Estimation of Fibres from Different Flax Varieties for Textile Production

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Abstract **– The flax is one of the oldest textile fibres in Latvia, but after the Second World War there was no work done in flax breeding. Therefore, there were only some local varieties, but mainly farmers had to use foreign varieties. The first task of the research has been to determine the best foreign varieties for Latvian climatic conditions and soils. Ten foreign varieties have been compared, namely: Vega 2, Snaigiai, Dangiai, Sartai, Jarok, Blakit, Vasilok, Levit, Iva and Hermes. The second task has been to determine the potential use of such Latvian varieties as Osupes 30, Priekulu 665. It has to be mentioned that the previously mentioned Latvian varieties have very low fibre yield, small percentage of long fibres and bad fibre quality. The best varieties for Latvian climatic conditions in 2010 were Vasilok and Dangiai. The research should be continued because in 2010 the weather was hot and dry and not typical for Latvia.**

Keywords – flax, fibre, fibre content, fibre length, flexibility, linear density, quality, stress, strain, stem

I. Introduction

The correct choice of varieties suitable to local soil and climatic conditions is the main key for further development of flax cultivation. During the time of the first Latvian independence, the flax was grown throughout the whole territory of the Republic of Latvia [1].

Priekulu, Stendes and Osupes plant breeding stations were involved in flax breeding in the 20-ties and 30-ties of the 20th century [3]. Flax breeding in Latvia stopped in 1970.

Nowadays varieties bred in other countries are grown in Latvia. They do not provide a stable stem yield and fibre quality in our climatic conditions.

Collection of flax genetic resources has been created by the staff of the Agricultural Science Centre of Latgale. Several accessions of the Latvian origin, created and collected before the Second World War were repatriated from N.I. Vavilov Institute of Plant Industry (Russia), the Flax Research Institute of Russia, and the Institute of Plant Genetics and Crop Plant Research (Germany) [1].

To determine suitability of Latvian soils and climatic conditions to foreign flax varieties, ten pilot fields were arranged in the Agricultural Science Centre of Latgale in 2010.

II. Materials and Methods

Twelve foreign and two Latvian flax varieties were used for experiments: Lithuanian – Vega 2, Snaigiai, Dangiai, Sartai, Belorussian – Jarok, Blakit, Vasilok, Levit, Iva, French – Hermes and Latvian – Osupes 30, Priekulu 665.

Flax cultivars sown on May 6, 2010 in four repeats with the seed density 110 kg/ha. Size of one field was 20m^2. During June 1 – 12, massive flax blooming was observed. Flax was ripened on August 16, 2010. Flax stems were dew retted for obtaining of better fibres.

To determine flax varieties that are suitable for Latvian climatic conditions and give a better quality of fibres for textile production, the following aspects were evaluated:

- Vegetation period;
- Stem yield;
- Stem length;
- Fibre content;
- Fibre colour;
- Fibre strength and extension;
- Fibre flexibility;
- Fibre fineness.

Flax fibre flexibility and colour was determined according to standard method ГОСТ 10330-76. Universal tester Instron was used to determine flax bundle strength and elongation characteristics (gauge length – 10 cm, rate of extension – 15 mm/min). Fibre linear density was determined according to the test method specified in the standard ГОСТ 10379-76.

From the selected fibres, bundles of 100 – 300 g were made. Fibres were straightened and kept for several days under load. At least for 24 hours fibre bundles were aged under normal climatic conditions before the experiments.

For fibre flexibility, tensile strength and elongation testing, at first the bundles were prepared as described above. After that 270 mm long middle parts were cut out. From the middle parts 30 new fibre bundles were formed with the mass of 420 ± 20 mg.

