fuel consumption, oil and lubricants. This proves the priority of improving the techniques and technologies tillage and harvesting of crops. In addition, the transition to the new technology will increase in dry years the yield of grain and tilled crops by at least 10-15%.

Conclusion

Application of zero technology can and should increase productivity in harsh climatic conditions of Kazakhstan. There are several climatic zones in Kazakhstan, so application of this technology will be different in different oblasts, and even different rayons. The concept of zero-technology states that constant plowing and soil cultivation disrupt its natural structure and turning layers accelerates evaporation. At the same time, preserving the land untouched keeps in safety the channels for transportation of nutrients, moisture and living organisms.

Data analysis results of studies of the proposed technology allow assessing their cost-effectiveness and relevance. The revenue from the implemented technology per 1 hectare of sown area is predicted to be equal to 8 475 tenge per hectare. Application of the proposed method of cultivation of agricultural crops can increase soil moisture reserves, increase productivity and provide significant cost savings, which will lead to the competitiveness of grain production in Kazakhstan. The proposed innovation "The cultivation method of agricultural crops" contributes to a change in agricultural practices for: **soil improvement – increased yield – increased profits**.

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