Evaluation of flax varieties of the long-lived Tomsk breeding in the CRNZ

A.D. Simagin*, *A.S.* Simagina, *E.K.* Barnashova, *E.A.* Vertikova, and *D.A.* Pokrovskaya

Federal State Budgetary Educational Institution of the Russian Academy of Agriculture named after K.A. Timiryazev, Moscow, Russia

Abstract. In 2024, 6 varieties of the Tomsk school of breeding were tested at the RGAU MSHA field experimental station. the conditions of the year for the cultivation of flax proved to be optimal. Among all varieties, the Tomich variety was distinguished by the highest fiber yield (36.5%). In terms of seed productivity, the Tomsk 18 variety was the leader (82.5 pieces per plant), however, the same variety showed the lowest safety for harvesting (420 plants from 1 plot). The Krepkov Memory variety had the highest technical length (71.28 cm).

1 Introduction

Flax is a traditionally Russian culture, which from time immemorial has occupied not the least place in strengthening the Russian economy. Initially, it was cultivated in the Vladimir, Tver, Pskov, Smolensk and Yaroslavl regions [1]. However, with the development of scientific breeding of this crop, the area of cultivation began to increase and already in the twentieth century, flax was cultivated on the territory of 25 regions. The first variety of flax registered in the State Register was the 806/3 variety bred by Rudzinsky D.L. at the breeding station of the Petrovsky Agricultural Academy. This variety was zoned in 1932. By breeding this variety, the problem of increasing the collection of fiber from a hectare of arable land was solved. In comparison with the cultivated samples of those times, grade 806/3 exceeded the fiber yield by 90-110%, and the yarn was characterized by the least breakage and high quality. However, the 806/3 variety was tall and had a high tendency to lodging. Among other things, the first grade of flax was severely affected by fungal diseases [4].

In general, by the early 50s of the twentieth century, the problem of fungal diseases of flax was already widespread, rust and fusarium wilt of flax were found everywhere. Therefore, already in 1951, the L-1120 variety was zoned, which was just noted for its resistance to lodging and rust. Its stem height was less than that of the 806/3 variety [3].

In the Tomsk region, the study of flax began in 1937. Siberia, in principle, is not an optimal region for the cultivation of flax. Therefore, the main task immediately became the breeding of varieties of this crop adapted to the climatic conditions of the region. Tomsk scientists studied the meteorological conditions of the region, after which it became known that the number of days with temperatures above 10 °C is 110, and the sum of active

* Corresponding author: alexander.d.simagin@yandex.ru

temperatures is 1700°C, while for flax the optimal growing season is 70 ...90 days, while the growing season can be prolonged up to 100 days. Therefore, such environmental conditions forced breeding for precocity [10].

In addition, during the growing season in the Tomsk region, on average, only 200-220 mm of precipitation falls, and in May, recurrent frosts are possible, which, according to a combination of factors, forces breeding for resistance to a low hydrothermal coefficient [5].

At the moment, 73 varieties of flax have been registered in the State Register of Breeding Achievements Approved for Use in the Russian Federation [7], of which 11 varieties are selected by the Siberian Federal Research Center for Agrobiotechnology of the Russian Academy of Sciences. On average, the growing season of all these varieties is 75-85 days. Tomsk varieties are the most precocious among all varieties of flax. The fiber content of these varieties ranges from 24.7-29.3%. The varieties of the Tomsk school of breeding are not highly resistant to fungal diseases and, moreover, complex resistance to a group of diseases [9].

Varieties of Tomsk selection annually occupy at least 30% of all sown varieties of flax. Figure 1 shows the data of the Rosselkhozcenter on the volume of sowing of flax seeds in 2023.

Variety	Years	
	2023	2022
Long-lived flax, thousand t.		
Grant	0,71	0,49
Tomskiy 17	0,31	0,30
Tomskiy 18	0,21	0,32
Universal	0,19	0,18
Marilyn	0,14	0,37
Tomic 2	0,13	0,05
Caesar	0,13	0,21
Nadezhda	0,13	0,12
Dobrynya	0,08	0,07
Tverskoy	0,08	0,07

Fig. 1. The volume of flax varieties sown in the Russian Federation in 2023, according to the Federal State Budgetary Institution Rosselkhozcenter [11].

As can be seen from Figure 1, the top 10 sown varieties include 3 flax varieties of the Tomsk school of breeding (Tomsk 17, Tomsk 18, Tomich 2). At the same time, the volume of sowing of the Tomich 2 variety has increased almost 3 times.

2 Materials and methods

The objects of the study were 6 varieties of long-lived flax (Tomich, Tomich 2, Tomsky 17, Tomsky 18, Toast 5, in Memory of Krepkov).

