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ECONOMIC EFFICIENCY OF SUNFLOWER CULTIVATION, DEPENDING ON THE CULTIVATION TECHNOLOGY

Elena Drepa (a)*, Olga Vlasova (a), Julia Bezgina (a), Ludmila Trubacheva (a)
*Corresponding author

(a) Stavropol State Agrarian University, 12, Zootekhnichesky Per., Stavropol,
drepa-elena@mail.ru, 89064780972

Abstract

The article presents data that indicate the effective feasibility of sunflower cultivation using direct sowing technology. In the experiments of 2016 and 2017, the previous crop under sunflower was a winter wheat. After harvesting, winter wheat on the variant with the use of direct sowing, 5.9 t / ha of plant residues remained on the surface, whereas in the variant with the use of traditional technology, the amount of plant residues was 1.4 t / ha less. The fields without autumn mechanical treatment do not require measures for the closure of moisture and pre-treatment. For direct sowing, the density of the soil was 1.33 g / cm^3 and 1.39 g / cm, respectively. In the absence of mechanical tillage, the average value of the density indicator was 1.26 g / cm^3 with a slight variation over the years within 1.22-1.29 g / cm^3, which is a significant excess of this indicator compared with the traditional technology option. Any mechanical treatment of the soil leads to its drying. With zero technology, the mechanical impact on the soil is minimized and the evaporation of moisture from the soil is significantly reduced. Moisture-saving function is performed by stubble and mulch, which remain on the field. In the variant with the traditional technology, the moisture content was 89 mm, whereas in the variant with direct seeding, this indicator was 104 mm, which is a difference of 17%. Before harvesting, this indicator decreased in both variants. The decline was from 5 to 28%.

Keywords: Sunflower, tillage, zero technology, economic efficiency.

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1. Introduction

Sunflower is the main oilseed crop in our country. It accounts for 75% of the area sown for all oil crops (Pankov, 2015). Sunflower is placed in a tilled field of crop rotation after winter or spring crops on fields clean from hard weeds after barley, spring wheat and other crops. The technology of growing sunflower in the traditional way has long outlived itself. It was replaced by new, more modern methods (Pankov, 2017). In modern conditions, traditional soil tillage with the use of plowing has been replaced by technologies with resource saving elements (Drepa, Golub, & Bezgina, 2017). These technologies, unlike traditional ones, meet the requirements of conservation agriculture (over-compaction is eliminated, soil destruction processes are weakened, and the rate of mineralization of organic matter is reduced). One of them is the cultivation of sunflower using zero technology, the main principle of which is to avoid plowing. The ground should not be broken, and its structure should remain complete. However, in the domestic science and practice there was not an unequivocal attitude to the technology of direct sowing, but in fact to the new farming system (Drydiger, Drepa, & Matveev, 2015; Stukalov, 2017; Stukalov, 2018). Zero tillage involves direct sowing, which is performed on the untreated field with the rejection of all types of mechanical tillage. Plant residues (stubble and chopped straw), which remain on the field surface, contribute to the retention of snow, reduce erosion processes, improve soil structure, protect winter crops from low temperatures, and accumulate nutrients (Drepa, Popova, Matveev, & Chaplygin, 2012; Drepa & Popova, 2011). The population of earthworms and soil microorganisms increases significantly. Significantly reduced production costs, including fuel. Saved environment. When using direct sowing, the soil provides for accumulation of a larger volume of moisture, which, if it is deficient, contributes to an increase in yield due to the consumption of nutrients, which is deep in the soil, minimal and zero tillage (Belobrov et al., 2018).

2. Problem Statement

Direct sowing technology is a modern crop cultivation model. Direct sowing technology should not be perceived as a technology in which only refusal from plowing occurs, since this technology is a complex technological process that requires special knowledge and the availability of highly qualified specialists and special equipment, therefore the positive effect of its application can be obtained only using an integrated and systematic approach. However, in practice, it has been proven that the use of direct sowing technology can significantly reduce the cost of agricultural work, since with this technology, the cultivation of agricultural crops reduces labor costs and saves a significant portion of expensive resources (Dorozhko, Penchukov, Vlasova, & Borodin, 2011). The main advantage of using direct sowing technology in sunflower cultivation is that in the soil (since the soil is not loosened) it retains moisture better, therefore this technology is most often used in dry regions and in fields with difficult terrain, where the traditional method of plowing is basically impossible (Pankov, 2015). Crop waste remains on the surface, the amount of humus increases in the soil, the level of phosphorus increases, soil fertility is restored, and due to the fact that the cost of fuel is significantly reduced when using a zero treatment system, the amount of carbon dioxide emissions to the atmosphere is reduced accordingly. In this case, there is an obvious saving of resources, since depreciation costs are reduced, which certainly has a positive effect on profitability. The

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technology of direct seeding reduces labor costs in 1.6 times, fuel and lubricants by more than 2.2 times, and equipment by almost 1.5 times. At the same time, the total yield increases at least three times, and production costs are reduced overall by 12% (Slyusarev, Podkolzin, & Osipov, 2015).

