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## The cultivation efficiency of new hybrids of spring rape in the conditions of the Krasnoyarsk Region

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# The cultivation efficiency of new hybrids of spring rape in the conditions of the Krasnoyarsk Region

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**Abstract.** The article deals with the effectiveness of the cultivation of new hybrids of spring rape by Rapool company selection in the conditions of the Krasnoyarsk forest-steppe. In modern agriculture the role of different kinds is increasing, the attention is paid to such indicators as a high level of adaptability, resistance to diseases, the stability of oilseed production, and the improvement in the fatty-acid composition of marketable seeds. Six new spring rape hybrids of the Rapool company selection were studied, the biological and actual crop yields were assessed, and the effects of crop structure elements on yields were determined. The assessment of the biological crop yield of the main alimony of the crop structure shows that it varies by hybrids and varies greatly from 8.8 t / ha for the Currie KL hybrid to 13.8 tons for the Miracle hybrid. The correlation analysis of the obtained data showed a significantly high correlation of yield with a mass of 1000 grains (correlation coefficient +0.86) and a high negative correlation of yield with the number of seeds in the pod and the number of fruits per plant (-0.89). The highest seed yield of 6.25 t / ha in 2018 formed a Cultus hybrid. A high economic effect was shown by the applied technology of complex protection of spring rape: the increase in production profitability of the Cultus KL hybrid was 31%, and that of the Curry KL - 14% compared with the control variant without the use of protective equipment and growth-promoting products.

## 1. Introduction

The high demand for oilseeds in the world and Russia is due to the need to provide the growing population of the planet with vegetable oils, the growth of the livestock industry, which needs high-protein feed, the development of other industries where rapeseed, camelina and mustard oils are raw materials. An analysis of the current state of the plant growing industry of oilseeds has shown that an increase in the area under oilseeds is accompanied by an increase in the supply of new varieties and hydrides of these crops [1]. The yield of oilseeds depends on the kind, the quality of the seed, natural and climatic conditions, the applied agricultural technologies and etc. The role of different kinds in modern agriculture is increasing, the attention is paid to such indicators as a high level of adaptability, resistance to diseases, the stability of oilseed production, and improvement in the fatty-acid composition of marketable seeds.

In recent years, the area of spring rape sowing and its production have increased dramatically in the Krasnoyarsk Region. According to the Ministry of Agriculture and Trade of the Krasnoyarsk Region in 2012, the area under rapeseed was 16,600 hectares, in 2018 a little more than 100,000 hectares, in six years they grew almost 7 times. The growth of acreage in Russia for this period amounted to 5 times. The areas of oilseeds are increasing due to the development of trade relations with Southeast Asia, in



particular with Mongolia and China. In 2017, about 20 thousand tons of rapeseed were shipped for export to these countries, this year it is planned to ship about 40 thousand tons of this crop there. Consumption of rapeseed is also increasing in the Krasnoyarsk Region itself. In this regard, there is interest in expanding the range of varieties and hybrids of spring rape.

Foreign scientists are also engaged in the study of new kinds and hybrids of spring rape. According to S.E. Roques and P.M. Berry, seeding rates affect plant density and oilseed yield, while the optimum plant population density for hybrid kinds is lower than for open-pollination kinds [2].

In the work of V. Krček and P. Baranyk the issues of the impact of the use of new kinds and hybrids on increasing the yield were studied and the economic effect of their introduction into production was calculated. The results were obtained that hybrid varieties, despite their higher cost, can generate revenue 5% more than linear varieties [3].