Tomsk 17 (T-17). The variety is early-maturing, the growing season is 75 days. High-yielding. The yield of flax seeds is 8 c/ha, fiber is 14 c/ha. The average fiber number is 15, the flexibility is 56.3 mm. The quality of the combed fiber reaches 22 grades. The fiber content in the stems is 35%. The variety is resistant to shedding, lodging, disease resistant to fusarium and rust. It was zoned in 1996: in Russia - in the Northwestern (2), Central (3) and West Siberian (10) regions [8].

Tomsk 18 (T-18). Early-maturing variety, the growing season is 80 days. High–yielding seeds - 12.2 kg/ha. The yield of fiber is 13.6 c/ha. The fiber content in the stems is 32-36%.

It is resistant to lodging and the main fungal diseases - rust and fusarium. The variety was included in the State Register for the Volga-Vyatka (4), West Siberian (10) and East Siberian (11) regions in 1996 [8].

TOST 5. A medium-ripened variety. In the Northwestern region, the average straw yield is 45.7 c/ha, and the seed yield is 4.4 c/ha. The weight of 1000 seeds is 4.8 g. The fiber content is 29.3%, the relative breaking load is estimated at 15.8 gs/tex. The growing season is 80-86 days. Resistance to lodging is 4.3, to shedding - 4.7, to drought - 4 points. The variety was included in the State Register for the Northwestern (2), Volga-Vyatka (4) and West Siberian (10) regions in 2006 [8].

In memory of Krepkov variety. An early-maturing variety. The growing season is 82 days. The seed yield is 6.2 kg/ha. The weight of 1000 seeds is 4.5 g. The average yield of flax straw in the region is 55.4 kg/ha. The yield of fiber is 12-14 c/ha. The fiber content is 26.7%. Resistance to lodging is 3.9 points. The variety was included in the State Register for the West Siberian (10) region in 2012 [8].

Tomic. An early-maturing variety. In the North-Western region, the average yield of flax is 39.6 c/ha, seeds - 4.5 c/ha. The weight of 1000 seeds is 4.8 g. The fiber content is 28.8%. The growing season is 79 days. Resistance to lodging - 4.3 points, to shedding - 4.3 points, to drought - 3.7 points. It was included in the State Register for the Northwestern (2) and Central (3) regions in 2017 [8].

Tomic 2. Early ripening variety. The total fiber content is 27.9-32.8%. In the North-Western region, the average yield of flax is 39.5 c/ha, seeds - 4.5 c/ha. The weight of 1000 seeds is 4.7 g. The growing season is 85 days. Resistance to lodging - 4.4 points, to shedding - 4.5 points. In the Vologda oblast, the yield of flax straw is 44.4 c/ha. It is included in the State Register for the Northwestern (2), Central (3) and Volga-Vyatka (4) regions [8].

Each variety was sown on a plot of 1 m^2 in three-fold repetition. 7 rows with 15 cm aisles were marked on the plot. The samples were sown with a seeding rate of 290 seeds per row, which was equal to 20.3 million pieces of germinating seeds per hectare.

Soil treatment was carried out mechanized. The main treatment was carried out in autumn, on April 25, the treatment was carried out with a disc harrow. The breakdown of the acreage was carried out on May 2. The shape of the plot is rectangular. Right angles were beaten off by superimposing a right triangle with an aspect ratio of 3:4:5 using twine. The breakdown of the field was checked by carefully measuring the sides of the rectangle, the corners were marked with firmly hammered field pegs. On both sides of the tier, the sides were measured along the longitudinal line, taking into account the tracks and pegs were placed.

The sowing was carried out on May 3. They were sown manually, a certain amount of seeds was poured into a bag, which was completely sown on each row. The depth of seeding is 2-3 cm. The marking of the rows was carried out with a manual marker (7 working organs – horns). During the growing season, the onset of phenological phases was assessed.

The crop structure was carried out after a week and a half of drying of the material. During the assessment of the crop structure, 20 plants were selected from which the technical length and height of the plants, the diameter of the stem at the base and at the inflorescence were measured. After that, the number of boxes was counted, then the number of seeds was counted, and at the end the mass of seeds from the plant was measured. At the end, the indicators were calculated: meanness, fluidity and the average number of seeds in a box. Meanness is an indirect indicator of the amount of fiber in flax stems, and fluidity is an indirect indicator of fiber quality (that is, the amount of long fiber in the stem). After assessing the structure of the crop, the number of plants in the sheaf was calculated in order to calculate the safety of plants for harvesting.

The cold-water lobe method was used to determine the fiber yields. After assessing the structure of the crop, 20 stems without boxes were placed in a tank with cold water for 3 weeks. After that, the stems were taken out of the water and hung up to dry. After drying, the resulting flax was weighed, the fiber was isolated using a laboratory flax grinder LM-3. The percentage yield of fiber was determined by the proportion, where the mass of the obtained flax was taken as 100 percent.

