Comparative evaluation of the economic efficiency of the rapeseed cultivation by the traditional method and using the principles of organic production

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Abstract. The possibility of applying the principles of organic farming in the cultivation of spring rape is considered in the article. The adoption of the Federal law "On organic products and on amendments to certain legislative acts of the Russian Federation" contributed to the creation of an effective mechanism for the production and sale of organic products in accordance with international standards and the orientation of the export potential of culture not only to the APEC countries, but also to the EU countries. Based on the analysis of the existing legislation in the field of organic production of agricultural crops and the used technologies, as well as taking into account the requirements for organic production and products, production and auxiliary processes of organic agricultural production in the cultivation of spring rape were developed. The agrotechnological plan of spring rape cultivation on organic technology in the conditions of Krasnoyarsk territory was developed, and then technological maps of production of oilseeds on traditional technology and organic were developed. The comparative evaluation of two technologies was carried out; economic indicators of efficiency are calculated. The calculations showed that due to the increase in the number of seeding-down treatments, the cost of production by organic technology is 8.4% higher than in technologies with the use of chemical means of protection. Due to the high selling price, which is more by 14.9 %, the profitability of rapeseed production by organic technology increased by 16% compared to traditional.

1. Introduction
The demand for high-quality agricultural products is growing all over the world every day, especially for products produced on organic principles. Organic production, both in developed and developing countries, is a cost-effective method of production, and every year the number of farms switching over to this system of production increases. Over the past 10 years, organic production has continued to expand in Europe due to government support measures and the growing market demand for organic products [1]. At the same time, organic production is subject to strict regulation and rationing. In the EU countries, it consists of a regulatory framework supplemented by implementation rules and guidelines. Other important normative acts / standards are the U.S. National Organic Program, The Codex Alimentarius guidelines, and the core standards of the International Federation of Organic Agriculture Movements (IFOAM) [2].
The article of Friedt W., Tu J., Fu T. noted the great economic importance of rapeseed: it is an indispensable component of crop rotations in such large cultivation regions as Australia, Western Canada, Central China and many countries of the European Union; it contributes to the maintenance of soil fertility and sustainable production. Rapeseed processing products contribute significantly to the gross national product of a series of countries, such as Canada. It is also noted that due to the rejection of agrochemicals such as insecticides (for example, the ban of neonicotinoids in the EU) due to environmental problems, great demands are made on modern varieties of rapeseed, their genetic and agronomic properties aimed at resistance to fungal diseases and insect pests [3].

In the previously published article, the authors studied the features of spring rape cultivation in the Krasnoyarsk region and the prospects for the use of products of its processing. Due to the biological plasticity of the crop and resistance to low temperatures in mild climate regions, including Eastern Siberia, rapeseed production is growing. In the Russian Federation and the Krasnoyarsk region over the past 10 years there has been an increase in acreage under rape, mainly spring form: 4 times in the Russian Federation, 13 times in the Krasnoyarsk region. In the region in 2018, compared to 2015, the acreage of spring rape increased 2.4 times, and the volume of production of oilseeds – 2.9 times. The average yield of spring rapeseed in the Krasnoyarsk region is comparable to the average yield in Russia: according to Krasnoyarsk Statistics Service in 2018, it was 1.63 t / ha, in Russia – 1.68 t / ha. Oilseed rapeseed is a highly profitable export commodity, especially for the countries of the Asia-Pacific region [4]. However, the share of organic rapeseed produced in the region is negligible. It is necessary to gradually switch to organic production, which is based on the application of ecological production methods, achievements of modern breeding and intensive technologies without damage to the environment and aimed at improving the quality of consumers’ life [5].

2. Research methods

During the production of organic products in the Russian Federation, great demands are made, first of all, to land and soils, which must comply with the requirements of GOST 17.4.2.01-81, Technical regulations TS 021/2011 "On food safety") and the new Federal law "On organic products and on amendments to certain legislative acts of the Russian Federation", adopted by the State Duma on 25.07.2018 and coming into force on 01.01.2020. The new Federal law regulates relations related to the production, storage, transportation, labeling and sale of organic products, and does not regulate relations related to the production, storage, transportation and sale of perfume and cosmetic products, medicines, seeds of forest plants, hunting products, fish products (except for aquaculture products) [6]. However, despite the adopted legislative acts of the Federal level, Russia has not created an effective economic mechanism for the production and sale of environmentally friendly products that meet international standards, which can interest employees of the agro-industrial complex [7].

Conformity assessment of compliance of production sites for growing rapeseeds for compliance with the principles of organic farming was carried out on the basis of soil samples of land plots identified for the production of organic rapeseeds. Sampling was carried out in accordance with the regulatory documentation for sampling methods WD 52.18.156-99 and MR 2015-79 in accordance with GOST 17.4.2.01-81. Normative documents regulating the value of characteristics and indicators: HS 1.2.3111-13 "Hygienic standards for the content of pesticides in environmental objects (list)" (as amended on July 13, 2016) and TR TS 021/2011 "On food safety") [8, 9]. The transition to the production of organic rapeseed is possible only in those areas where the analysis of soil samples for the content of the main dangerous elements and pathogenic microflora did not exceed the norm for all studied values. In areas contaminated with pesticides and herbicides, a gradual transition to organic production of spring rape is recommended within 2-3 years.