III. Results and Discussion

Vegetation periods for different varieties were from 85 till 91 days. The longest vegetation period was for the French variety Hermes – 91 days, but the shortest one for the Lithuanian variety Dangia – 85 days. Vegetation period of 87 days was for the varieties Sartai and Osupes 30, but 89 days – for the varieties Vega – 2, Snaigiai and Jarok, Blakit, Vasilok (Table 1). The similar experiment was done in Lithuania with different varieties [6]. Lithuania borders Latvia to the north and the climate is just a little different from that of Latvia, but the vegetation period for different flax varieties is shorter from 79 to 87 days.

The largest stem yield was for the variety Hermes – 6.4t/ha and the fibre yield was the second largest 1.9 t/ha (Fig.1). As to the variety Vasilok, stem yield was slightly lower, but fibre content was higher in the stems, and therefore the obtained fibre yield was higher – 2.1t/ha. The lowest stem yield was for the variety Blakit, but its fibre yield was higher than of the Latvian varieties: Osupes 30, Priekulu 665 and the Belorussian variety Iva.

Three different stem lengths were determined: total stem length, technical stem length and flowerhead length. Technical length is of primary importance – the length of stems after flowerhead was cut off. When taking into account technical length, it should be mentioned that the longest stems were those of the varieties Jarok 68.3 cm, Hermes 67.4 cm and Dangiai 64.6 cm, but the shortest ones for the varieties Osupes 30 and Priekulu 665 (Table 1). For the variety Priekulu 665, stem technical length was only 64% of stem length of the variety Jarok.

TABLE I
CHARACTERISTICS OF FLAX STEMS

Variety	Vegetation period; days	Stem yield; t/ha	Fibre content; %	Fibre yield; t/ha	Total stem length, cm	Technical stem length, cm
Vega -2	89	4.7	30.7	1.44	76.7	57.7
Snaigiai	89	5.2	31.5	1.64	72.8	59.3
Dangiai	85	5.1	31.8	1.62	81.7	64.6
Sartai	87	5	30.3	1.52	77.0	61.6
Osupes 30	87	4.3	29.3	1.26	66.8	52.6
Priekulu 665	87	3.8	30	1.14	65.3	43.5
Jarok	89	4.5	31.4	1.41	82.5	68.3
Blakit	89	3.6	35.7	1.29	75.9	58.2
Vasilok	89	6	34.8	2.09	78.4	64.6
Levit	89	4.8	32.6	1.56	78.0	58.4
Iva	87	4.5	29.8	1.34	70.2	56.9
Hermes	91	6.4	30.3	1.94	78.6	67.4

