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Developing The Regional System Of Oil Crops Production Management.

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ABSTRACT

The article presents brief analysis of oil products market in the Russian Federation. Perspectives of growing new oil crops in the non-black soil zone of Russia were studied. The studies of possibilities to use several oil crops at once at one farm were undertaken. The analysis of oil crops growing in the region shows that their overall production and use do not correspond to the consumer's market. The increase of oil crops interests in cropping areas and the work to get the maximum yield are requirements of market economy. Lasts years were characterized by unstable and difficult to anticipate price of grain.

Keywords: oil crops, rape, sunflower, flax, vegetation period, yield, oil content, economic efficiency.

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INTRODUCTION

Modern economic conditions are characterized by uncertainty and risk. To reduce their negative impact in agriculture it is necessary to expand the range of cultivated crops paying attention to those that are in steady and high demand of consumers. Among such crops are oilseeds consumed for food, technical, fodder and other purposes (Bogaci, R., 1989; Mineev, V.G., 2001; Byshov, N.V., 2015; Shpaar, D., 2007; Ilieva, A., Vasileva, V. 2013).

Nowadays special attention in the agriculture of Ryazan oblast is paid to oil crops. So, Ryazan oblast took the second place in mustard seeds production the 6th place in winter and spring rape production, the 13th place in camelina production, the 18th place in soybeans production and the 22nd place in sunflower production.

Table 1 – Oil crops yield in Ryazan oblast in 2015-2016

Crops	Harvested area, thous. ha			Bulk yield, thous. tons			Yield, dt/ha		
	2015	2016	"+/-" to 2015	2015	2016	"+/-" to 2015	2015	2016	"+/-" to 2015
Oil crops, altogether	96	91.2	-4.8	141.8	139.6	-2.2	14.8	15.3	0.5
which include									
Rape	43.7	38.7	-5.0	65	47.1	-17.9	14.9	12.2	-2.7
Sunflower	23.4	33.4	10.0	42.8	64.6	21.8	18.3	19.4	1.1
Soybean	10	10.4	0.4	17.2	21.2	4.0	17.2	20.3	3.1

The data in Table 1 demonstrate multidirectional dynamics. Sunflower and soybean harvest in Ryazan region in 2016 increased by 50.9 % and 23.2 % correspondingly and comprised 64.6 and 21.2 thousand tons (0.4 % of the total Russian harvest). These results became possible both due to the expansion of crop areas and the yield of the agricultural crops. The relative decline in rape popularity among Ryazan agricultural producers coincided with the reduction of extensive and intensive factors. As a result the bulk yield of rape decreased by 17.9 thousand tons in 2016 and comprised 47.1 thousand tons.

In general, the bulk yield of oilseeds in Ryazan region in 2016 was 139.6 thousand tons with crop productivity of 15.3 dt/ha or 0.5 dt/ha more than in 2015. To determine the future state of the industry the oil crops bulk yield in Ryazan oblast will be predicted. To do this the built-in function "Trend Line" in MS Excel is used. The investigation has shown that the trend line approximates the original data most precisely (Konkina, V.S, 2015). This is evidenced by the value of the determination coefficient approaching one (R2 = 0.9078) that allows us to conclude that the forecast will be reliable (Fig. 1).

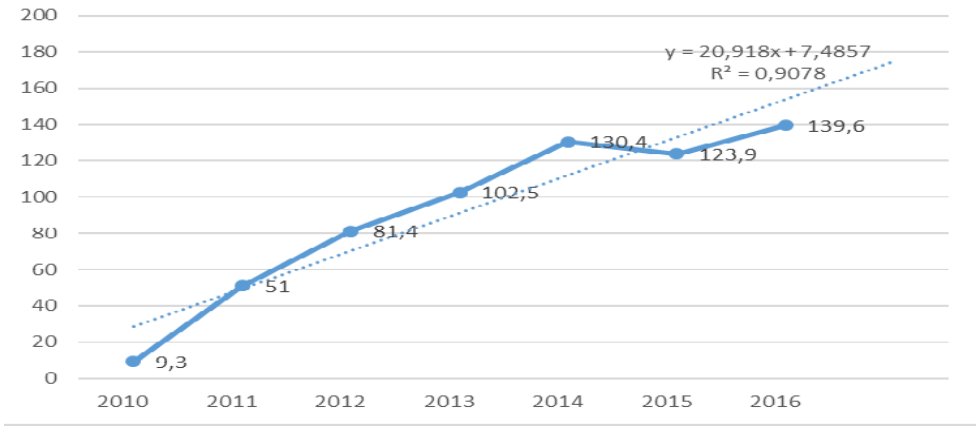

Figure 1 – The trend line of oil crops bulk yield in Ryazan oblast determined with the help of least-squares procedure in MS Excel