The most common diseases of oilseed rape are the Alternaria blight, powdery mildew, Sclerotinia (white rot), Phoma rot (dry rot). The spread of diseases contribute to increased soil moisture, thickened crops and deep planting of seeds. In order to avoid significant crop losses at the first signs of disease, it is necessary to spray plants with solutions of appropriate agents.
For spring rape, the most common pests are cruciferous flea beetles, rapeseed beetle, rapeseed sawfly, cabbage seedpod weevil and rape stem weevil, cabbage moth, cabbage white butterfly and aphids. Cruciferous flea beetles are the main threat of spring rape crops during the sprouting period. The most effective methods of plant protection from beetles are pre-sowing grain treatment and early sowing period.

Table 1 shows biological products for pest control of spring rape, acceptable for organic farming.

| Products                  | Preparative form          | Hazard class, in the numerator for man/for bees | In the fight with whom (what) applies                                      |
|---------------------------|---------------------------|-------------------------------------------------|--------------------------------------------------------------------------|
| Lepidocide, SC            | Suspension concentrate    | (4/3)                                           | Cabbage white butterfly and small white butterfly, cabbage moth.          |
|                           |                           |                                                 | Mamestra brassicae (cabbageworm 1-2 of age)                               |
| Bitoksiballin, P          | Powder                    | (3/3)                                           | Cabbage white butterfly and small white butterfly, cabbage moth.          |
|                           |                           |                                                 | Mamestra brassicae (cabbageworm 1-2 of age)                               |
| Vitaplan, WP              | Wettatable powder         | (4/3)                                           | Root rot.                                                                |
|                           |                           |                                                 | Oidium, Alternaria blight                                                |
| Trichozin, WP             | Wettatable powder         | (4/3)                                           | Root rot.                                                                |
|                           |                           |                                                 | Oidium, Alternaria blight                                                |
| Mycefit, SP (the metabolic products of the endophytic fungus) | Soluble powder            | (4/3)                                           | Strengthening of growth processes, the formation of resistance to disease and drought, increasing yields. |

The use of chemical means of spring rape protection is the most effective means of crop protection against pests and diseases, but this is unacceptable in organic farming system in which the protection should only apply safe biological products and used processing methods that ensure soil fertility and biological activity of soils and biological protection of this culture. The use of biological products in organic farming is associated with an increase in the number of treatments and increased control over crops.

Other substances are permitted in the production of organic rapeseed:

- Copper in the form of hydroxide, chloroxide (tribasic), sulfate, Bordeaux and Burgundy liquid, as a fungicide. Subject to the rules of application.
- Lime sulfur (polysulphide) as a fungicide, insecticide and acaricide.
- Sulfur as a fungicide, acaricide and repellent.
- Wet lime. It is used in such a way as to minimize the accumulation of copper in the soil.
- Potassium bicarbonate as a fungicide.
- Hydrogen peroxide. Is used only when the immediate threat to the crop.
- Nitrogen. Is used only when the immediate threat to the crop.
- Ethyl alcohol. Is used only when the immediate threat to the crop.
- Natural herbal preparations (except tobacco-based preparations).

To prevent contamination by radioactive, chemical, biological substances and their compounds, microorganisms and other biological organisms that pose a danger to the health of current and future generations (SanPiN 2.3.2.1078 p. 6.7.1), plots of land intended for organic crop production shall be
located away from sources of environmental pollution, industrial activities, areas of intensive agriculture, which must be certified for organic production by an accredited competent authority.

To limit the transfer of pollutants from the territories adjacent to the production unit, where organic production is carried out, barriers and buffer zones are installed.

3. Results

As a result of the research and analysis of the existing legislation and technologies of organic agriculture, production and auxiliary processes of organic agricultural production in the cultivation of spring rape were developed.

The main problem in the cultivation of spring rape is the need for constant monitoring and application of crop protection against pests and diseases.

According to GOST 56508-2015, the principles of organic production provide for the rejection of using the synthetic herbicides, fungicides and insecticides, synthetic growth regulators and dyes, as well as nitrogen fertilizers. Therefore, it is necessary to take into account the conditions listed below [8] when developing production and auxiliary processes of organic agricultural production in the cultivation of rapeseed.

In organic crop production of rapeseed, whenever possible, soil cultivation methods are used to preserve its natural composition, prevent the development of degradation processes and maintain the biodiversity of ecosystems.

For preservation and increase of fertility and biological activity of soils apply special crop rotations, including cultivation of legumes and other break crops, and also soil-improving substances and the substances of an animal and vegetable origin received in system of organic agriculture and passed a stage of composting or anaerobic fermentation.

The use of fertilizers and soil-improving substances only in accordance with approved lists is also allowed.