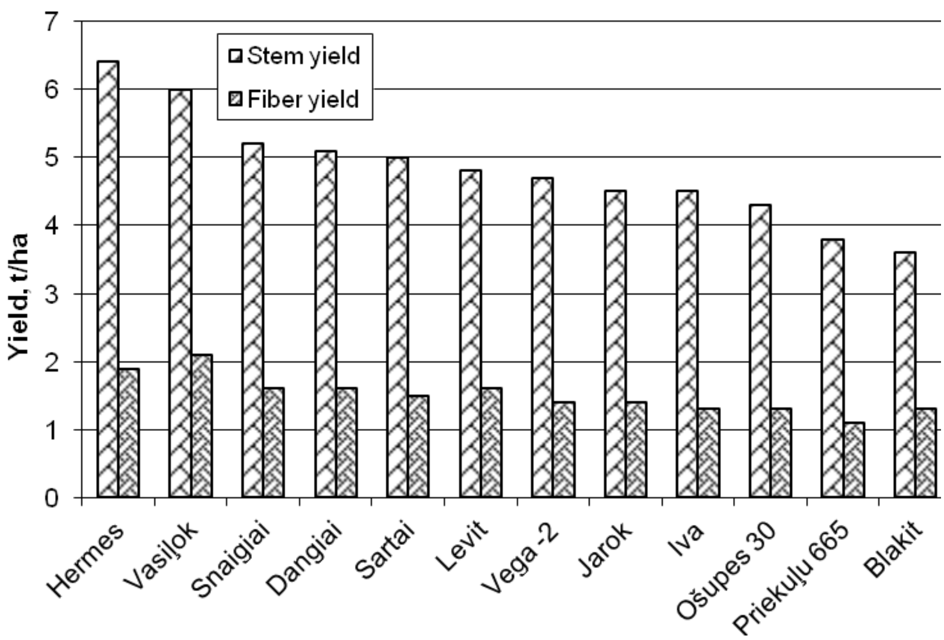


Fig.1. Stem and fibre yield of different flax varieties

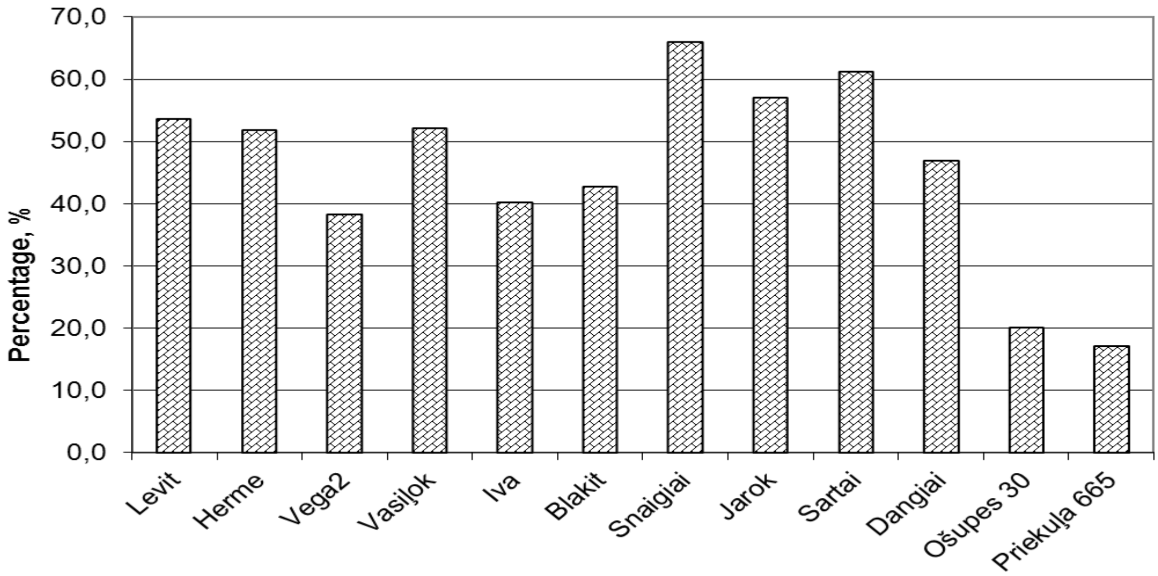
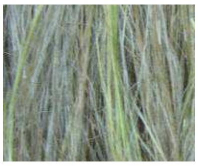


Fig.2. Long fibre percentage from the whole fibers mass

TABLE II
CLASSES OF FIBRE COLOUR

2	Levit			Blakit	3
2	Hermes			Snaigiai	2
1	Vega2			Jarok	2
3	Vasilok			Sartai	2
2	Iva			Dangiai	3

fibre mass. As the experiment was carried out during fibre bundle preparation for determination of flexibility and strength characteristics, then fibres, which were longer than 27cm, were selected as long fibres. The results are shown in Fig. 2. The largest long fibre percentage was for the variety Snaigiai (66%) and slightly lower percentage – for variety Sartai (61.2%) and Jarok (57.1%). Again the worst results were shown by the varieties Osupes 30 and Priekulu 665.

As the obtained results for the varieties Osupes 30 and Priekulu 665 were rather bad, the fibre quality of these varieties were not tested further.

The fibre colour was determined and divided into three classes. Fibres which are dark (deep green or green-brown) belong to the first class. Fibres which are grey-yellow, green-yellow or grey, but not dark grey belong to the second class. The third class is represented by fibres which are light or slightly yellow. The colours of fibres and their classes are shown in the Table II. For textile industry it is better when fibres belong to the third class. In this case, fibres of three varieties – Blakit, Vasilok and Dangiai – belong to it.