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According to the forecast the positive trend in agriculture will remain. According to the calculations the bulk yield of oilseeds in Ryazan oblast will increase by 62.75 thousand tons or 47.19 % in the next three years and will comprise 195.75 thousand tons by 2019. This situation is largely due to price environment. The level of prices for oil crops sale by agricultural producers in 2015-2017 was higher than in previous years (Fig. 2). Oil crops price environment at the domestic market is currently influenced by the decline of their initial reserves and increase in demand from oil refineries. In years to come, according to forecasts of experts, the prices for oilseeds will continue to grow, as raw materials will only decrease. Moreover, it becomes vitally important to increase the acreage of oil crops, the price of which is most stable at the background of market grain prices (Konkina, V.S., 2011; Vinogradov, D.V., 2009; Shchur, A.V., 2016).

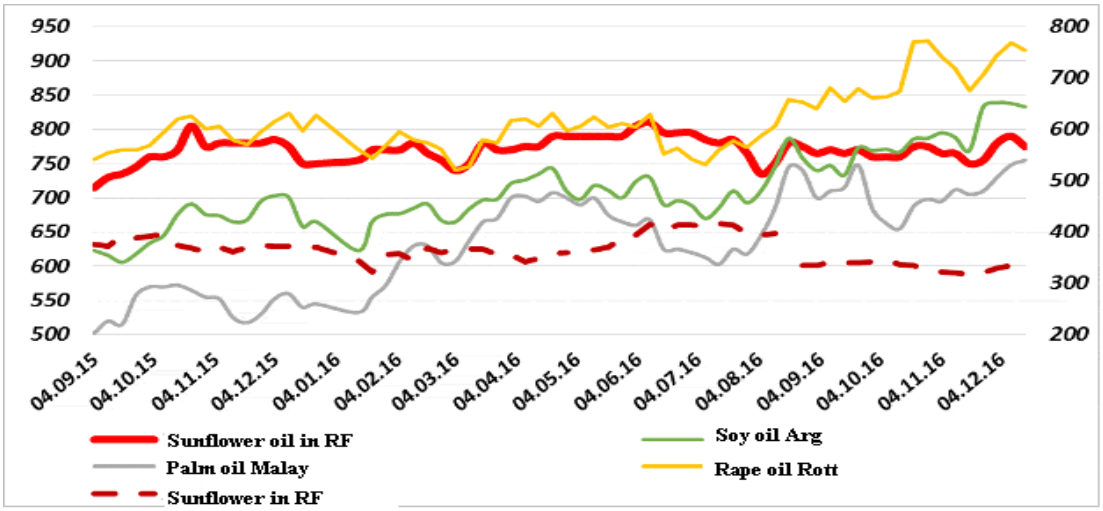

Figure 2 – Global oil crops prices, dollars/ton

The analysis of oil crops growing in the region shows that the current volumes of their production and use do not correspond to the consumer market. The increase in the share of oil crops in the structure of crops acreage and the work to get the maximum yield are requirements of market economy. The more so, as recent years have been characterized by unstable and difficult-to-predict grain prices.

At the same time, it was established in the course of the analysis that agricultural farms of Ryazan oblast have quite significant unused in-farm reserves, which will promote the growth of oilseeds yield, some increase in gross production of products and some decline of production costs and, consequently, improve the economic efficiency of the industry.

As a result of the analysis, it was revealed that the most important factors directly affecting the yield of oilseeds are the doses of mineral and organic fertilizers.

At the same time, as the investigation results showed, in the analyzed farms the doses of mineral fertilizers did not exceed 0.8-1.7 dt/d in recent years, and based on the fertility of available soils, they must be used at least 2.5-3 dt/d.

In addition, the results of the correlation-regression analysis of the relationship between yield and doses of mineral fertilizers showed that an increase in the dose of their application by 1 dt/d per 1 hectare causes the increase of oilseeds yield by 2.942 dt/ha.

The results of calculations showed that in agricultural organizations of Ryazan oblast, it is possible to add 0.35 dt/d per 1 hectare from available reserves of mineral fertilizers.