Measures to prevent losses caused by pests, diseases and weeds should be based on the protection of entomophages, the selection of appropriate species and varieties of plants, the selection of appropriate crop rotation, optimal cultivation methods and thermal treatment methods.

The total amount of organic fertilizers introduced into the soil on the basis of animal waste should not exceed 170 kg of nitrogen per year per hectare of agricultural land.

To improve the general condition of the soil or increase the content of nutrients in the soil or crop, it is allowed to use preparations based on the waste products of microorganisms, as well as containing living microorganisms.

During the research, the technology of spring rape production was developed using the principles of organic farming and production of organic products – oilseeds.

The agrotechnological plan of production of organic grower including the list of works, terms of their application, necessary for this purpose technical cluster and the equipment was developed. On the basis of the prepared agrotechnological plan the technological map of spring rape production on organic technology, which allowed calculating cost effectiveness indicators of new technology application, was developed.

The cost effectiveness were calculated on the basis of the developed technological maps for the two applied technologies of cultivation of spring rape while accounting for costs in calculating the cost of production was made by all elements: the cost of seeds, depreciation of machinery and equipment, fuel and lubricants, auxiliary materials, the cost of biological products, herbicides and pesticides, salaries of main and auxiliary personnel, maintenance costs, as well as general economic and general production costs. Table 2 presents the calculations cost effectiveness indicators of oilseeds production for the two considered technologies.

With the same sowing time and seeding rates of 0.13 C / ha, the yield of spring rape by traditional technology was 20 C/ha, by organic – 18 C / ha.
Table 2. The economic efficiency of rapeseed production.

| Indicator                                  | Traditional technology | Organic technology |
|--------------------------------------------|------------------------|--------------------|
| Acreage, ha                                | 283.5                  | 283.5              |
| Crop productivity, c by 1 ra               | 20                     | 18                 |
| Gross yield of grain, C                    | 5670                   | 5103               |
| The sold amount of grain, C                | 5670                   | 5103               |
| Inputs on 1 ha, rub.                       | 17257.16               | 16843.01           |
| Cost value 1 C, rub.                       | 862.86                 | 935.72             |
| Absorption costing, thousand rub.          | 4892.4                 | 4775.0             |
| Netback price 1 C, rub.                    | 2270                   | 2610               |
| Sale proceeds, thousand rub.               | 12870.9                | 13318.83           |
| Profit, thousand rub.                      | 7978.5                 | 8543.9             |
| Level of profitability, %                 | 163.1                  | 178.9              |

Thus, in the production of rapeseed by organic technology, there is a decrease in yield by 10% in comparison with the traditional technology of cultivation of this crop, in this regard, there is a reduction of total output to 567 kg and an increase in the cost of production of 1 kg on 8.4 %, due to the increase in the number of treatments rape crops from pests. But due to the higher quality of rapeseeds when growing it by organic technology, there is an increase in the sale price of 1 C and due to this, the profit growth by 565.4 thousand rubles and the level of profitability by almost 16 %.

4. Conclusion

In modern agriculture, the role of varieties and hybrids increases, especially such indicators as resistance to diseases, high level of adaptability, stability of obtaining commercial oilseeds [10].

Over the past 5 years, there has been a sharp increase in acreage in the region under spring rape (4.9 times), and, consequently, the production of oilseeds (6.1 times). Due to the use of high-yielding varieties and hybrids of rapeseed and the use of intensive technologies of their cultivation, the crop yield is gradually increasing (2017 – 12.1 C / ha, in 2018 – 16.9 C / ha). To increase the export potential of the crop and export orientation not only to the countries of the Asia-Pacific region, but also to European countries, it is necessary to introduce technologies of organic production of spring rape.

To increase the economic interest of agricultural producers currently in Russia, in accordance with international standards, an economic mechanism for the production and sale of organic products is being created, which was largely facilitated by the adoption of the Federal Law N 280-FZ "On organic products and on amendments to certain legislative acts of the Russian Federation".

As a result of the conducted research it is established that the technology of organic production of oilseed rape makes significant demands on the land plots allocated for cultivation of spring rape: first of all, this refers to the residual effects of the previous use of herbicides and pesticides.

On the basis of the analysis of technological process of production of spring rape and GOST 33980-2016 "The production of organic grower. Rules of production, processing, labeling and realization" technological maps for the production of organic spring rape oilseeds have been developed.

A comparative evaluation of the economic efficiency of seed production by the two technologies considered in Eastern Siberia showed that despite the increase in costs when applying the principles of organic farming for the production of oilseeds, and therefore the increase in the cost of production, the profitability of rapeseed production by organic technology, in comparison with traditional, increased by 16 %. First, this is due to the pricing system for organic grower; the sale price of such products is 14.9% higher than the products produced by traditional technologies. Secondly, organic growers are in high demand, which favorably affects the price of such products. In addition, organic growers have a
high export capacity, which is an additional incentive to increase the economic interest of agricultural producers. Therefore, the enterprises of the agricultural sector of the region, which have large production and technological resources for the production of organic oilseed rape, are interested not only in increasing the acreage under spring rape, but also in the application of new intensive technologies of cultivation.

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