DISEASE RESISTANT VARIETY – A WAY OF THE ECOLOGICAL FLAX PROTECTION IN LITHUANIA

Izturīgu šķirņu daudzveidība - linu ekoloģiskās aizsardzības ceļš Lietuvā

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Abstract
Different methods to control flax diseases are admissible in the modern plant protection. It is advised to treat seeds and growing plants by fungicides to kill the pathogens of fungal diseases. Fertilisation by microelements and using of right means of agrotechnology (optimal sowing time, resistant varieties etc.) are preventing plants from physiological injures. However, one of the most effective means against diseases is development and growing of resistant varieties.
Fibre flax breeding has been carried out in Lithuania since 1922 in Dotnuva Plant Breeding Station. Since 1965 this work is being done in Upyte Research Station.
In this paper we analyse a fibre flax collection in Upyte Research Station and show that some varieties are resistant to most widespread flax fungal diseases.
Keywords: *Linum ussitatissimum, fibre flax, fungal diseases, resistance, variety.*

Introduction

Fibre flax breeding has been carried out in Lithuania since 1922. The first flax breeder was the professor Dionizas Rudzinskas in Dotnuva Plant Breeding Station. Later in Savitiskis and Upyte worked flax breeders Z. Mackevicius, A. Vycas, N. Gaiziunene. Since 1966 in Upyte Research Station breeder K. Bacelis, has developed 8 flax varieties, employing conventional plant breeding methods and experimental mutagenesis.

Initial material for fiber flax breeding must be not only diverse and abundant but also must meet the key requirements under local conditions. The flax collection is continuously replenished by local breeding lines and the samples of the latest varieties obtained from other research institutions. The tested varieties, which most closely meet the requirements set for the direction of the breeding work, are used for intervarietal crossings with a view to developing new initial material. Since 1971 physical and chemical mutagenes have been used for the development of such material.

The parasitic fungus Colletotrichum lini causes the most widespread disease of fibre flax in Lithuania, known as seedling blight or anthracnose, M. Et B. Many authors' data suggest that anthracnose is a very harmful and widespread flax disease. In Lithuania, like in many other countries involved in flax production, the spread of anthracnose is controlled by chemical plant protection measures such as seed treatment, fungicide spray applications during the vegetative growth period. However, one of the most effective means against this disease is development of resistant varieties. Plant breeders and immunologists use various methods to attain this purpose such as crossing of resistant varieties, physical, chemical mutagenesis and others.

Flax wilt occurs at different growth and development stages of flax. The causal agents of fusarium are fungi of the *Fusarium spp.* genus: *F.oxysporum, F. avenaceum, F. solani*, et al. The fibre flax varieties grown in Lithuania are not resistant to fusarium. Therefore this disease incurs losses to growers by deteriorating the quality of straw and linseed, reducing fibre output and yield. Fusarium spreads through seed, contaminated soil and during the vegetative growth period through the air with spores. The most favourable conditions for fusarium infection are created in wet and warm environment (22-25°C). When the air

ISBN 9984 – 585 – 68 – 9

temperature drops below 13°C, the development of fusarium fungi is retarded, therefore early-sown flax does not catch infection. Many authors believe that the most reliable and efficient way of plant protection is development and cultivation of fusarium-resistant flax varieties. Selection of such varieties is relevant not only from the viewpoint of economy but also ecology.

The harmful flax disease pasmo is caused by *Septoria linicola* (Speg.) Gar. It was a quarantine flax disease in Lithuania till 2000. The most favourable conditions for pasmo spreading are created in wet and warm air conditions in summer (+25°C). The earliest symptoms appear as small brown lesions on the cotyledons and leaves of young plants but in the field, the disease is usually not noticed until shortly before harvest when patches of the crop suddenly become brown and defoliation of the plants occurs. This fungus may be seed-borne but spores acumulate on the stems and on the stubble, which remains after the crop has been cut. Crop debris carrying the infection may, therefore, be a means of carrying the parasite over from year to year. The fibre flax varieties grown in Lithuania are not resistant to *Septoria linicola*.

Rust is a disease, caused by the fungus *Melampsora lini* Desm. The phase of disease to which the term "rust" is commonly applied is characterised by the appearance in early summer of small yellow or orange pustules on the leaves. Later in the growing season elongated, slightly raised, black incrustations appear on the main stem and seed bolls. The winter spores (teleutospores) are thick walled and resistant, they may survive at least two winters. There are five stages of the rust development – basidiospores, spermogonia, aecidia, uredospores and teleutospores. The fungus is normally carried with the seed rather than on the seed. In seed processing, small fragments of stem, leaves and bolls bearing fragments of the winter spore stage may be left in the seed sample after it has been finally cleaned and this is the principal method by which the disease is spread by winter spores from season to season.

The aim of our work was to assess the incidence of mean flax fungal diseases in the flax varieties sown in the fibre flax collection of Upytė Experimental Station.