This will make it possible to obtain additional 1.0297 dt of oil crops per hectare (2.942 dt/ha 0.35), and 1946 dt (1.0297 dt/ha, 1890 hectares) from the entire area.

Then the total gross yield is 71498 dt (table 2).

Additional products will require additional expenses in the amount of $ 4.63 thousand, including:

a) labor expense of $ 1,684.58:
0.87 $ 1,946 dt = 1,684.58 $ (0.87 $ - actual costs of labor remuneration);
b) electricity 98.6 $:
0.05 $ * 1,946 dt = 98.6 $;
c) oil products 2,623.53 $:
1.35 $ * 1,946 dt = 2,623.53 $;
d) other costs (including costs for finalizing additional products, etc.) 220.87 $:
0.11 $ * 1,946 dt = 220.87 $.

Therefore, total costs will be made in the amount of $ 549.78 thousand, and the estimated prime cost of 1 dt of grain is $ 7.69, which is lower than the actual level by $ 0.15 (table 2).

Table 2 – Reserves of increasing the product gross output

	Increase of fertilizers doses		Total
	mineral	organic	
Bulk yield, dt:			
factual	69,552	69,552	69,552
additional	1,946	2,156	4,102
total	71,498	71,708	73,654
Production expenditures, thousand $:			
factual	545.15	545.15	545.15
additional	4.63	6.90	11.53
total	549.78	552.05	556.68
Prime cost 1 dt, $:			
factual	7.84	7.84	7.84
additional	7.69	7.70	7.56
Prime cost decline 1 dt, $	0.15	0.14	0.28

The second most important reserve for increasing the yield of oilseeds is an increase in the doses of organic fertilizers.

The analysis showed that at farms of Ryazan oblast, they are not supplied with sufficient quantities on the basis of nutrient content in soils, especially since mineral fertilizers will not be introduced in full. At the same time, each additional ton of organic material gives increase of 2,821 dt from each hectare (as a result of the correlation-regression analysis, the following equation was obtained for the relationship between yields of oilseeds and the doses of organic fertilizers: $\overline{Y}$ xt = 9.388 + 2.821 + 3.191t).

During the analysis it was found that in most agricultural enterprises there is an opportunity, based on cattle manure, to add 0.5 tons of organic fertilizers per hectare. This will increase the yield by 1.1405 dt (2.281 dt/ha 0.5). Additional 2,156 dt will be received (1.1405 dt/ha 1,890 ha) from the total area.

This amount of products will require additional expenses in the amount of $ 6.90 thousand (table 2), including:

a) labor expense of $ 1,866.38:
0.87 rubles. 2,156 dt = 1,866.38 $ (0.87 $ - actual costs of labor remuneration);
b) own organic fertilizers (including the cost of making) 1,777.07 $:
(1,890 hectares * 0.5 tons) * 1.88 rubles. = $ 1,777.07.
c) electricity 109.23 $:
0.05 $ * 2,156 dt = 109.23 $;
d) oil products 2,906.65 $:

$ 1.35 * 2,156 dt = $ 2,906.65;
e) other costs (including expenses for finalizing additional product) 244.7 $:
0.11 $ * 2,156 dt = 244.7 $.

In total, costs (including additional ones) will comprise $ 552.05 thousand and the estimated prime cost of 1 dt will be $ 7.70, which is below the actual level by $ 0.14.

Table 3 – Composition and structure of prime cost of 1 dt of the product in 2016

Cost of accounts	Expenditures for 1 dt of grain	
	$	% to total
Costs of labor with social security contributions	0.87	11.0
Seeds and planting stock	0.40	5.1
Mineral fertilizers	3.06	39.1
Organic fertilizers	0.27	3.5
Chemical crop protection products	0.30	3.8
Electric energy	0.05	0.7
Oil products	1.35	17.2
Insurance costs	1.13	1.7
Fixed capital	1.28	16.4
Others	0.11	1.5
Total	7.84	100.0

In general, due to the implementation of two proposed measures in the farm, it is possible to receive additional 4,102 dt of the product.

The total gross production (actual + additional) will be 73,654 dt. Total costs (including additional) are $ 556.68 thousand. Based on this, the estimated production cost of 1 dt will be reduced to $ 7.56 (or $ 0.28 compared to the actual level).

Thus, the implementation of the proposed measures will not only increase the production of oilseeds, but the efficiency of agricultural production as well.