## 2. Research methodology

In 2018, for the first time, experiments were conducted on the experimental field of the EScPC “Borsky” FSBEI HE Krasnoyarsk SAU, 51 km north of the city of Krasnoyarsk, and experiments were carried out to study the yield and main elements of the spring rape crop in the Krasnoyarsk forest-steppe conditions. For research, hybrids of spring rape of a new generation were selected: Solar KL, Salsa KL, Cultus KL, Curry KL, Lumen, Miracle. Each hybrid was laid in replications, and its placement was in two blocks systematically, the working plot is 30 m<sup>2</sup>. The rape hybrids were sown according to the vapor precursor, before planting the rape, mineral fertilizer was cut in the amount of 100 kg of Azafoska, in the summer at the beginning of budding the rape plants were fed with the microbiological preparation Azofit, Phytaprom LLC at a rate of 1 l / ha. Protection against harmful organisms (weed vegetation, pests and diseases) was carried out with preparations of JSC August. The crop protection chemicals are used when a pest (weeds, pests and diseases) reach an economic threshold of harm (ETH). The sowing date is May 25, 2018, the seeding rate is 70 pcs / m<sup>2</sup>, depth is 3–4 cm, sowing by the SSFC seed drill - 7, post-sowing rolling. The control variants did not use chemical methods of plant protection and microbiological preparations. Experiments on spring rape were laid according to the method of conducting field agrotechnical experiments with oilseeds [4]. Methods of accounting for rape harvest: a week before the combine harvesting, test sheaves were selected from each of the four typical working plots of 0.25 m<sup>2</sup>. In total, one square meter to determine the structure of the crop and biological yield. The number of plants was counted, the height of the plants was measured, the mass of the sheaf as a whole and the seeds were determined separately, the number of pods from each plant was calculated, and selectively 25 pods from each sheaf (totaling 100), and the number of seeds in the fruit was also calculated. The mass of 1000 seeds was determined after drying and bringing their moisture content to standard.

The actual yield of various rapeseed hybrids was taken into account on October 4, 2018 by the selection harvester TERRION 2010. The yield resulted in 12% humidity and 100% purity in accordance with GOST 10583-76 [5]. The height of the cut was maximum, so as to completely remove the entire crop on the branches, but not lower, since the lower part of the stems was still green.

## 3. Results

In 2018, the time of sowing rape due to cold and rainy May shifted by 2 weeks, usually spring rape is sown at the end of the first and beginning of the second decade of May. When sowing rape hybrids on May 25, the first shoots appeared almost simultaneously on all hybrids, the first phases of growth and development, shoots, leaf growth, stem formation and the beginning of budding in all hybrids occurred simultaneously, and the duration of interphase periods was sharply reduced (table 1). Most likely, this was due to the very hot June weather and severe drought (HTI -0.3).

**Table 1.** Dates of the onset of the main growth phases of spring rape hybrids in 2018.

Hybrids	Sprouts	Caulis growth	Budding	Blossom time	Green	Yellow	Full
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Solar KL	13.06	23.06	30.06	13.07	27.07	29.08	29.09
Salsa KL	13.06	23.06	30.06	14.07	27.07	24.08	27.09
Cultus KL	13.06	23.06	30.06	16.07	27.07	2.09	29.09
Currie KL	13.06	23.06	30.06	14.07	21.07	27.08	26.09
Lumen	13.06	23.06	01.07	20.07	30.07	2.09	29.09
Miracle	13.06	23.06	01.07	19.07	30.07	11.09	30.09

The length of the growing season from germination to the end of the growing season was almost the same. It varied from 106 days at the Currie hybrid, to 110 at the Miracle hybrid. Due to the late sowing dates, the ripening time of rape has been very long.

On the control variant, without the use of chemical protection agents and growth-promoting preparations, the plants were low, did not bloom for a long time, the caulis of the inflorescences were eaten by the blossom weevil.

To bring the harvest into account and determine its structure, a week before the combine harvest, test sheaves were selected (figure 1) using the above method.



**Figure 1.** Test sheaves to determine crop structure.

According to GOST 10583-76, to determine the yield, the moisture content of pure oilseeds was adjusted to 12%. Rape hybrids were evaluated for the main elements of the crop structure (table 2).