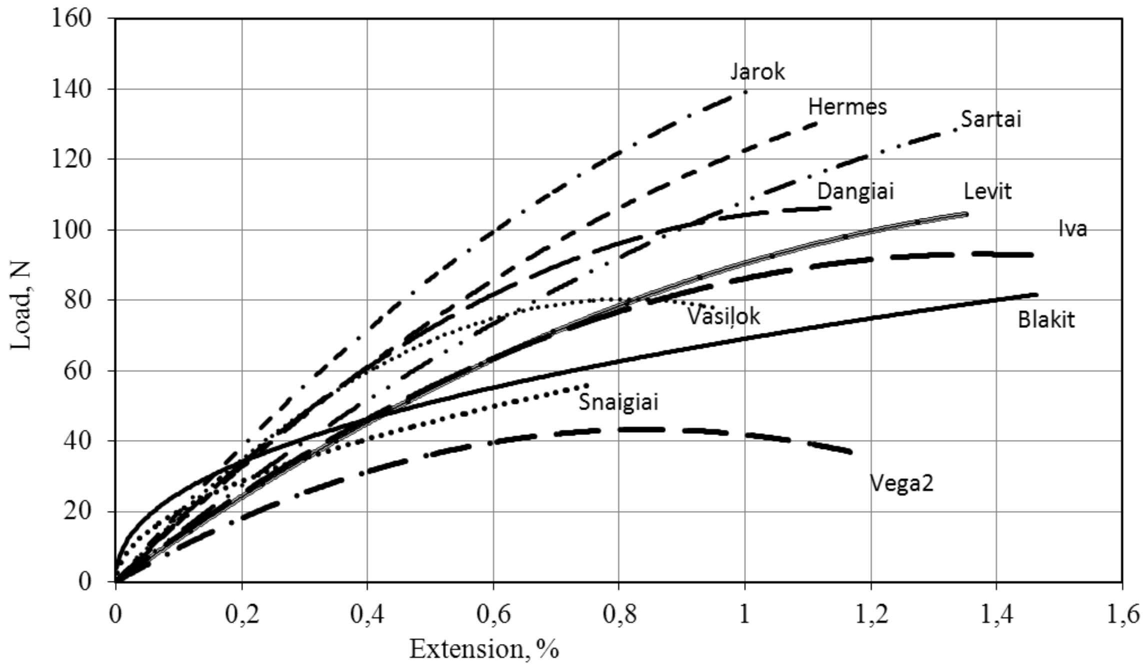


Fig. 3. Stress-strain curves of fibre bundles

TABLE III
CHARACTERISTICS OF BREAKING TENACITY

Variety	Average, cN/tex	Maximal, cN/tex	Minimal, cN/tex	Coefficient of variation,%
Levit	5.0	12.0	2.00	52.5
Herme	5.0	14.2	1.2	58.1
Vega2	2.4	12.3	2.0	48.3
Vasilok	4.9	8.9	0.5	36.8
Iva	5.0	8.9	0.5	36.8
Blakit	4.4	7.7	1.2	44.2
Snaigiai	2.2	3.8	0.8	39.0
Jarok	6.4	12.6	1.8	42.0
Sartai	5.2	9.7	1.8	40.1
Dangiai	7.2	11.3	2.7	28.6

Strength-strain characteristics were determined for fibre bundles. Results are shown in the Fig.3. Practically for all curves in the beginning when loads are low, non-linear regions are observed. It can be explained by sliding of elementary fibres in the bundle. Then more linear regions appear, except for the curves of the varieties Vega 2 and Vasiļok.

Flax fibre bundle extension ability was very small from 0.7% to 1.5%.

The working length of each fibre bundle between clamps was cut out and weighed to obtain a precise breaking tenacity. The results are shown in the Table III. The difference of breaking tenacity for different varieties is very large from 2.2 cN/tex to 7.2 cN/tex. The significant unevenness of results should be mentioned. Coefficient of variation is from 28.6% to 58.1%. Fibre bundles of the variety Dangiai have the highest breaking tenacity. Moreover, it is very interesting that for this variety the lowest coefficient of variation is observed.