The agro climatic conditions of Ryazan and neighboring oblasts are favorable to grow oil cruciferous crops and soybean. The market of oilseeds is unlimited. Besides, these crops are good preceding crops for many agricultural plants, have phytosanitary and weeds removing effect, are high protein fodder for animals and are indispensable for providing livestock with green fodders until late autumn in the green conveyor system (Vinogradov, D.V., 2009; Khabarova, T.V., Trishkin, 2016).

Such crops as spring rape and sunflower occupy a significant share in the structure of oil crops in the southern part of the Non-black soil zone (Fig. 3). However, this sub-sector as a whole has not been reconstructed in accordance with the principle of high adaptability and productivity and biologically full products. In this regard the introduction, expansion of oil plants range and selection of new high-productive crops are determinants in optimizing production systems. One of the advantages of non-traditional and minor crops is increased genetically determined resistance to stress factors of the environment. In connection with this such crops have great potential and high economic importance (Vinogradov, D.V., 2012; Torma, St., 1992; Mustafayev M.G., 2008). In our opinion, the complex investigation of oil crops, first of all, Brassicaceae (cruciferous) and studying their adaptive and productive potential at the population, specific and ecotypic levels in the Non-black soil zone of Russia are very important.

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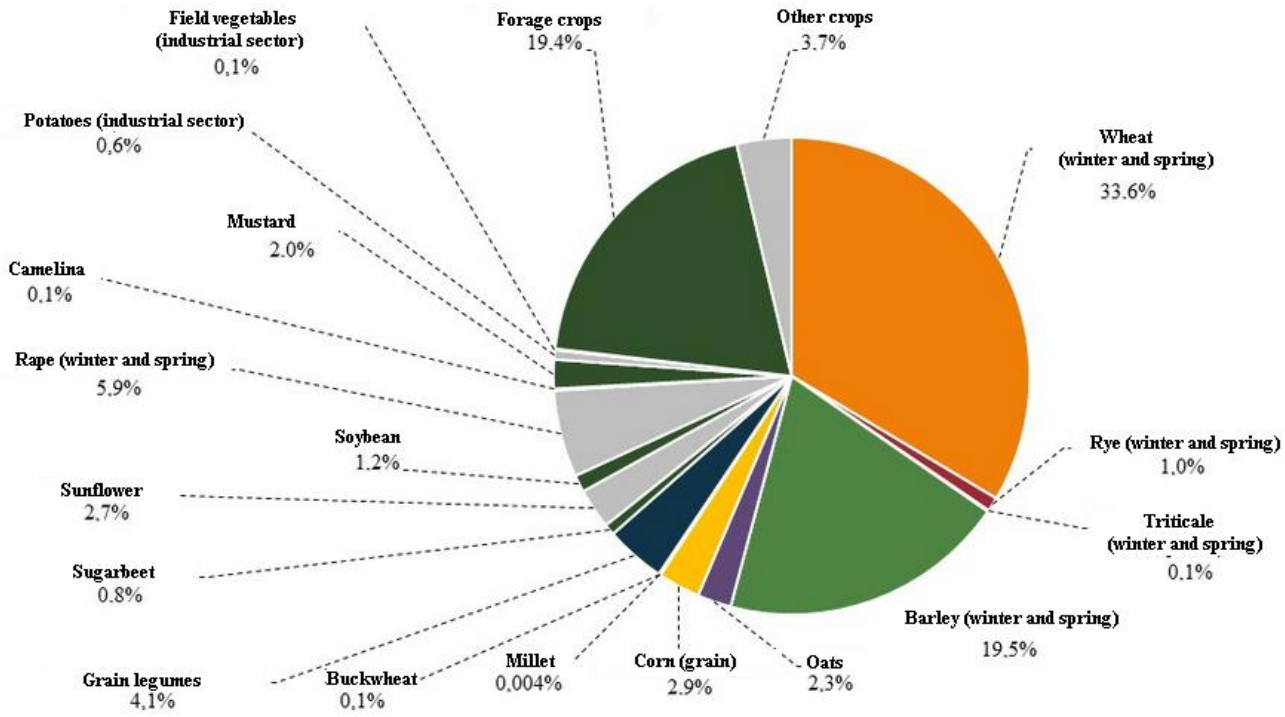

Figure 3 – Structure of crops acreage in Ryazan oblast in 2015, %

RESULTS AND DISCUSSION

Such promising oil crops as flax, spring and winter bird rape, winter rape, white and brown mustard, oil radish and some others can be considered as alternatives to spring rape and sunflower.

An important factor is the fact that a short vegetation period significantly reduces the natural risks of crop shortage and sales revenues of spring bird rape, rape and flax can be received already in July and the first half of August.