3. Research Questions

To achieve this goal it is necessary to solve the following tasks: to study the effect of sunflower cultivation technology on the basic agrophysical properties of leached chernozem; to establish the influence of the cultivation technology on the formation of sunflower oil seed crops; determine the economic efficiency of various technologies for the cultivation of sunflower oilseeds.

4. Purpose of the Study

The main goal of the research is to study the effect of direct sowing technology on sunflower growing on oilseeds on its productivity grown in the zone of unstable moistening of the Stavropol Krai on leached chernozem.

The studies were held in field and laboratory experiments in 2016-2017. Field experiments were conducted at the Department of General Agriculture and Plant Breeding named after Professor F.I. Bobryshev, laboratory experiments took place in the laboratory of this Department. It was an one-factor experiment, the location of the plots was two-tier, the repetition of the experience was threefold, the placement of options was organized repetition, the plot area was 750 m2 (width 15.0 m, length 50 m), accounting 112.5 m2. Records, observations and analyzes in the experiments were carried out in accordance with generally accepted methods and are in Table 1.

In the experiments used traditional technology and technology of direct seeding:

Table 01. The Technology Of Cultivation Of Sunflower On The Predecessor Of Winter Wheat

Crop	**Traditional Technology**		**Direct Seeding**	
	Technological Operation, The Aggregate	**Terms, Technological Requirements**	**Technological Operation, The Aggregate**	**Terms, Technological Requirements**
Sunflower	Disk Dehulling	6-8 And 8-10 Cm (Immediately After Cleaning The Predecessor)	-	-
	Plowing	20-22 Cm (September)	Herbicide Spraying, John Deere	August - September
	Cultivation With Harrowing,	8-10 Cm, 6-8 Cm As Needed	-	-
	Early Spring Harrowing,	When Soil Ripens	-	-

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	Seed Dressing,	Before Sowing	Seed Dressing	Before Seeding
	Pre-Sowing Cultivation	Before Sowing To A Depth Of 6-8 Cm	-	-
	Sowing With Simultaneous Fertilization	55-60 Thousand Plantlets Seed / Ha, Depth 6-8 Cm At Soil Temperature 10-12 C	Direct Seeding	55-60 Thousand Plantlets Seed / Ha, Depth 6-8 Cm At Soil Temperature 10-12 C
	Compacting Of Soil	After Sowing	-	-
	Pre-Emergence Harrowing	4-5 Days After Sowing	-	-
	Cultivation	In A Phase Of 3-4 Leaves Appearing	Herbicide Treatment Of Crops, John Deere	In A Phase Of 3-4 Leaves Appearing
	Cultivation With A Banking-Up	Before Closing Of The Rows	Herbicide Treatment Of Crops, John Deere	Before Closing Of The Rows
	Crop Treatment With Insecticides And Fungicides, John Deere	In Time Of Vegetation	Crop Treatment With Insecticides And Fungicides, John Deere	In Time Of Vegetation
	Harvesting	Upon The Occurrence Of Physical Ripening	Harvesting	Upon The Occurrence Of Physical Ripening

5. Research Methods

One of the basic principles of No-Till is the preservation and accumulation of plant residues on the field. Plant residues, besides being a source of organic fertilizers, perform several more important functions - protect the soil from heating and moisture loss, prevent wind and water erosion, and hold snow in the fields in winter (Petrova, Drydiger, & Kaschayev, 2015; Glazunova, Bezgina, Maznitsyna, Drepa, & Ustimov, 2018). In the variant of using traditional technology, disk peeling and plowing were used in a depth of 20-22 cm, therefore all plant residues were embedded in the soil, so no significant residues were available before planting sunflower.

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In the variant of using of direct sowing, all the plant residues from the autumn, in the winter and before the sowing of sunflower, remained on the surface and under the action of soil microorganisms, their decomposition occurs.

Therefore, by the time of sowing sunflower, depending on the variant, on average over 2 years of research, from 1.8 to 2.7 t / ha remained on the surface, or 33.0-44.0% of their initial amount. The same pattern was observed in both years of research. The difference in the by-products remaining after harvesting of winter wheat over the years of research was obtained due to the different development of its plants, which depended on weather conditions during the growing season of the crop. The decomposition of plant residues contributes to the accumulation of organic matter in this process contributes to an increase in microorganisms in the variant without tillage and an increase of earthworms' number.

