

Special Features of Biology, Technology and Economic Efficiency of Long-Fibred Flax Cultivation in the Subtaiga Zone of Omsk Region

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Abstract—In order to increase production and improve the quality of linen flax products, it is necessary to use scientifically-based technologies of flax cultivation: espacement on the best backgrounds, timely and high-quality soil treatment, sowing seeds of zoned varieties of high generations, compliance with the optimal timing of sowing and harvesting, the use of crop protection chemicals, fertilization, taking into account the fertility of the soil and the planned harvest. According to the results of many years of research on the technology development of flax cultivation, the following agrotechnical scientifically grounded methods of its cultivation in the taiga zone of the Omsk region were recommended to the production: variety, sowing time, soil treatment system, fertilizer, term and method of sowing, seeding rates for fiber and seeds cultivation, care, harvesting terms. At this rate, in the variety test, the highest crop productivity of flax straw – 5.1 t/ha was provided by the variety Tost 5, and the highest crop productivity of flax straw-5.58 t / ha in 2000-2007 was obtained from a layer of grasses. Recommendations are given for each element. The technology analysis of cultivation of flax for fiber and seeds is carried out. Its economic evaluation is made. Economic calculations have shown that the flax cultivation can be highly profitable production, providing sustainable development of flax-growing companies.

Keywords—*fibred flax, crop productivity, variety, background, seeding, economic efficiency.*

I. INTRODUCTION

Long-fibred flax is a valuable technical crop that is cultivated in order to produce natural fiber. There is 18-33 % of its substance in the stems. Seeds are used for oil production. Flax fiber is one of the main raw materials of the textile industry in Russia, as it has high technological properties. Flax is one of the most time-taking crops, but with a correct and scientific approach to its cultivation, it is a profitable crop.

The present day, the strategy implementation of adaptive crop production in the long-fibred flax cultivation requires patterns identification of the culture productive process in different soil and climatic conditions [1], including in the taiga zone of the Omsk region, where in recent years its processing has been developing.

Soil and climatic conditions of the taiga zone of the Omsk region are suitable for growing long-fibred flax, as it is moisture-loving and temperature tolerant. Weather conditions during the growing season of flax in the Northern regions of the Omsk region meet the requirements of long-fibred flax to heat, and natural moisture conditions provide a high quality crop of flax fiber in most years.

To increase production and improve the quality of flax products, it is necessary to use scientifically-based cultivation technologies: espacement on the best backgrounds, timely and high-quality soil treatment, sowing seeds of zoned varieties of high crop productivity, compliance with optimal sowing and harvesting times, the use of crop protection chemicals, fertilization, taking into account soil fertility and the planned harvest [2].

For this reason, in the taiga zone of the Omsk region, the Department of Northern agriculture of the Omsk Agricultural Scientific Center (former SibNIICH) conducts research on the biology and technology of long-fibred flax cultivation.

The goal of research: to study the biological characteristics of lon-fibred flax varieties and culture practices of growing in the subtaiga zone of Western Siberia.

II. LITERATURE REWIEW

For long-fibred flax are favorable moderate temperatures of the growing season when the rains alternating with clear weather. Seeds begin to germinate at a temperature of 3 ... 5°C, but more evenly their germination occurs at a temperature of 10 ... 12°C. The sum of active temperatures required is about 60°C. Flax shoots endure frosts up to -5 ... -7°C. Favorable temperature during the "shoots - sprouting" period for the development of the stem and fiber is 10 ... 14°C, to bloom -15...16°C. Thereafter, the favorable temperature is 16 ... 18°C. For the period "shoots-the beginning of flowering" the required amount of active temperatures is 418...440°, "flowering-early yellow ripeness" - about 410°C. During flowering flax tolerates freezing to -2... -3°C, maturation--2... -4°C. The air temperature of more than 22°C in combination with dry weather minimises the growth of plants and strengthens the branching of stems and degrades the quality of fiber. Wide fluctuations in temperature during

the day, hot weather during the growth and development of long-fibred flax negatively affects its growth, crop productivity and quality of fiber. Under these conditions, the development of flax is faster; plants bloom earlier, and as a result are stunted with a shorter technical length of the stem. The sum of temperatures above 10C during the growing season of flax is 1100-1500°C.

