Scientific and practical basis of rapeseed production in the Central Federal district

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Abstract. The Central Federal district has soil and climate resources, scientific and industrial experience that allows it to produce basic types of food in full from the need. The main task at the present stage is to increase the production of dairy and meat products of cattle by increasing the gross production of feed and improving their quality, especially in terms of protein availability. Cold-resistant oilseeds, and above all, rapeseed, should play a leading role in solving the problem of providing protein for feed. In relation to the region, the scientific and practical bases of rapeseed production have been developed to meet the needs of the fat-and-oil industry and animal husbandry in rapeseed oil seeds. A range of varieties of spring and winter oilseed rape, spring and winter colza different ripening, allowing to obtain raw materials for masloekstraktionnych plants from early July to late September. The varieties of spring rapeseed with a potential seed productivity of up to 3.5 t/ha created in the Federal Research Center "VIC named after V. R. Williams" provide up to 1.5 t / ha of edible oil and 0.7 t / ha of raw protein. Winter rapeseed varieties have a potential productivity of 6 t / ha, in production conditions they guarantee 4-5 t/ha, which allows you to get more than 2 t / ha of oil and more than 1 t / ha of raw protein. Created varieties of colza, distinguishing itself with reduced fiber content and increased digestibility, can be successfully used in the poultry industry.

In the Central Federal district, the main task at the present stage is to increase the production of dairy and meat products of cattle by increasing the gross production of feed and improving their quality. At present, protein deficiency does not allow for the realization of the potential of animal husbandry industries, even with existing livestock [1-3]. In most of the territory of the Central Federal district, soil and climate resources are most favorable for the cultivation of cold – resistant oilseed cabbage crops – rapeseed – Brassica napus L. and surepitsa-Brassica rapa L. [4]. Plant raw materials of these types can be widely used in animal husbandry in the production of high-protein feed additives and bulky feed.

Scientific research on the scientific support of rapeseed in the district began in the 80 - ies of the last century. During these years, the all-Union rapeseed Institute was established in Lipetsk, and work was launched at the Institute of feed for breeding and technology of rapeseed cultivation [5-7]. As a result of the analysis of soil and climatic conditions, species and varietal composition of oilseeds zoned in the region, and their biological characteristics, the main research areas were identified, including:

- justification of the species composition of crops, their zoning, requirements for varieties and hybrids;
- creation of varieties and hybrids that meet the soil and climate conditions of the region;
- development of resource-saving, environmentally friendly cultivation technologies that ensure high productivity, quality of plant raw materials and economic efficiency [8-11].

Based on the conducted research, the most promising species were identified: spring and winter rapeseed, spring and winter surepitsa; additionally, oilseed radish, white mustard. According to biological requirements, these species met the soil and climatic conditions of all regions of the district. When studying the biological features of the varietal composition of species, they were found to be inconsistent with the climatic conditions of the region (for the duration of vegetation), the requirements of modern production (lodging, uneven maturation) and use (quality indicators of oilseeds).

As a result, the main requirements for spring rapeseed varieties were developed, including early maturity, resistance to adverse weather conditions, high productivity and quality of oilseeds (increased fat and protein content, low content of glucosinolates, absence of erucic acid, improved fatty acid composition), uniformity of seed maturation and their non-precipitation [12].

There were practically no studies on winter rapeseed in the district. Evaluation of the existing varieties of domestic and foreign selection showed that the main requirements for new varieties were winter and frost resistance, rapid initial growth and formation of vegetative organs in the autumn period with high resistance to adverse wintering conditions, as well as higher productivity, manufacturability, and quality of oilseeds [13].

As a result of breeding work with the involvement of promising domestic and foreign samples, cabbage varieties with high productive and adaptive properties to the soil and climatic conditions of the region were created in the Institute of feed (table 1).

| Name of the variety | Average seed yield over 8 years, t/ha | Vegetation period, days | Fat collection, t/ha | Protein harvest, t/ha | Glucosinolate content, μmol/g |
|---------------------|-------------------------------------|-------------------------|----------------------|-----------------------|-----------------------------|
| Spring rape         |                                     |                         |                      |                       |                             |
| Podmoscovny         | 2.50                                | 105                     | 1.4                  | 0.7                   | 10.0                        |
| Novik               | 2.66                                | 102                     | 1.27                 | 0.57                  | 12.2                        |
| Novosel             | 2.59                                | 100                     | 1.3                  | 0.6                   | 12.6                        |
| Bizon               | 2.54                                | 101                     | 1.5                  | 0.64                  | 11.6                        |
| Winter rape         |                                     |                         |                      |                       |                             |
| Severyanin          | 4.25                                | 90**                    | 1.9                  | 1.0                   | 20                          |
| Winner              | 4.04                                | 98**                    | 1.9                  | 0.9                   | 15.5                        |
| Capital             | 3.8                                 | 95**                    | 1.7                  | 0.9                   | 15.9                        |
| guarantor           | 4.86                                | 102**                   | 2.45                 | 1.2                   | 14.5                        |
| Horizon             | 4.45                                | 86**                    | 2.0                  | 1.1                   | 16.5                        |

*All varieties are zoned in the Central Federal district.

