# DEPENDENCE OF WINTER WHEAT GRAIN YIELD ON THE METHOD OF TILLAGE AND CULTIVATION TECHNOLOGY IN THE CONDITIONS OF SOUTHERN KAZAKHSTAN

**Turebayeva Sagadat**

PhD student, Kazakh National Agrarian Research University, Republic of Kazakhstan, Almaty

**Zhapparova Aigul**

Professor, Kazakh National Agrarian Research University Republic of Kazakhstan, Almaty

**Bimurza Z.**

Master student, Kazakh National Agrarian Research University, Republic of Kazakhstan, Almaty

**Balgabaev A.**

Candidate of agricultural sciences, professor, Kazakh National Agrarian Research University, Republic of Kazakhstan, Almaty

**Salykova A.**

Candidate of agricultural sciences, professor, Kazakh National Agrarian Research University, Republic of Kazakhstan, Almaty

**Abstract.** The article presents the results of scientific research for 2019-2020 in the bogharic conditions of South Kazakhstan. It was found that the highest yield of winter wheat grain (37.7 q/ha) on average over two years of research was formed on the treatment with simultaneous application of phosphorus fertilizers at the rate of $P_{45}$ kg/ha with direct sowing and feeding with nitrogen fertilizer at the rate of $N_{70}$ kg /ha in early spring periods in the tillering phase of winter wheat, that is, the grain yield increased 2.9 times in comparison with the background without fertilizers. Optimization of the phosphate regime of winter wheat with the nitrogen fertilizers during the period of their greatest need in the tillering phase will balance nutrition. During the laying of productive organs in the phase of booting, stalking and formation of winter wheat grain, the reserves of productive moisture were good and fully satisfied the need of winter wheat for moisture during the indicated growing periods of plants, as a result, a consistently high yield of winter wheat grain was formed for rainfed conditions in the south of Kazakhstan.

**Keywords:** direct sowing, mineral fertilizers, micronutrients, growth stimulant, moisture reserves, weeds, herbicide.

**Introduction.** In the south of Kazakhstan, the main limiting factor of agricultural crops is soil moisture, since during the growing season there is an insufficient amount of atmospheric precipitation, and the moisture reserve in the soil due to autumn-winter precipitation does not satisfy the water demand of crops.

"The reserve of soil moisture for obtaining a high yield - as noted by K.A. Timiryazev [1] under our climatic conditions, with our frequent droughts, should be the subject of our concerns, perhaps

even more significant than the supply of nutrients". At the same time, soil moisture during the growing season plays a certain role for the formation of productive elements of plant productivity.

It is known that one of the main limiting factors regulating the productivity of grain crops is the presence of plant nutrition in the soil. The cultivation of intensive varieties of cereals is characterized by increased requirements for the conditions of mineral nutrition and only with a full and balanced supply of nutrients is it able to form a high yield.

Agriculture of the Turkestan region (South Kazakhstan) is traditionally dominated by medium and small farms. The basis of agricultural production is irrigated agriculture. The bulk of the land has been privatized - it is owned mainly by agricultural enterprises and individual farms, several agricultural cooperatives, joint-stock companies, limited liability partnership, as well as a number of state-owned enterprises. Water scarcity remains one of the most important problems for irrigated agriculture in South Kazakhstan oblast. This area, with its low groundwater levels and saline soils, requires water-saving technologies and efficient irrigation systems to grow a variety of crops. Currently, cereals such as winter wheat and winter barley are continuously cultivated. In most cases, irrigation of fields under wheat and barley is carried out by flooding, which as a result causes the death of a significant part of the crop due to the high mineralization of groundwater and the formation of a crust on the soil. No-till is an effective alternative to reduce the effects of salinity.