Long-fibred flax is a moisture-loving plant. For swelling and germination of its seeds need 100 ... 160% water from their weight. The transpiration coefficient is 400 ... 430. Flax moisture demand increases from the "herringbone" phase to flowering, becoming high during periods of rapid growth and flowering. With a lack of moisture, the growth of the stem, the formation of fiber is delayed, and its quality decreases. Excessive moisture, especially after flowering, causes lodging of flax, tangling of stems, damage by diseases and leads to a decrease in crop productivity. Deposits of productive moisture in the soil in the layer 0 ... 20 cm-30 mm and more are sufficient for the growth and development of long-fibred flax.

Long-fibred flax is a long-day plant, moderately demanding to the intensity of sunlight. Under strong light, the branching of the stem increases, which leads to a decrease in the long fiber. With excessive shading, flax lies down, loose fibrous bundles are formed, and, as a consequence, flax of the worst quality develops.

The duration of the growing season (shoots - maturation) of long-fibred flax, depending on the group of ripeness and weather conditions, averages 70-90 days. Under rainy cold weather it tightens until 100 days and more, and under hot, dry weather is shrinking until 60-65 days. At this rate, in the conditions of dry hot summer of 2012, in the experiments of the Department of Northern agriculture of SibNIICH, the duration of the growing season of flax when sowing on May 15 was reduced to 52 days (early yellow ripeness).

Long-fibred flax is a culture demanding to soils. The best soils for it are well cultivated, fertile, structural, medium - and light - loamy, slightly acidic with a humus content of 2.5. 3.0% and good physical characteristics. Unsuitable for flax sandy, clay, overcrusted (easily forming a soil crust), swampy, with a high level of groundwater and saline soils.

An important condition for obtaining high flax yield is the presence of easily digestible nutrients in the soil. Since having an underdeveloped root system, long-fibred flax poorly absorbs nutrients in a hard-to-reach form. In addition, most of the nutrients consumed by flax for a fairly short period and unevenly. The maximum amount of nitrogen flax absorbs in the budding phase, and the lack of it in this phase greatly reduces the flax yield. The greatest amount of phosphorus flax consumes in the budding phase and in the period of "sowing-shoots". Potassium is needed since the beginning of growth and until flowering. To this phrase flax assimilates 60.84% of nitrogen, 63.80% of phosphorus and 71.90% of potassium of the total need. On the formation of 1 ton of fiber, flax takes out from the soil on average up to 80 kg of nitrogen, 15.40 kg of phosphorus and 60.100 kg of potassium. Flax is also very demanding to the trace element content in the soil: manganese, molybdenum and, especially, boron [3-5].

III. METHODS

The influence of varieties, backgrounds, fertilization, terms and norms of sowing, care methods, harvesting time on the crop productivity of long-fibred flax were studied in different years (since 1994).

Experiments were laid on gray forest soil in 4-fold repetition, with systematic placement of plots. Records and observations were carried out by the National Uniform Measurement Assurance System method.

Agricultural equipment in the experiment was used zonal: under-winter ploughing, early spring harrowing, pre-sowing treatment of seeds and soil. The sowing was conducted in mid-may (in the experiments with sowing date – according to the scheme) at a depth of 1.5-2.0 cm narrow way seeder SN-16 with tyne coulters. Handling included the packing, chem. weeding, insecticidal treatment if necessary. Harvesting was carried out by hand, straw was spread on the seasoning.

IV. RESEARCH RESULTS AND ECONOMIC EFFICIENCY

In the Omsk region, 3 varieties of long-fibred flax are zoned: Tomsk 16, Tomsk 18, Tost 5. Long-fibred flax variety testing conducted in the Department of Northern agriculture of SibNIICH for 5 years showed that on average during these years the highest crop productivity of straw – 5.1 t/ha, plant height – 76 cm and fiber output – 31.1% was formed by the Tost variety 5 (table.1).

TABLE I. LONG-FIBRED FLAX VARIETY TESTING, 2009-2013.

Variety	Crop productivity, /ha		Plant height, cm	The fiber output, %
	straw	seeds		
Tomskiy 16	4.3	0.67	63	30.7
Tomskiy 17	4.8	0.72	67	29.9
Tomskiy 18	4.5	0.74	71	29.5
Tost 4	4.9	0.62	70	30.0
Tost 5	5.1	0.57	76	31.1
Pamyati Krepkova	4.9	0.59	70	30.7

Therefore, it is necessary to include Tost 5 variety in the structure of sown areas and increase the area of sowing of this variety.