When creating varieties, methods of hybridization, chemical mutagenesis, incarceration, individual and mass selection, environmental testing and selection using artificial climate chambers and greenhouses were used. During the breeding work, the biochemical composition of seeds, including glucosinolates and erucic acid, was constantly monitored [14].

Two-zero varieties of spring rapeseed with a growing period of 100-110 days, have a potential productivity of up to 3.5 t/ha of seeds, fat content of 44-50%, crude protein of 22-28%, glucosinolates of 11-15 mmol/g: Lugovskoy, Vikros, Podmoskovny, Novik, Grant, Novosel, bison. For the first time, winter rapeseed varieties (Severyanin, Laureate, Stolichny, horizon, Garant, Nord) with high winter hardness, complex resistance to abiotic factors of overwintering, high potential productivity (up to 6 t/ha of seeds and 35 t/ha of green mass), fat content 42-48%, protein 22-25% were created for the Central Federal district. Varieties of spring surepitsa Svetlana and Nadezhda with seed productivity up to 2.5
t/ha ripen 2 weeks earlier than spring rapeseed, have a high fat content (up to 48%), low fiber content (4.5-5.5%) and glucosinolates (11-13 mmol/g), which allows them to be used in high doses when feeding animals and especially poultry. Winter surepitsa Zarya ripens a week earlier than winter rapeseed, is characterized by high winter hardiness and seed quality.

All rapeseed varieties selected by the Federal research CENTER "VIC named after V. R. Williams" are characterized by a low content of glucosinalates in seeds, from 10.0 (Podmoskovny variety) to 12.9 mmol/g (Vikros variety) and fiber (8-10%), which allows them to be used as energy components in poultry feeding [15-16].

Oil danusevich varieties of rapeseed and colza is used in the food and feed industry to balance their energy, and containing arukou acid for industrial purposes; is well balanced in composition, and contains little saturated and a moderate amount of polyunsaturated essential fatty acids in the form of linoleic (the family of "omega 6") and α-linolenic (omega - 3), which are not synthesized in humans and animals and play an important role in the processes of growth and reproduction. Rapeseed oil is widely used for the production of lubricants and motor fuel, both directly in its pure form, and for the production of" biodiesel", which does not emit sulfur oxides, and when it enters the soil, it decomposes quickly, and does not pollute water sources. According to the EU Directive, the share of biodiesel should be 20% by the end of 2020. Mustard oil is used in cosmetology, food and chemical industries, and cake is used in medicine for the production of mustard plasters [17-27].

In feed production, green mass and silage prepared from it are used; seeds and waste from their processing-cake and meal are used as high-protein and energy additives. For the production of green mass, cruciferous crops are used in mowing and crop crops. Especially effective are mixed crops of cabbage oilseeds with cereals (oats, barley), legumes (peas, vetch, pelyushka, lupine, fodder beans), sunflower and annual ryegrass.

The most important role in providing animal husbandry with feed protein belongs to the cake and cabbage meal. When processing oilseeds of new varieties, the yield of cake is 62-66%, meal-55-58%, which contains up to 38-45% protein, which is not inferior in the number of essential amino acids to soy, and the content of sulfur-containing surpasses it.

Promising use of rapeseed as a sideral crop, which reduces costs by 1.5-2.0 times compared to the introduction of manure [28].

In specialized enterprises for the production of feed grain, zoned types and varieties of oilseeds with different vegetation periods allow creating conveyor production of oilseeds lasting up to 2 months: winter surepitsa Zarya-1-2 decades of July, winter rapeseed Severyanin, Stolichny, Laureate - 2 decades of July-1 decade of August, early-maturing varieties of spring rapeseed Vikros, Grant-2-3 decades of August, medium-maturing varieties-Podmoskovny, Novik-3 decades of August-1 decade of September (Fig 1).
Fig. 1. Scheme of production of oilseeds during the growing season

This scheme makes it possible to efficiently use technical means and drying facilities, eliminate the impact of unfavorable conditions on the gross harvest of oilseeds, and increase the commercial efficiency of production.

When developing technologies for the cultivation of cruciferous crops, the main factors that determine the level of productivity, stability of oilseed production and their quality are established.

The leading factors are organic and mineral fertilizers, especially nitrogen fertilizers, which provide an increase in productivity up to 60%, plant protection products (25-30%), and varieties (7-8%). Technological bases for cultivating crops and varieties have been developed [29-32].