And if we compare the classical method of tillage and zero technology, using No-Till per square meter increases the number of worms in 5-6 times. Earthworms have a positive effect not only on the agrophysical properties of the soil, but also on its fertility, contribute to the formation of humus, processing plant residues and other organic matter. That is, plant residues, which are an indispensable condition for the cultivation of any crop, including sunflower, without tillage, contribute to the emergence and living in it of earthworms, which are significantly more than when sowing sunflower using traditional technology with annual tillage (Esaulko, Dorozhko, & Drepa, 2013; Esaulko, Grechishkina, & Sigida, 2017).

Plant residues contribute to the preservation and accumulation of soil moisture. With traditional cultivation technology, the amount of productive moisture at a depth of 0-50 cm before sowing was 71 mm, and before harvesting it was 56 mm. This is a quite understandable fact, because despite the large amount that fell out during the whole growing season, moisture is rather heavily consumed in crop formation. With the technology of direct sowing, these figures at the same depth were much higher: before sowing, the amount of moisture was 90 mm, and before harvesting, this figure decreased to 61 mm.

A similar picture opens at a depth of 50-100 cm, when with traditional technology, before sowing, the amount of productive moisture was 89 mm, and before harvesting - 64 mm. With direct sowing technology, these figures were much higher, and before sowing it was 104 mm, and before harvesting it was 82 mm. The difference between the variants before sowing was 12.3%. On average, over two years, the decrease in humidity by the time of harvesting was 24-25%.

6. Findings

For years of research, the yield of sunflower had its own characteristics and depended on many factors. The highest yields for all variants of experience were obtained in 2016, when precipitation fell during the budding, flowering and seed loading (June-July months), more than the climatic norm. In 2017 at this time less rain fell, and the harvesting was lower.

The density of the plants standing for harvesting according to the traditional technology was 46.0 thousand units, which is 0.6 thousand units more than direct sowing technology. According to the research results, it was established that direct sowing in the conditions of the zone of unstable moistening reduces the mass index of a thousand seeds by 13%. Productivity at the same time provides an increase in the traditional technology of 20.0%. According to the technology of direct sowing, the average yield for two years amounted to 1.15 t / ha, whereas by traditional this figure was 1.34 t / ha.

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The economic efficiency of cultivation of culture depends on the size of the cost per unit of production and the cost of primary products. The cost of production is the most complex synthetic index, the level of which is formed under the influence of causal factors that increase the volume of production of products. The profitability of a specific type of product depends on the level of goods, prices of raw materials, product quality, labor productivity, material and other production costs.

The values of the indicators suggest that the project of organizing the production of soybeans will ensure the receipt of additional cash and increase the profitability of production as a whole.

The economic efficiency of sunflower cultivation is also influenced by the technology by which this crop is cultivated (table 2). This is due to the fact that different agricultural equipment is used, the multiplicity of treatments of both the soil and the plants increases or, conversely, it affects the financial expenses of the enterprise.

Table 02. The economic efficiency of the application of various technologies of cultivation of sunflower (on average **over 2 years)**

№	Indicators	Experience variants	
		Traditional technology	**Direct seeding**
1	Productivity from 1 hectare, t	1,34	1,15
2	Selling price 1 t, rub	15000,0	15000,0
3	Sales take from 1 ha, rub	20100,0	17250,0
4	Labor costs per 1 ha, man / h	6,8	4,7
5	Labor costs per 1 t, man / h	5,1	4,1
6	Production costs per 1 ha, rub	13671,3	13654,1
7	Prime cost of 1 t of product, rub	10202,5	11873,1
8	Profit per 1 ha, rub	6428,7	3595,9
9	Profitability level,%	47,0	26,3

Based on the data of table 2, when calculating the proceeds from sales of products from 1 hectare, with the traditional technology received 20,100.0 rubles, while for direct sowing under the same conditions, revenues amounted to 17,250.0 rubles. The selling price of sunflower products was the same for both technologies. Such differences were due to the fact that with direct sowing the yield was lower by 0.19 t / ha.

The difference in production costs per 1 ha was also noted: whereas with the traditional technology, this figure was 13,671.3 rubles, while with direct sowing, production costs were higher and amounted to 13,654.1 rubles. A similar situation was with the cost of 1 t of sunflower products, which was higher in direct sowing.

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The profitability of sunflower oilseed production with traditional technology was 47.0%, and with direct sowing it was 26.3%, which despite the lower yield and lower profitability still allows using both technologies in this area.

7. Conclusion

In conclusion, it should be noted that the use of direct sowing technology or N-Till technology requires more detailed study and its success will depend on a number of factors: the soil and climatic conditions of the place of cultivation of sunflower for oilseeds, compliance with all technological conditions when growing sunflower, observing crop rotation in crop rotation with a warm and cold period, a clear approach to the system of plant protection from pests, diseases and weeds and the gradual reduction of the load by pesticides and many other factors. A systematic approach and communication with science will increase the yield of sunflower and reduce the cost of oilseeds.

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