In crop rotation within 6...7 years the flax is being returned to the former field, since frequent return of flax on the same field there is a "flax-culture fatigue" of soil, which is reflected in the reduction in the harvest of flax because of the strong development of harmful microorganisms, and infestation of the flax crops of specific weeds, leading to significant reduction of crop productivity.

Sowing 2 years in a row does not significantly reduce the crop productivity and quality of flax. Typical "flax-culture fatigue" of the soil is expressed in the third or fourth year of re-sowing. As a result, the crop productivity of seeds is reduced by 50-60% due to the appearance of seedless and unicapsular plants, and flax straw -by 30-40 %.

One of the best backgrounds for long-fibred flax is clover and its mixtures with perennial Pooideae herbs. Clover with hay crop productivity of more than 30-40 C / ha is undesirable as a background, since the flax stalk becomes uneven, lies down, which complicates harvesting and reduces the quality

of products. In the subtaiga zone, the best background is the turnover of the grass layer, but high yields of flax can be obtained after other backgrounds: for seeded fallow, winter ruttishness, barley. Studies conducted in different years with Tomsk 16 and Tomsk 18 varieties showed that these backgrounds provided an increase in the yield of fiber and seeds compared with monoculture (table. 2, 3).

TABLE II. CROP PRODUCTIVITY OF STRAW AND OF TOMSK 16 VARIETY OF LONG-FIBRED FLAX SEEDS DEPENDING ON BACKGROUNDS, T / HA 1994-1997.

Background	Crop productivity of straw	Adding to continuous sowing	Crop productivity of seeds	Adding to continuous sowing
Continuos sowing of flax	1.45	-	0.24	-
Layer of herbs	2.56	1.11	0.61	0.37
Oats on the layer of herbs	2.61	1.16	0.56	0.32
Winter ruttishness on fallow	2.50	1.05	0.66	0.42
Barley (flax sowing in 2 years)	2.81	1.36	0.54	0.30
NSR ₀₉₅	0.644	-	0.058	-

TABLE III. CROP PRODUCTIVITY OF STRAW AND OF TOMSK 18 VARIETY OF LONG-FIBRED FLAX SEEDS DEPENDING ON BACKGROUNDS, T / HA 2000-2007.

Background	Crop productivity of straw	Adding to continuous sowing	Crop productivity of seeds	Adding to continuous sowing
Continuos sowing of flax	3.84	-	0.45	-
Seeded fallow	4.95	1.11	0.81	0.36
Layer of herbs	5.58	1.74	0.96	0.51
Barley on the layer of herbs	4.80	0.96	0.77	0.32
Winter ruttishness on fallow	4.26	0.42	0.64	0.19
NSR ₀₉₅	0.10	-	0.024	-

Flax is also demanding to quality soil treatment, which after perennial grasses begin with disking to a depth of 10 ... 12 cm in two directions. After 2-3 weeks, plow plough with plough-points to a depth of 20...22 cm, and in areas with less arable layer to its full depth. The best results are provided by August plowing of a layer of perennial grasses. Studies conducted by the tarsk agricultural experiment station showed that in the variant with plowing, the crop productivity of straw and flax seeds was 3.1 and 0.48 t / ha, when replacing plowing with flat-cut processing and disking, the crop productivity of straw decreased by 0.60-0.56 t/ha, seeds-by 0.06...0.14 t / ha. After early harvested grain crops (winter ruttishness, barley, annual grasses), the main soil treatment is carried out by the type of half-fallow. Immediately after harvesting the background-plowing, then harrowing and two cultivations as weeds grow: to a depth of 10 ... 12 and 8...10 cm.

Pre-sowing soil treatment begins with early spring harrowing to close the moisture, immediately before sowing the pre-sowing cultivation is carried out. All techniques should be aimed at leveling the soil. The best results are provided by preparation to a depth of 4...6 cm by combined

units coinciding the operations of bursting, smoothing and soil compaction. Soil preparation by combined units is the most cost-effective and less costly. In the experiments of the tarsk agricultural station, the best unit for pre-sowing soil treatment was RVC-3.6 combined unit. Using RVC-3.6 during soil preparation decreased weed infestation of crops. The increase in crop productivity of flax straw was 0.44 t/ha compared to the cultivation by the KPS-4 unit.