An important reserve for increasing the efficiency of the technology of cultivation of agricultural crops is the optimization of conditions for plant nutrition. Many works are devoted to the use of fertilizers and the search for ways of their effectiveness. However, in the south of Kazakhstan, the problem of resource-saving technology for the cultivation of winter wheat with no tillage, that is, direct sowing is one of the many priority areas and is only being developed. The issues of mineral nutrition of winter wheat with direct sowing in rainfed conditions of the south of Kazakhstan are not touched upon, a more detailed study and justification of the use of fertilizers, micronutrient fertilizers, a growth stimulator and the identification of the most optimal norms, the timing of their introduction in dry farming is an urgent direction of agricultural science. In the context of the use of soil-protective and resource-saving agriculture, the consumption of fossil fuels for agricultural production is significantly reduced and the burning of plant residues is completely eliminated, which also contributes to a decrease in greenhouse gas emissions. In addition, with no tillage, depending on the agricultural technique, the soil may emit less nitrous oxide (Izaurralde et al., 2001) [2]. Improving the physical and chemical properties of soil is an important task of both conventional agriculture and soil-protective and resource-saving agriculture, however, improving the biological properties is especially significant in the conditions of soil-protective and resource-saving agriculture, since the soil biological environment is highly degraded depending on the type and degree of soil cultivation, and soil-protective and conservation agriculture provides better conditions for improving biological health and soil functioning. For example, improving the biological potential of the soil under conditions of soil-protective and resource-saving agriculture affects the release of nutrients as a result of the decomposition of plant and animal debris and the subsequent increase in populations of beetles, other insects, worms, fungi and bacteria involved in the processes of decomposition and formation of humus. Therefore, the development of methods for the use of fertilization for direct sowing of winter wheat under dry farming conditions with the choice of the most rational norms of mineral fertilizers, micronutrient fertilizers and growth stimulants with testing of new generation systemic herbicides are of particular interest for science and have important practical significance in the production of winter wheat grain.

The purpose of this research was to study the norms and timing of the introduction of mineral, micronutrient fertilizers and plant growth stimulants and their use in different phases of growth, plant development, taking into account the biological needs of wheat and the peculiarities of the soil and climatic conditions of the south of Kazakhstan.

**Material and research methods**

Laboratory and field experiments were carried out at the stationary site of the Department of Agriculture and Crop Production of the South-West Research Institute of Animal Husbandry and Crop Production. Objects of research: zoned winter wheat variety Steklovidniy 24. Research, analyzes and accounting on winter wheat crops to study different terms, rates of application of

mineral fertilizers , micronutrient fertilizers and plant growth stimulators with "no till" soil cultivation in the conditions of rainfed agriculture in the south of Kazakhstan. The soil cover of the study area is represented by ordinary sierozem, developed on a thick thickness of loess-like loam and sandy loam. The texture of the upper horizon refers to medium loam. The humus content in the topsoil (0-30 cm) is 1.29%, mobile phosphorus - 11.4 mg / ha, nitrate nitrogen - 19.2 mg / kg, exchangeable potassium - 268.1 mg / kg.

According to the degree of supply with nutrients, the experimental plots of rainfed agriculture are characterized by a low supply of nitrogen, phosphorus and medium supply of potassium. The reaction of the soil solution in the arable layer is slightly alkaline (pH - 7.47).

Field experiments on the use of fertilizers for direct sowing of winter wheat were laid down according to the following scheme:

1. Control - without fertilizers;

2. $P_{30}$ kg/ha in active substances was applied when sowing winter wheat simultaneously to a depth of 10 cm;

3. $P_{45}$ kg/ha was applied when sowing winter wheat at a depth of 10 cm;

4. $P_{30}$ kg/ha when sowing winter wheat at the same time $N_{50}$ kg/ha in the tillering phase in early spring periods;

5. $P_{30}$ kg /ha when sowing winter wheat at the same time, $N_{70}$ kg/ha in the tillering phase in early spring periods;

6. $P_{45}$ kg /ha when sowing winter wheat at the same time, $N_{50}$ kg/ha in the tillering phase in early spring periods;

7. $P_{45}$ kg/ha when sowing winter wheat at the same time, $N_{75}$ kg/ha in the tillering phase in early spring periods;

8. Seed treatment and growth stimulator "Vympel" 0.5 l/t + micronutrient fertilizer "Oracle" seeds 1.0 l/t + dressing agent, autumn treatment in the tillering phase of winter wheat "Vympel" 0.5 l / ha + "Oracle" »Multicomplex 2.0 l/ha, at a similar rate of consumption with the indicated preparations, crops were treated twice in the tillering phase of winter wheat in early spring periods and in the flag leaf phase.

**Research results.** In the conditions of the south of Kazakhstan, resource-saving technologies for the cultivation of winter wheat with direct sowing were studied under the guidance of Professor D. Sydyk and his followers, experiments were carried out since 2006. Over these years, the highest yield of winter wheat on dry land of 43.8 c / ha was formed with direct sowing with a SZS-2.1 seeder against the background of mineral fertilizers $P_{30}N_{50}$ kg / ha and with the use of the Target systemic herbicide at a rate of 1.0 l /ha . It was found that direct sowing of winter wheat over the years of research ensured a decrease in direct costs by 28-44% of fuel and lubricants by -36.5-38.6%, the cost price by 24.3-26.3% with an increase in conditionally net income by 16.7-31.5% [3, 4, 5.6]. The lack of moisture in the soil has been and remains one of the most pressing problems, therefore, it becomes obvious that under the current circumstances, the improvement of the crop sector should be achieved, first of all, on the basis of the use of moisture, soil, energy, resource and nature-saving technologies. It is this system of conservation agriculture that is today the key lever for the survival of farmers engaged in crop production. Conserving farming technologies also include minimal and zero-tillage [7].