To obtain 2.5-3 t/ha of spring rapeseed seeds, the following technological methods should be used:
- sowing should be carried out in two periods-when the upper soil layer temperature reaches +8 +10°C, the second-10-15 days after the first;
- seeding with seeds treated with insecticidal and fungicidal agents
- taking into account field germination, the seeding rate should be 1.2-2.0 million germinating seeds per ha;
- the cost-effective norm for applying nitrogen fertilizers is 60-90 kg of d. v. per ha against the background of applying phosphorus and potash fertilizers to the estimated crop, taking into account the content of elements in the soil;
- to protect crops from weeds, it is necessary to apply a soil herbicide, in case of severe weeding, depending on the spectrum, use the appropriate approved herbicides;
- compliance with disease and pest control measures:
  - cultivation of disease-resistant varieties;
  - strict observance of crop rotations and the accepted alternation of crops with the return of cabbage to its former place no earlier than in 4-5 years;
  - incorporation of stubble and crop residues;
- destruction of weeds and pests that are accumulators and vectors of diseases;
- incrustation of seeds;
- when the first signs of the disease appear during the growing season, the use of drugs allowed on the territory of the Russian Federation.

- pest control using yellow trap cups half-filled with water. When the threshold of harmfulness is reached, treatment with appropriate insecticides is carried out, possibly with a tank mixture with non-root top dressing.

To obtain 3.5-4.5 t/ha of winter rapeseed, the following technological requirements must be met:
- for Central regions with stable snow cover, sow in the second decade of August; for a more accurate selection of the sowing date, you need to take into account the amount of active temperatures above 5°C in the period from sowing to the establishment of stable frosts, which should be at least 450 0C;
- optimal standing density of 40-70 plants per 1 m², which is provided by the seeding rate of 0.7-1 million germinating seeds per ha;
- seeding with seeds treated with insecticidal and fungicidal agents;
- in case of threat of overgrowth of plants in autumn and fungal diseases – use of fungicides and growth regulators;
- the technology of winter rapeseed cultivation on oilseeds provides for a comprehensive system of weed control measures, including preventive, mechanical and chemical techniques. Compliance with crop rotation in crop rotations, high level of agricultural technology contribute to reducing the contamination of crops. To control weeds use soil herbicides before rapeseed shoots in the recommended doses or use herbicides based on the range of weeds;
- compliance with disease and pest control measures
- apply phosphorus-potash fertilizers to the calculated crop, taking into account the content of elements in the soil, nitrogen fractional - 30 kg in the fall before sowing (after grain precursors) and from 60 to 120 kg of nitrogen in the spring, depending on the state of crops.

Practical measures to increase the gross yield of oilseeds are determined by the region's need for food and technical oils, bulky feed and high-protein additives for animal husbandry, and an increase in agricultural export opportunities.

In the future, to fully provide the population of the Central Federal district with livestock and poultry products, it is necessary to produce about 32 million tons of feed, including 22 voluminous, 16 concentrated. To balance concentrated feed for basic nutrients, about 4.1 million tons of feed additives are needed, including oilcake and oilseed meal about 2.0 million tons.to produce this amount of oilcake and meal, it is necessary to produce at least 4 million tons of sunflower oil seeds, soy, rapeseed. In the structure of gross collections of oilseeds, rapeseed can take up to 50% or 2 million tons. In recent years, the production of oilseeds in the district is about 580 thousand tons, of which no more than 55 are processed. At the same time, the production of cake and meal is about 26 thousand tons, which is extremely insufficient even for the existing livestock.

The main areas of rapeseed should be concentrated in the Central economic region of the soil and climate conditions that are most favorable for cabbage crops. If productivity increases from 1.6 to 2.5 tons per 1 ha, the total area of rapeseed (spring and winter) should reach 800 thousand hectares or increase by 2.5 times compared to the current level. To achieve these indicators, it is necessary to:
- develop a rapeseed program that includes optimizing the zoning of oilseeds, improving the structure of sown areas based on the limits of their saturation with oilseeds, including soy and sunflower, placement in crop rotations, development of advanced cultivation technologies, the need for material and technical resources and processing industry;
- improve the legislative, subsidized and credit policies that provide incentives for the production and domestic consumption of raw materials, the availability of material and technical resources to the producer, including working capital, guaranteed sales of oilseeds and profitability;
- create a system of sustainable seed production and industrial seed production;
- improve industry standards for oilseeds for the production of food and industrial oils, cake and meal;
- improve standards for the introduction of cake and meal into feed for cattle, pigs and poultry;
- introduce statistical reporting on the processing of oilseeds, production and consumption of cake and meal.

Thus, for most of the territory of the Central Federal district, cabbage crops are most adapted for the production of food and process oils, bulky feed and high-protein feed additives for livestock and poultry farming. Currently, the scientific foundations of rapeseed cultivation have been developed, the practical implementation of which will help solve the problem of food security in the region, increase the profitability and export potential of the district's agriculture.

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