Fertilizer is the most important means of obtaining high and stable yields of long-fibred flax, as it is very demanding to the availability of nutrients in the soil in an easily accessible form. This is due to the short period of nutritional utilization, poor development of the root system with low taking capacity, sensitivity of plants to excess and lack of macro- and microelements in the soil.

Doses of fertilizer are calculated taking into account the fertility and the planned crop productivity. Research by tarsk agricultural experiment station, conducted on gray forest soil, showed that the decisive role in increasing the productivity of flax play nitrogen fertilizer. The most effective nitrogen fertilizers were when they were combined with phosphorus and potassium in different doses and combinations. The highest crop productivity of flax straw and flax seeds, respectively, 5.67 and 0.89 t / ha, was obtained by applying a complete mineral fertilizer at a dose of 60 KGD.V. / ha. From an economic perspective, the most effective was the application of fertilizers at a dose of N₃₀P₃₀K₃₀. In this variant, fertilizers were most highly paid for by the additional crop, and the resulting fiber was of high quality [6].

Researches of tarsk agricultural experiment station was found that the formation of straw and flax seeds crop, especially in dry years, a positive effect of micronutrient fertilizers. Under challenging environments, the use of micronutrients contributed to an increase in the fiber content in the straw. The greatest increases in straw yield: from 0.24 to 0.45 t / ha were obtained when processing seeds before sowing with boric acid at a dose of 0.4 kg per ton of seeds, cobalt sulphate-0.4-0.5 kg per ton of seeds, copper sulphate-0.8-1.0 kg. The most effective use of micronutrient elements is usage against the backdrop of complete mineral fertilizer. Before sowing biological fertilizer (agropol, Flavobacterium and risogrin) are also applied during seed treatment.

It is necessary to conduct sowing by quality seeds of zoned varieties. To obtain even sprouts, the seeds should be aligned and heavy. On the seeds flax for early harvesting and threshing is used, since with late harvesting and threshing, flax seeds have lower energy of sprouting and germination.

In order to increase the field germination and crop productivity of flax, it is necessary to conduct air-heat heating on the installations of active ventilation with warm air. In warm sunny days, the heating of seeds is carried out for 4...5 days on a tarpaulin or on dry concreted or asphalted areas, scattering them with a layer of 5...6 cm.

In order to disease control, the pretreatment of flax seeds is carried out. It has been established that the use of protectants increases the yield of flax straw by 15 ... 23%, increases the yield of fiber and improves its quality. Fungicides approved for use in the territory of the Russian Federation are used for pretreatment. The best effect is achieved by predressing with moisture and the use of micronutrients.

The productivity of long-fibred flax is significantly affected by the sowing period. Long-fibred flax must be sown at an average daily soil temperature of 7 ... 8°C at a depth of 5 ... 10 cm and the humidity of this layer is 50 ... 60% according to moisture storage capacity factor. Studies of the Department of Northern agriculture of SibNIISH conducted on gray forest soil found that a high crop productivity of flax is provided when sowing is carried out in the 2nd decade of May: the yield of seeds in an average of five years was 8.6 C / ha, flax straw-56.2 C / ha. The crop productivity and quality of long-fibred flax decreases when when sowing was carried out at a later date.

The study of seeding rates of long-fibred flax at tarsk agricultural experiment station (V. P. Kazantsev, V. A. Finagin, 2002) showed that the optimal conditions for the formation of a high crop productivity of flax with high quality are created at the seeding rate of 25 million germinating seeds per 1 hectare (120...130 kg/ha). The decrease or increase in the seeding rate relative to the optimal one had a negative impact on the productivity of flax. Thus, it reports that the most optimal seeding rate for straw production is 25 million germinating seeds/ha, which provides 37.0 – 59.0 C/ha; for seed purposes – 11 million of germinating seeds/ha, while it possible to produce 6.0-7.7 kg / ha of seeds.

The best way of sowing of long-fibred flax is a narrow row with a row spacing of 7.5 cm to a depth of 1.5...2.0 cm in heavy soils, 2.0...2.5 sm on light and medium loam soils, on light sandy loam soils - no deeper than 3 cm.