The research results showed that the application of phosphorus fertilizers at the rate of $P_{30}$ and $P_{45}$ kg/ha accelerated grain ripening by 5-6 days compared to the option without fertilizers, and the use of phosphorus and nitrogen fertilizers at the rate of $P_{45}$ $N_{70}$ kg/ha in active ingredients extended the length of the vegetation the period of winter wheat up to 257 days or the maturation of winter wheat grain came 4 days later compared to the option without fertilization (253 days) and 9 days later compared to the background of phosphorus fertilization $P_{45}$ kg/ha (248 days). Consequently,

the use of phosphorus fertilizers accelerated the ripening of grain, and phosphorus-nitrogen fertilizers contributed to the lengthening of the growing season of winter wheat plants with the formation of consistently high grain yields in comparison with other variants of the experiment. When using plant growth stimulants "Vympel" with micronutrient fertilizer "Oracle" of the multicomplex from sowing to grain ripening, the length of the growing season was 247 days, that is, these preparations accelerated the processes of grain ripening by 6 days in comparison with the treatment without fertilizers.

***Table 1.***

**Yield of winter wheat grain, depending on the norms of fertilization with direct sowing on bogharic lands in the south of Kazakhstan**

| Treatments | Grain yield, q/ha | | Average grain yield, q / ha | Deviation from control, q/ha |
|---|---|---|---|---|
| | 2019 | 2020 | | |
| 1.Control | 12.4 | 13.2 | 12.8 | - |
| 2. $P_{30}$ | 17.6 | 17.5 | 17.6 | +4.8 |
| 3. $P_{45}$ | 20.1 | 19.1 | 19.6 | +6.8 |
| 4. $P_{30}$ $N_{50}$ | 31.9 | 31.7 | 31.8 | +19.0 |
| 5. $P_{30}$ $N_{70}$ | 34.8 | 34.3 | 34.6 | +21.8 |
| 6. $P_{45}$ $N_{50}$ | 35.8 | 35.4 | 35.6 | +22.8 |
| 7. $P_{45}$ $N_{70}$ | 38.5 | 36.8 | 37.7 | +24.9 |
| 8.Microfertilizers+grouth stimulant | 24.0 | 27.7 | 25.9 | +13.1 |

When treating seeds with a growth stimulator "Vympel" at a rate of 0.5 l / t and micronutrient fertilizer "Oracle" at a rate of 1.0 l / t seeds with simultaneous dressing of grain "Dividend Extreme 115", this amount of a stimulant at a rate of 0.5 l / t with a working fluid consumption of 10 l / t before sowing, autumn leaf cultivation of winter wheat crops in the tillering phase with the Vympel growth stimulator - 2.0 l / ha, as well as early spring cultivation of crops in the tillering phase and in the flag leaf phase at the above rates the consumption of the growth stimulator and micronutrient fertilizers, the grain yield of winter wheat on average for two years amounted to 25.9 c / ha, or increased by 2.0 times in comparison with the unfertilized control treatment.

The use of growth stimulants and micronutrient fertilizers turned out to be an advantageous agro-technological method for direct sowing of winter wheat with a significant reduction in direct costs of growing winter wheat crops.

With the improvement of nutritional conditions, the mass of 1000 grains increased and their largest value, 37.5-37.2 g, was obtained against the background of mineral fertilizers $P_{45}$ $N_{70}$ kg / ha, significantly exceeding the indicators of the control variant (30.6-30.3 g), over the years of the experiments when using a growth stimulator and microfertilizers, the mass of 1000 grains was 35.1-34.6 g, significantly exceeding the background without fertilizers (control).

Against the background of phosphorus fertilizers $P_{30}$ kg / ha with the introduction of nitrogen fertilizers at the rate of $N_{50}$ and $N_{70}$ contributed to an increase in grain yield by 19.0-21.8 c / ha compared to the control, forming a consistently high grain yield per hectare at the level of 31.8 and 34.6 centners / ha, that is, the use of phosphorus-nitrogen fertilizers, the nutritional regime is balanced with the satisfaction of their needs for the named elements of winter wheat during the entire growing season, and thus formed a high grain yield.

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