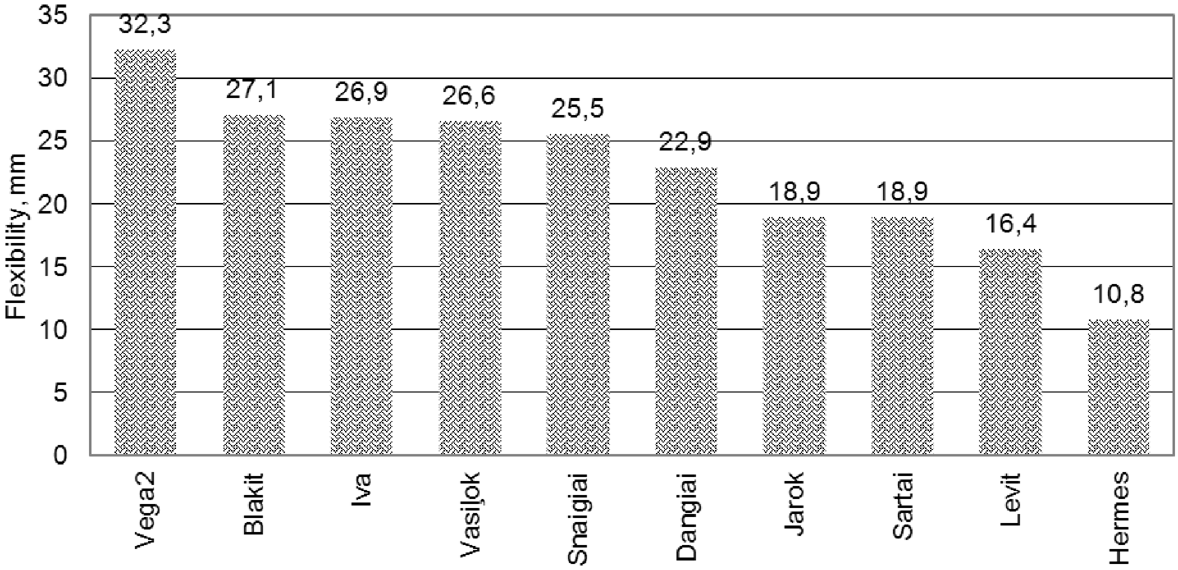


Fig. 4. Flexibility of fibre bundles

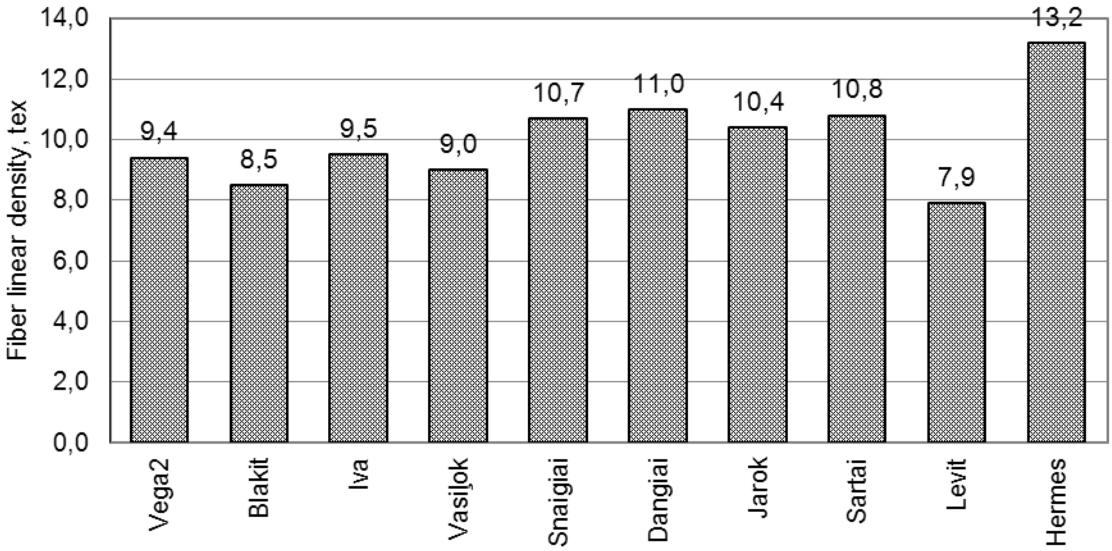


Fig. 5 Fibre linear density

The flexibility of fibre bundles is from 32.3 mm to 10.8 mm (Fig. 4). The most flexible fibres were obtained from the variety Vega2 (32.3mm), but the most inflexible fibres – from the variety Hermes. Unevenness of the results is very high. The coefficient of variation is from 48% to 87%.

The diagram of fibre linear density (Fig. 5.) shows that flexibility is not only influenced by fibre fineness. For example, the fibres of the variety Levit have the lowest linear density. It means that they are finer than all others, but their flexibility is the second lowest.

TABLE IV
RANKS OF FOREIGN FLAX VARIETIES

Characteristics	Points, a_i									
	Vega -2	Snaigiai	Dangiai	Sartai	Jarok	Blakit	Vasilok	Levit	Iva	Hermes
Vegetation period	5.5	5.5	1	2.5	5.5	5.5	5.5	5.5	2.5	6
Fibre yield	5.5	4	4	5	5.5	6.5	1	4	6.5	2
Stem yield	7	3	4	5	8.5	9	2	6	8.5	1
Stem technical length	8	5	3.5	4	1	7	3.5	6	9	2
Percentage of long fibres	10	1	7	2	3	8	5	4	9	6
Breaking tenacity	9	10	1	3	2	8	7	5	5	5
Linear density	4	7	9	8	6	2	3	1	5	10
Flexibility	1	5	6	8.5	8.5	2	4	9	3	10
Colour	5	4.5	2	4.5	4.5	2	2	4.5	4.5	4.5
$\sum a_i$	55	45	37.5	42.5	44.5	50	33	45	53	46.5
Rank	10	5/6	2	3	4	8	1	5/6	9	7

All ten foreign flax varieties were ranged taking into account such characteristics as (Table IV):

Vegetation period;
Fibre yield;
Stem yield;
Stem technical length;
Percentage of long fibres;
Breaking tenacity;
Linear density;
Flexibility;
Colour.

The points were given according to the range of the value for each variety. For the best value of each characteristic feature one point was given, for the second highest value two points were given and etc. For equal values of characteristic features the points were recalculated as the mean ones. Then all points for each variety were summed up. The highest rank was given to the variety that had the minimal number of points.

IV. CONCLUSIONS

The fibres from the Belorussian variety Vasilok turned out to be the most suitable for textile production. The Lithuanian varieties Dangiai and Sartai also showed good results. The worst results were shown by fibres from the variety Vega 2, which is the Latvian standard variety. It means that in Latvia there can be bread varieties that have better productivity and quality characteristics. The existing Latvian varieties Osupes 30 and Priekulu 665 have shown very low productivity of stem and fibre and can be used only for technical textiles from short fibres.

The research should be continued because in 2010 the weather was hot and dry and not very typical for Latvia.