Care of long-fibred flax crops includes postseeding compacting, destruction of soil crust, control of weeds, pests and diseases, improving the growth and development of long-fibred flax.

In order to accelerate the ripening of long-fibred flax for 2 weeks before harvesting, the crops are treated with drugs: glyphor, tayfun (2-3l / ha).

Harvesting is the most difficult stage in the production of long-fibred flax goods in terms of conditions and labor intensiveness. To obtain high-quality flax fiber, it is removed in the phase of early yellow ripeness.

The main way to obtain retted stalks - dew lobe of flax stems, in which the straw is spread out in a thin layer on the

stem (flax). In this case, the duration of seasoning of retted stalks depends on the period of flax sowing (table. 4) [7].].

TABLE IV. THE DURATION OF RETTED STALKS SEASONING DEPENDING ON THE SOWING TERM OF LONG-FIBRED FLAX (KREPKOV A. P. 2000).

Sowing date	Variety	Harvesting date	Retted stalks receipt date	Seasoning days number
the 13 th of May	Tomskiy 17	August 10	August 28	20
	Tomskiy 18	August 17	September 8	23
the 23 rd of May	Tomskiy 17	August 21	September 13	22
	Tomskiy 18	August 23	September 16	25
the 2 nd of June	Tomskiy 17	August 28	September 28	30
	Tomskiy 18	August 30	September 5	36

In the Northern parts of the Omsk region, the optimal temperature for flax seasoning is observed only in August; in September it is 2 times lower, and in October it decreases to 0°C. Humidification conditions are also most favorable in August. Therefore, flax preparation for the purpose of receiving retted stalks should be conducted in August, preferably in the first two decades. When spreading later than the end of August flax does not have time to lie down and remains under the snow until spring. The retted stalks turns out to be of very poor quality and even with the most careful sorting it is not possible to get a good quality fiber.

Studies on the influence of sowing and harvesting on the crop productivity of the TOST 5 variety , conducted in 2015-2017, showed that when growing it on fiber, the optimal sowing time is 10th of May and harvesting in the phase of early yellow ripeness [8].

In highly arid, not typical for the zone conditions in 2012, the weather had the greatest impact on the retted stalks seasoning. The duration dynamics of retted stalks seasoning was the reverse in relation to the long-term average. When harvesting flax at early dates - on 16th , 23rd and 30th of July - the seasoning duration due to lack of moisture and high air temperature was 35 days. With increased rainfall, the receiving duration of retted stalks was reduced to 28 days. The most favorable conditions were formed in September, when the seasoning days number was reduced to 15, the average daily temperature was 11.3 C, the amount of precipitation was 33.7 mm (table.5).

TABLE V. RETTED STALKS SEASONING DURATION DEPENDING ON THE TIMING OF SOWING AND HARVESTING, TEMPERATURE AND PRECIPITATION (TARA, 2012)

Sowing date	Harvesting date	The ripening phase	Retted stalks receipt date	Seasoning days number	Average daily temperature, C	The amount of precipitation, mm
the 15 th of May	July 16	early yellow	August 20	35	19.8	13.5
	August 6	yellow	September 3	28	19.2	37.0
the 20 th of May	July 23	green	August 27	35	17.7	25.6
	August 6	early yellow	September 3	28	19.2	37.0
	August 27	complete	September 17	22	12.9	53.1
the 30 th of May	August 6	green	September 3	28	19.2	37.0
	August 27	early yellow	September 17	22	12.9	53.1
	September 10	yellow	September 25	15	11.3	33.7

The technology analysis of long-fibred flax cultivation and its economic efficiency made it possible to draw a number of conclusions.

First of all, it is established that the efficiency of cultivation of long-fibred flax in agricultural enterprises

linearly depends on the age of specialized equipment and the availability of its production process. The older the equipment and its obvious lack in the technological process of long-fibred flax cultivation, the lower the crop productivity, gross harvest and higher the production cost [9,10].

The economic efficiency and profitability of flax production is greatly influenced by the long-fibred flax cultivation technology and is based on its background - the culture previously concentrated on the area intended for long-fibred flax sowing.

We considered three options in the course of the investigations carried out:

- 1) Flax cultivation on the retted stalks (background - grain).
- 2) Flax cultivation on the retted stalks (background – perennial grasses).
- 3) Flax cultivation for seeds (background - perennial grasses).