Investigations at farms of Tula and Ryazan oblasts in 2003-2016 showed that despite practically simultaneous seeding periods the duration of biotic seasons of the oil crops being studied varied widely depending on the plant and growth conditions (Table 2).

Table 4 – Oil crops ontogenesis phases duration (days) in the southern part of the Non-black soil zone

Crop	Sowing-sprouting	Sprouting-budding	Budding-blossom	Sprouting-harvest	Sowing-harvest
Spring rape	9	31	22	97	106
Spring bird rape	8-9	23	19	75	84
White mustard	7-8	22	18	72	80
Brown mustard	8	35	19	93	101
Oil radish	8	26	21	86	94
Flax	9	40	18	105	118
Sunflower	11	43	27	116	127

The earliest ripening crops are spring bird rape and white mustard (in average 72-85 days from sowing to harvest depending on the variety), that is they ripen in the region in the second decade of July. As a rule, the harvesting machinery is relatively not so busy at this time and, consequently, harvesting these crops can be carried out in the shortest agro technical terms with minimal crop losses. Harvesting these crops in July (in good weather) also saves money on their postharvest conditioning. And the main thing is spring bird rape

growing makes possible to supply oil pressing factories with early oilseed raw material and agriculturalists to sell it for a more expensive price.

Then spring rape ripens (102-111 days from sowing to harvest) and flax (104-116 days), which can be harvested in the second - third decade of August as well as in early September.

Spring rape production nowadays is based on high-yielding non-erucic and low-glucosinolate varieties (type “00”) guaranteeing oil and meal and meeting the world quality standards. The State Register of Selection Inventions includes more than 50 varieties of spring rape approved for use in the Russian Federation of which about 30 ones are of Russian selection. New varieties and hybrids of spring rape exceed the ordinary ones in yield by 25-30 %. Over the past 10 years more than 30 spring rape varieties of both native and foreign selection have been studied in the competitive test at variety test plots of Ryazan oblast. When regionalization some preference was given mainly to varieties of native selection due to their better fitness to the regional conditions of growth, more stable yield (13.8-23.0 dt/ha) and high oil content (41.1-48.1 %). Varieties and hybrids of foreign selection, as a rule, are not drought-resistant, having longer maturation and unstable yields in different years.

Nevertheless, spring rape promising varieties and hybrids of German company Rapool Ring GmbH selection and registered for growing in our region show good results. These varieties and hybrids of rape are adapted, first of all, to the extreme conditions of the continental climate. Along with high yield and oil content they are highly resistant to drought, diseases, lodging and cracking of pods, and possess early and medium-ripeness making possible to get high yield of quality products before unfavorable conditions.

Our investigations at JSC “Avangard” in Ryazan district, JSC “Maliniosccchi” in Pronsk district of Ryazan oblast, JSC “Spasskoe” in Novomoskovsk district of Tula oblast and other farms of the zone in 2011-2016 showed high efficiency of growing foreign hybrids and varieties of spring rape. So the yield of spring rape hybrids Salsa, Mirko, Hunter, Hidalgo and others was from 25.1 dt/ha to 33.5 dt/ha depending on the investigation variant.

Only after harvesting of all crops, including cereals, sunflower ripens in the second half of September. The southern and south-eastern districts of Ryazan oblast having the average crop yield of 15-20 dt/ha grow sunflower to get seeds. For example, there have been investigations of sunflower varieties and hybrids at JSC "Voskhod" in Sarai district of Ryazan oblast for several years in order to determine the most productive and adapted to local conditions variety. Good results in growing sunflower have been achieved at JSC “Ukholovo-Agro” planning to increase the area for this crop next year.

Long terms of oil crops ripening allow organizing a conveyor system for their harvest, reducing the harvesting and grain processing facilities load.

Let's take a closer look at flax. Crown flax (v. Brevimulticaulia) or oil flax is a relatively new crop for Ryazan and Tula oblasts having great prospects. Due to early planting time, short vegetation period and absence of common pathogens, oil flax is a good precursor for most agricultural crops grown in the oblast, including winter wheat, and does not limit other oil crops in the rotation. These features make it an ideal insurance crop in a case of winter crops loss and make possible to form the planned yield even in drought conditions due to the effective use of winter moisture reserves in regions where sunflower growth is very risky. The absence of this crop pests and diseases in our conditions allows us not to use insecticides and fungicides. Flax can occupy up to 30 % of acreage. For comparison, rape and bird rape can occupy up to 20 % of acreage and sunflower - 2 times less.