ACKNOWLEDGEMENTS

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Ilze Baltiņa, Veneranda Stramkale, Rita Tetere, Nadežda Ozoliņa. Pētījums par dažādu linu šķiedru šķirņu piemērotību tekstiliju ražošanai
Linu šķiedras Latvijā audzē jau kopš sen seniem laikiem, bet linu selekcija veikta tikai Pirmās Neatkarīgās Latvijas laikā, bet pēc Otrā Pasaules kara darbs netika turpināts. Tikai pēdējos gados tas nedaudz atsācies. Līdz ar to vietējie lauksaimnieki ir spiesti pievērsties ārzemju šķirņu linu audzēšanai. Dotā darba mērķis, pirmkārt, ir noteikt Latvijas klimatiskajiem apstākļiem un augsnēm piemērotākās ārzemju šķirnes. Darbā salīdzinātas desmit ārzemju šķirnes - Vega 2, Snaigiai, Dangiai, Sartai, Jarok, Blakit, Vasiļok, Levit, Iva un Hermes, pēc to stiebru un šķiedru ražības, veģetācijas ilguma, garo šķiedru procentuālā daudzuma, šķiedru krāsas, stiprības, lokanības un smalkuma. Šķiedras audzētas un iegūtas Latgales lauksaimniecības zinātniskajā centrā 2010. gadā, bet testētas Rīgas Tehniskās universitātes, Tekstilmateriālzinību laboratorijā. Kā potenciāli visperspektīvākās šķirnes Latvijas apstākļiem ranžēšanas rezultātā iegūtas Baltkrievijas šķirne Vasiļok un Lietuvas šķirne - Dangiai. Vissliktākos rezultātus uzrādījusi šķirne Vega2, kas pašlaik apstiprināta kā linu šķiedru standartšķirne. Otrs darba mērķis bija noskaidrot Latvijas šķirņu Ošupes 30 un Priekuļu 665 konkurētspēju ar ārzemju šķirnēm. Secināts, ka minētajām šķirnēm ir ļoti zema gan salmiņu, gan šķiedru ražība, kā arī mazs garo šķiedru procentuālais daudzums. Līdz ar to šīs šķirnes nav piemērotas garšķiedras linu iegūšanai. Ņemot vērā visu iepriekš teikto, ļoti nepieciešams strādāt pie jaunu Latvijas linu šķirņu selekcionēšanas. Tā kā darbā analizēti tik viena gada dati, tad rezultātu precizēšanai nepieciešams darbu turpināt. It īpaši tāpēc, ka 2010. gada vasara bija karsta un sausa.

Илзе Балтыня, Веналанда Страмкале, Рита Тетере, Надежда Озолиня. Исследование разных сортов льняных волокон для производства текстиля
Льняные волокна в Латвии выращивали с давних пор, но селекционная работа была начата только в тридцатые годы прошлого века, а потом была прекращена. В настоящее время работа постепенно возобновляется. В связи с этим, сельские хозяйства вынуждены использовать зарубежные сорта. Целью данной работы является определение зарубежных сортов, подходящих для латвийских почв и климатических условий. В работе проведено сравнение десяти различных зарубежных сортов - Vega 2, Snaigiai, Dangiai, Sartai, Ярок, Блакит, Василек, Левит, Ива u Hermes по показателям урожайности соломы и волокон, длительности периода вегетации, процентного содержания длинных волокон, цвета, прочности, гибкости и тонины волокон. Волокна получены из льна, выращенного в Латгальском Сельскохозяйственном Исследовательском Центре в 2010 году, и тестированы в лаборатории исследований текстиля Рижского технического университета. Методом ранжирования как наиболее перспективные определены белорусский сорт - Василек и литовский сорт - Dangiai. Наиболее плохие показатели у литовского сорта Vega2, который в данный момент утвержден как стандартный сорт для Латвии. Также в работе было необходимо определить конкурентоспособность латвийских сортов Ošupes 30 u Priekuļu 665. Установлено, что у данных сортов не только маленькая урожайность соломы и волокон, но также низкий процент содержания длинных волокон. В связи с этим данные сорта не рекомендуется использовать для получения длинноволокнистого льна. Учитывая данные результаты, можно сделать вывод, что в Латвии более активно нужно проводить селекционную работу. В работе обобщены результаты исследования одного года, поэтому для их уточнения данная работа должна быть продолжена. Особенно это важно потому, что на волокна оказывали влияние слишком жаркие и сухие погодные условия лета 2010 года.