TABLE VI. COMPARATIVE ANALYSIS OF TECHNOLOGIES OF LONG-FIBRED FLAX CULTIVATION IN THE SUBTAIGA ZONE OF OMSK REGION

Indicator	Cultivation technology of long-fibred flax			Score, points ^a		
	variant №1	variant №2	variant №3	variant №1	variant №2	variant №3
The cost of 1 centner of flax straw, RUB.	226.0	211.6	236.7	0.5	1.0	0
The cost of 1 centner of flaxseeds, RUB.	1517.0	1514.0	1479.2	0	0.5	1.0
Costs per 1 ha, RUB.	19660.5	20160.6	20401.3	1.0	0.5	0
Labor costs, person-hour.	1232.9	1253.1	1279.7	1.0	0.5	0
Gross yield of flax straw, centner	4000	4520	3620	0.5	1.0	0
Gross yield of flaxseeds, centner	700	700	800	0.5	0.5	1.0
The crop productivity of flax straw, centners from 1 hectare	40.0	45.2	36.2	0.5	1.0	0
The crop productivity of flaxseeds, centners from 1 hectare	7.0	7.0	8.0	0.5	0.5	1.0
Total, sum of points	×	×	×	4.5	5.5	3.0

^a. 1st place-1 point, 2nd place-0.5 points, 3rd place-0 points.

The most effective technology of long-fibred flax cultivation on retted stalks and seeds in the conditions of the zone of subtaiga (table.6) is option #2. This technology by the number of points scored takes 1 place. In this case, there is the lowest cost of flax straw, its high crop production and the highest gross harvest. This technology should be used in farms that cultivate long-fibred flax, mainly in order to obtain high-quality flax fiber. At the same time, enterprises using this technology will receive a high gross yield of flax seeds with an average cost - 1514.0 rubles per 1 cent.

Enterprises whose goal is to focus on long-fibred flax cultivation for high-quality seeds should apply technology number 3. In this case, there is the lowest cost of flax seeds-1479,2 rubles. per 1 centner and the highest gross yield-800 centners.

Option number 1 shows the average values of performance indicators. However, in economic terms, among the options under consideration, the long-fibred flax cultivation technology is less profitable both from the point of view of retted stalks obtaining and flax seeds production.

TABLE VII. EFFICIENCY (EFFECTIVENESS OF LONG-FIBRED FLAX CULTIVATION TECHNOLOGIES IN THE SUBTAIGA ZONE OF THE OMSK REGION

Indicator	Cultivation technology of long-fibred flax		
	variant №1	variant №2	variant №3
<i>Flax straw</i>			
Gross yield of flax straw, centner	4,000	4,520	3,620

Market price for 1 centner of flax straw, rub.	300	300	300
Revenue, thousand rubles	1,200	1,356	1,086
Cost price of 1 centner of flax straw, rub.	226.04	211.56	236.67
Cost of sold flax straw, thousand rubles.	904.2	956.3	856.7
Profit, thousand rubles	295.8	339.7	229.3
Level of profitability, %	32.7	35.5	26.8
<i>Seeds</i>			
Gross yield of flaxseeds, centner	700	700	800
Market price for 1 centner of flaxseeds, rub.	3,500	3,500	3,500
Revenue, thousand rubles	2,450	2,450	2,800
Cost price of 1 centner of flaxseeds, rub.	1,517.0	1,514.0	1,479.2
Cost of sold flaxseeds, thousand rubles	1,061.9	1,059.8	1,183.4
Profit, thousand rubles	1,388.1	1,390.2	2,316.6
Level of profitability, %	130.7	131.2	195.8
<i>Flax straw + flaxseeds</i>			
Level of profitability, %	85.6	85.8	124.8

The greatest profit and profitability is given by the long-fibred flax cultivation technology according to option No. 3 (table. 7), i.e., in the cultivation of flax for seeds. The overall level of profitability of sales (at 100% marketability) in this case is 124.8%.

The most favorable for the long-fibred flax cultivation for fibre is the option number 2. The level of profitability of sales of flax straw (with 100% marketability) is 35.5%, the total level of profitability of sales of flax straw and flax seeds is 85.8%.

Moreover, the influence of the level of marketability of long-fibred flax goods on the profitability of production is being determined (table. 8, 9).