Oil flax requirements for warmth and moisture supply differ somewhat from cruciferous oil crops. In 2007 and 2013 rape and bird rape yields were low, not more than 12-14 centners per hectare as the record dry hot weather in May-July promoted the rapid growth of the most dangerous pests of these crops and the emergence of thin shoots. 2010 was catastrophic for cruciferous oil crops, the maximum yield in the fields of the oblast was not more than 6-7 dt/ha.

Oil flax has rather high biological plasticity, resistance to lack of moisture, especially in the initial period of vegetation and high response to fertility improvement. In addition, oil flax in our investigations did

not have any pests and diseases at all which could not but affect higher yield (on the average 5-5.5 dt/ha higher than that of rape and bird rape). Flax is considered to be the most productive early spring oil crop and the potential of its yield exceeds 25-30 dt/ha.

The experience of oil flax growing at JSC "Avangard" in Ryazan district and at the agrotechnological experimental station of RSATU (variety Sunlin) in Ryazan oblast showed the crop planting efficiency and the annual yield exceeded 18 dt/ha and in some years (2008, 2009, 2013) was up to 27-30 dt/ha.

Interesting and promising for Ryazan oblast crops are brown mustard, winter rape and bird rape.

Mustard has the earliest seeding time and the shortest vegetation period. Brown mustard is most demanded by processors, the demand for white mustard is unstable. Gray mustard is divided into high-erucic (the content of erucic acid in seeds is more than 10 %) and low-erucic which is 15-20 % more expensive. Scientists have created several varieties of low-erucic gray mustard, the seeds of which will provide high price for the sale of commercial oilseeds. At present, gray mustard is not practically grown for oilseeds in Ryazan oblast.

Nevertheless, the wide experience of the technology of growing white and gray mustard was accumulated at KFK "Urozhaynoye" in Mikhaylovsky district of Ryazan oblast. Here, high yields are obtained annually, harvesting mustard for seeds from more than 500 hectares.

For many years there have been talks in the agrarian world of the region about food winter rape for oil seeds. It is difficult to imagine a crop whose technology is simpler than that of winter rape except for oil flax. Most believe that food winter rape is both a highly profitable and relatively risky crop in the oblast. Opinions differ only in the assessment of the ratio between the risk of rape partial loss in severe snowless winters and possible income. Nowadays some farms of the oblast have winter rape on small areas as an experiment. For example, winter rape of variety Severyanin proved to be very successful in the fields of Ryazan oblast with 24-26 dt/ha in 2008 and 2014.

Winter rape is a plant that has changed greatly in recent years as a result of human activities. This manifests itself both in appearance and in chemical composition. It is clear that new varieties in Russia today should present economic growth. However, there are few commercial double zero quality varieties and seeds of food winter rape.

Besides, widening oil crops assortment makes it possible to provide the population with a variety of very useful vegetable oils of local production.

The qualitative analysis of oils fatty acid composition of the period under study shows that spring rape (average 60.5 %) and spring bird rape (63 %) occupy the leading positions in most valuable oleic acid. Oil flax seeds as well as sunflower have not more than 21 % and 28.5 % of oleic acid correspondingly. For comparison, we note that the refined olive oil has more than 65 % of oleic acid and it is not coincidence that olive oil is recommended to prevent cardiovascular, gastrointestinal and other diseases. In addition, vegetable oil with high content of oleic acid is an indispensable component for the canning industry.

The vegetable oils expiry date depends on the content of linoleic acid increasing the resistance to oxidation. This oil is rich in natural antioxidants-tocopherols also causing some positive effect on the human body. From this point of view, there are no oil crops among those being studied equal to flax (the content of linoleic acid is more than 50 %).

CONCLUSION

The analysis of oil crops production in the southern part of the Non-black soil zone of the Russian Federation shows that the current volumes of their production and use do not correspond to the consumer market. An increase in the share of oil crops in the structure of agriculture and the work to get the maximum yield are requirements of market economy.

Thus, the possibility to grow successfully all studied oil crops without an exception in the south of the Non-black soil zone has been proved. The stable high yield of high quality seeds was obtained from spring rape, bird rape and oil flax. The increased interest in food rape, bird rape and flax is determined by high economic efficiency of production, good adaptation to moderate climate, high yield of oilseeds, high oil content and creating an ideal background for subsequent crops in crop rotation.

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