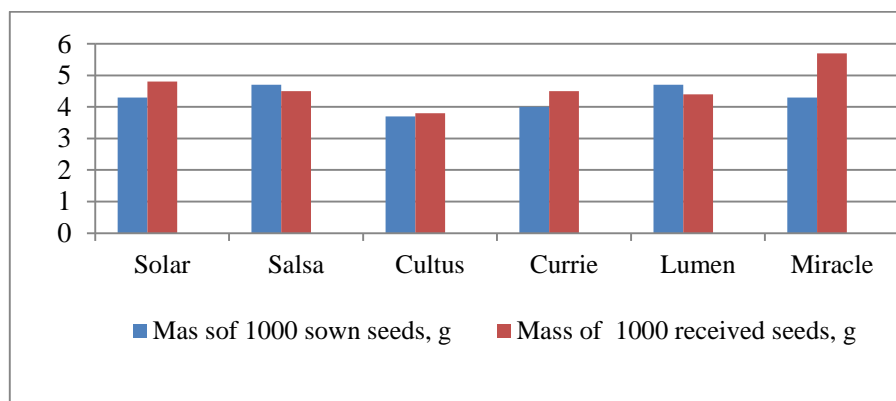
**Table 2.** The structure of the crop and the biological yield of oilseeds of spring rape hybrids.

Hybrids	Plants, for harvesting, pcs m <sup>2</sup>	Fruits on plant, pcs	Seeds in the pod	The mass Of 1000 seeds, g	Biological yield, seeds, t / ha
Solar	60	111	38	4,8	12,1
Salsa	60	163	26	4,5	11,4
Cultus	65	140	27	3,8	9,3
Currie	56	113	31	4,5	8,8
Lumen	63	169	22	4,4	10,3
Miracle	60	140	29	5,7	13,8

The analysis of the results showed that the survival rate of plants for harvesting was better at the Cultus hybrid, with a seeding rate of 70 pcs. square meter, 65 pcs. were left for harvesting - this is about 93%. The Currie hybrid had the lowest survival rate and it was 80%. According to the number of fruits

on one plant, Lumen and Salsa hybrids stood out. There were more seeds in the pod at the Solar hybrid. By the mass of 1000 seeds, the Miracle hybrid stood out; its mass of 1000 seeds was 5.7 g.

It should be noted that the mass of 1000 seeds obtained on hybrids in 2018 was almost the same with a mass of 1000 seeds obtained as seeds planted in the experimental plot - this is clearly seen in the graph of Figure 2. Only the Miracle Hybrid, the mass of 1000 seeds obtained during cultivation under Krasnoyarsk forest-steppe was 1 g higher.



**Figure 2.** The mass of 1000 seeds sown and obtained in research.

The assessment of the biological yield of the main alimony of the crop structure shows that it varies in hybrids and varies greatly from 8.8 t / ha for the Currie hybrid to 13.8 tons for the Miracle hybrid.

To determine the effect of crop structure elements on yield, a correlation analysis was performed using Microsoft Excel, which showed a significantly high correlation of yield with a mass of 1000 grains (the correlation coefficient was +0.86). The high negative relationship was between the number of seeds in the pod and the number of fruits per plant - 0.89.

The assessment of spring rape hybrids on the actual harvest yield, carried out by us in the combine method, showed that maturation at the end of the growing season did not take place simultaneously, although according to external signs (the seeds in the pods were black) and looked as if everyone had ripened equally. The hybrids, which by their varietal characteristics are included in the later groups of ripeness by the length of the growing season, such as Currie KL and Cultus KL (table 3), have the fastest ripening habits, and their moisture content during harvesting was the lowest.

**Table 3.** Assessment of spring rape hybrids by actual yield on varieties with plant protection.

Hybrids	Harvest Yield, t / ha	Harvest seed moisture, %	Actual yield, t / ha
Solar	5,23	19,5	4,70
Salsa	6,60	14,1	5,97
Cultus	6,62	14,0	6,25
Currie	6,22	13,4	5,70
Lumen	6,13	20,0	5,70
Miracle	6,00	18,5	5,42

The actual yield of oilseeds is reduced to 12% moisture and 100% physical purity of the seeds. The highest seed yield in 2018 was formed by the Cultus KL hybrid, the yield of which was 6.25 t / ha. Table 4 assesses the yield of hydrides on the control variants without the use of plant protection products.