TABLE VIII. OPTIMAL VARIANT DETERMINATION OF LONG-FIBRED FLAX CULTIVATION TECHNOLOGY FROM THE POSITION OF PROFITABILITY OF FLAX STRAW (WITH AND WITHOUT STATE SUPPORT)

Situation	Flax straw level of profitability, %					
	variant 1		variant 2		variant 3	
	without subsidies	in reliance on subsidy	without subsidies	in reliance on subsidy	without subsidies	in reliance on subsidy
1. Marketability of retted stalks – 100%, the company does not bear the costs of sale	32.7	106.2	41.8	120.4	26.8	97.0
2. Marketability of retted stalks – 100%, disposal is carried out at a distance of 25-30 km.	20.7	87.5	28.9	100.3	15.3	79.1
3. Marketability of retted stalks – 80%, disposal is carried out at a distance of 25-30 km.	-1.7	52.8	5.0	63.2	-6.1	45.9

4. Marketability of retted stalks – 60%, disposal is carried out at a distance of 25-30 km.	-24.9	16.8	-19.7	24.7	-28.2	11.5
5. Marketability of retted stalks – 50%, disposal is carried out at a distance of 25-30 km.	-36.8	-1.8	-32.5	4.9	-39.6	-6.2

The most acceptable flax straw cultivation technology, from the point of view of products marketability and the profitability level of production, is the technology number 2 (table. 8). In this case, the critical point after which the company begins to receive losses, even taking into account the support in the form of subsidies from the federal and regional budgets, is the level of marketability of flax straw-50%. If the manufacturer sells less than 50% of the flax straw gross collection, its activities are doomed to losses.

From the point of view of long-fibred flax seeds production, studies show that all technologies are effective

until the marketability of products is 45-40%. As soon as the threshold is lowered, the cultivation of the flax for seeds will be unprofitable. At all considered by us levels of production marketability (seeds of long-fibred flax), the level of production profitability is the highest on option No. 3.

In determining the most appropriate technology to obtain both retted stalks and flax seeds, flax growers should give preference to the option number 2. In this case, taking into account budget subsidies, with the marketability of 50% - retted stalks, 50%- seeds, the highest percentage of profitability -9.0% is observed (table. 9).

TABLE IX. OPTIMAL VARIANT DETERMINATION OF LONG-FIBRED FLAX CULTIVATION TECHNOLOGY FROM THE POSITION OF PROFITABILITY OF FLAX STRAW AND FLAX SEEDS (WITH AND WITHOUT STATE SUPPORT)

Situation	Retted stalks and flaxseeds level of profitability,%					
	variant 1		variant 2		variant 3	
	without subsidies	in reliance on subsidy	without subsidies	in reliance on subsidy	without subsidies	in reliance on subsidy
1. Marketability of flaxseeds – 100%, the company does not bear the costs of sale	85.7	119.5	88.8	126	90.5	120
2. Marketability of flaxseeds – 100%, disposal is carried out at a distance of 25-30 km.	73.0	104.6	75.8	110.5	77.9	105.4
3. Marketability of flaxseeds – 75%, disposal is carried out at a distance of 25-30 km.	34.6	60.2	37.1	65.2	37.9	60.3
4. Marketability of flaxseeds –60%, disposal is carried out at a distance of 25-30 km.	6.7	26.2	5.9	21.1	9.6	26.6
5. Marketability of flaxseeds – 50%, disposal is carried out at a distance of 25-30 km.	-10.4	5.9	-9.0	9.0	-8.0	6.2

At this rate, the long-fibred flax production with budget support is effective if the marketability of retted stalks and seeds is not less than 50%. In other words, if the producer does not ensure the sale of half of the goods produced, he will experience losses. In case of absence of the state support (subsidies), for ensuring profitable activity it is necessary to realize not less than 80-85% of flax straw and not less than 45-50% of flax seeds.

V. CONCLUSION

At this rate, the products of years of research to develop the long-fibred flax cultivation technology made it possible to recommend the following methods of its cultivation in the taiga zone of Omsk region: background, soil treatment system, fertilizer, term, method and seeding rate for fiber and seeds cultivation, care and harvesting.

Economic calculations show that the long-fibred flax production can be highly profitable, ensuring sustainable development of flax-growing companies.

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