3 Results and discussions

Meteorological conditions in 2024 were quite hot and arid, but in a few days in June, the monthly precipitation rate fell and the lack of moisture was avoided. Precipitation peaks occurred on June 6 (59 mm) and June 18 (25 mm). Figure 2 shows the meteorological conditions of 2024.

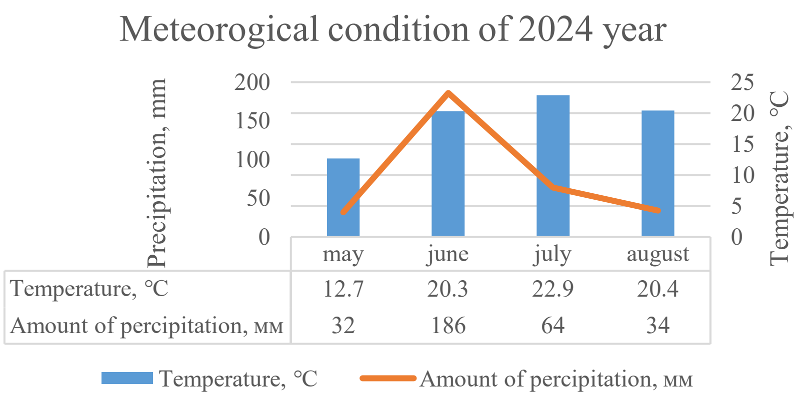

Fig. 2. Meteorological conditions in 2024

If we look at the average daily temperatures, then in May 2024 the deviation from the average annual temperatures was -0.9°C, in June - +2.6°C, in July - +2.4°C, in August - +1.2°C.

Table 1 shows the main results of testing of flax varieties of long-lived Tomsk breeding.

Table 1. The main results of testing Tomsk varieties at the field experimental station in 2024

Analysis of the structure of the flax crop						The number of stems from one plot, pcs	Weight of flax stems, g	Fiber output, %
Variety	Stem Analysis			Inflorescence analysis				
	Technica l length, cm	Mykness	Stem escape	Number of seeds per plant, pcs	The average number of seeds in one box, pcs			
Tomic	65.55	428.7	0.85	43.7	8.0	1536	7.99	36.5
Tomic 2	66.47	457.8	0.82	46.9	7.9	1351	6.46	33.6
In memory of Krepkov variety	71.28	406.7	0.92	41.7	7.6	787	17.48	28.8
Tomskiy 17	66.82	380.3	0.99	43.2	7.8	1333	10.52	28.2
Tomskiy 18	66.93	327.2	1.05	82.5	8.4	420	11.21	26.9
Tost 5	62.98	389.7	0.68	47.7	9.5	1422	8.78	25.7

In terms of technical length, the Krepkov Memory variety was in the lead (71.28 cm), while all other varieties showed more or less the same technical length in the range of 62-66 cm. In the course of the harvest structure, the meanness was also taken into account as an indirect indicator of the quality and quantity of fiber, Tomich 2 showed the highest meanness among all the others (457.8). According to the following indicator (fluidity), the Toast 5 variety turned out to be the best, which showed minimal fluidity.

If you look at the safety of plants for harvesting, you can see that the varieties of Memory of Krepkov and Tomsk 18 had the lowest safety for harvesting (787 and 420 pcs. accordingly). The seeds of these varieties showed relatively low germination, which further affected seed productivity. As can be seen from Table 1, the Tomsk 18 variety has the highest seed productivity compared to the rest (82.5 seeds on average per plant). At the same time, it can be noted that this variety showed a high mass of trusts due to the fact that it was gaining a lot of vegetative mass. This was also different from the Krepkov Memory variety, the mass of flax, which was 17.48 g.

In terms of fiber yield, Tomic was the leader among all other varieties (36.5%). Having the highest meanness, the Tomic 2 variety had a fiber yield slightly less than Tomic (33.6%). The lowest fiber yield was distinguished by the Toast 5 variety (25.7%).

4 Conclusion

Thus, in terms of fiber yield and preservation for harvesting, the Tomic variety was in the lead, with a percentage of fiber in the stems of 36.5%, and the number of plants for harvesting was 1,536 plants. A slightly lower fiber yield was shown by the Tomich 2 variety, which had this indicator at the level of 33.6%, however, this variety turned out to be better than all other varieties in the study in terms of meanness (457.8). In terms of the number of seeds from the plant, the Tomskiy 18 variety was in the lead, due to its low field germination. Tost 5 showed a rather low fiber content of 389.7, therefore, the fiber yield of this variety was low (25.7%), since the fiber content correlates with the amount of fiber in the stem. However, the Tost 5 variety turned out to have the best stem growth (0.68). The Krepkov Memory variety showed the largest technical length in the study (71.28 cm), however, this may also be due to low field germination in this variety.

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