**Table 4.** Assessment of spring rape hybrids by actual yield under control without protection.

Hybrids	Harvest Yield, t / ha	Harvest seed moisture, %	Actual yield, t / ha
Cultus	3,12	14,0	3,12

Currie	3,02	13,4	3,04
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Table 5 gives an estimate of the economic efficiency of using the full range of protection for new hybrids of spring rape, which showed the best biological indicators for growing: for the Cultus KL hybrid, the application efficiency was 5,812.5 rubles per 1 hectare compared to the partial protection option, for the Currie hybrid KL –2,508 rubles per 1 ha.

**Table 5.** The main indicators of the economic efficiency of spring rape hybrids in complex agrotechnology of cultivation compared with the control.

Indexes	Cultus (with protection)	Cultus (control)	Currie (with protection)	Currie (control)
Harvesting capacity, c / ha	62,5	31,2	57,0	30,4
Selling price for 1 c, rub.	2500	2500	2500	2500
Got from sale, rub.	15625	7800	142500	76000
Spending on 1 ha, rub.	50802	28249	50334	28181
Cost price 1 c., rub.	812	905	883	927
Profitability level, %	207	176	183	169

The increase in profitability of production of the Cultus KL hybrid was 31%, and in the Currie KL - 14% compared with the control variant without protection.

#### 4. Conclusion

As a result of the study, it was established that in modern conditions the role of different kinds in increasing the production of oilseeds increases. With the use of integrated agrotechnology for the cultivation of spring rape in the conditions of the Krasnoyarsk forest-steppe, new breeding hybrids of the company RAPOOL showed good performance of the elements of the crop structure and high harvest and actual yield. Analysis of the results showed that the survival rate of plants for harvesting was the best on the Cultus KL hybrid — about 93%; the Currie KL hybrid had the lowest survival rate and it was 80%. According to the number of fruits on one plant, Lumen and Salsa hybrids stood out. There were more seeds in the pod at the Solar KL hybrid. By the mass of 1000 seeds, the Miracle hybrid stood out; its mass of 1000 seeds was 5.7 g. High harvest yields were formed by Cultus KL and Salsa hybrids, 6.62 and 6.60 t / ha, respectively. The highest actual seed yield (6.25 t / ha) was shown by the Cultus KL hybrid due to the low harvest moisture of the seeds. The lowest moisture content at seed was the Currie KL kind (13.4%). A high economic effect was shown by the technology of integrated protection of spring rape: the increase in production profitability of the Cultus KL hybrid was 31%, and that of the Currie KL - 14% compared to the control variant without the use of protective equipment and growth-promoting products.

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#### References

- [1] Goncharov S and Gorlova L 2018 Oilseeds: new challenges and trends of their development *Scientific and technical bulletin of the All-Russian Scientific Research Institute of Oilseeds* **2** (174) 96-100
- [2] Roques S and Berry P 2016 The yield response of oilseed rape to plant population density *The Journal of Agricultural Science* **154** 305-20
- [3] Krček V and Baranyk P 2013 Comparison of the economic efficiency, growing hybrid and op winter oilseed rape varieties *Proceedings of International PhD Students Conf. MendelNet. 20-*

- 21 November 2013 (Brno, Czech Republic) pp 89-93
- [4] Lukomts V ets 2010 Methods of conducting field agrotechnical experiments with oilseeds (*Krasnodar: All-Russian Scientific Research Institute of Oilseeds Press*) p 327
- [5] GOST 10583-76 1976 Rapeseeds Industrial Raw Materials, as amended on November 22, 1990, No. 2897 *Moscow* p 14