Experiments and methods

For the investigation of flax varieties' susceptibility to the causal agents of fusarium, fungi of *Fusarium spp.* genus, infectious background is formed. Infectious-provocative background done in the following way: fusarium-affected flax stems cut into 1-1,5 cm length pieces are arranges at 30-40 g/m^2 on the soil in wooden boxes (85 x 50 x 20 cm) and are covered by 3-4 cm earth layer. The earth in the boxes is kept moist. After 5-6 days flax is sown in the boxes at a depth of 1,5 cm, and 2,5 x 2,5 cm intervals. The flax is sown at a rate of 10-20 seeds, with 2-3 replications in the 3rd ten - day period of May so that flax grows and develops at higher temperatures. Two standard varieties were sown – resistant to fusarium 'I-7' and the other – 'Svetoč' – susceptible to fusarium. During the vegetative growth period the flax was watered when the weather was dry.

Fusarium - affected plants were assessed having pulled flax at the early yellow maturity stage. The disease incidence on plants was estimated according to 4-point scale: 0 – healthy plants, 1 – weakly, 2 – moderately, 3 – strongly affected.

For the assessment of susceptibility to *Melampsora lini* Desm, flax varieties and numbers sown in the experimental field in a 1 m wide band, with 20 cm inter-row spacing at a rate of 100 seeds per row, with 1-3 replications late – in the 2nd or 3rd ten-day period of June. At the "fir-tree" growth stage the gaps between flax are placed with (40 g/m^2) stems (cut at 4-6 cm long segments) infected by *Melampsora lini* Desm. spores of winter stage. In dry weather the flax segments are watered. Until flowering flax is 2-3 times fertilised by nitrogen fertilisers (15 g/m^2).

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Assessment of infection by teleutospores and varietal susceptibility to this disease was done having pulled flax at the stage of yellow maturity.

To establish the incidence of anthracnose (*Colletotrichum lini* M. Et B.) infection background was created in wooden boxes (85 cm x 50 cm x 20 cm), filling them with sifted soil from the experimental field. Until sowing normal soil moisture was maintained in the boxes. Varieties and breeding lines were sown one seed ball per hole in the third ten-day period of May at the 1,5cm depth, with 2,5 x 2,5 cm intervals. In total 20 seeds were sown with 2 – 3 replications. Anthracnose causal agents were washed off the disease-affected stems, and at the seedling stage of flax cotyledons were sprayed by the suspension of spores. During plant vegetative growth period flax was abundantly watered. Severity of anthracnose was assessed having pulled flax at early yellow maturity stage.

We estimated plant damage by anthracnose according to 5 score scale: healthy plants – 0, weakly affected – 1, moderately affected – 2, strongly affected – 3, and very strongly affected or dead plants – 4 scores. We also estimated disease development intensity %.

To establish infection of pasmo disease (*Septoria linicola* (Speg.) Gar.) flax varieties were growing in the field in natural conditions. Assessment of infection and varietal susceptibility to this disease was done having pulled flax at the stage of yellow maturity.

Meteorological conditions in Upyte

Meteorological conditions during the experimental period were diverse, therefore the incidence of diseases in individual varieties was different. Although in 1999 there was little precipitation, the air temperature, which was normal, contributed to favourable conditions for the spread of anthracnose and pasmo disease. In 2000 and 2001 the summer was very rainy, the flax stands were heavily lodged, and high percent of plants were affected by diseases.

Unfavourable and droughty were 1999, the flax grew short and the stem and linseed yield was low. 2000 were favourable for the growth and development of flax: a high fibre and linseed yield was produced. In July 2001 heavy rainfall and hail lodged maturing flax, which had a negative effect on the yield and fibre quality.

Results and discussion

In the anthracnose-resistance trials on provocative backgrounds involving 100 fibre flax varieties and breeding lines no completely resistant varieties were found. Table 1 presents the data of several tested varieties. The following varieties and breeding lines were slightly less disease-affected: ‘Fibra’, ‘I-16’, 678-5; 777 where affected plants accounted for 15,3 – 23,6 %, and the disease severity was 4,8 – 9,3 %. The standard (susceptible) variety ‘Svetoch’ was affected during the experimental years on average 90,4 %, and the disease severity was 42,5 % (Table 1).

Table 1.

Resistance of fibre flax varieties, breeding lines and mutants to anthracnose (*Colletotrichum lini* M. Et B.). Upyte, (three years’ averaged data)

№ of the VIR Catalogue	Variety, breeding line, mutant	Country of origin	Infected plants, %	The disease severity %
1	**2**	**3**	**4**	**5**
5333	*‘Svetoch’ - standard (susceptible)*	*RUS*	*90,4 ± 3,8*	*42,5 ± 6,7*
7215	‘Banga’	LTU	32,0 ± 6,0	14,4 ± 5,7
7612	777	LTU	22,0 ± 6,0	13,4 ± 6,3
5740	‘VAIZHGANTAS’	LTU	34,0 ± 6,3	12,9 ± 4,7
6186	‘VNIIL-1’	RUS	28,9 ± 6,2	13,7 ± 5,0
6787	‘VNIIL-11’	RUS	28,1 ± 6,1	13,0 ± 5,0

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1	2	3	4	5
6820	‘VNIIL-19’	RUS	25,3 ± 5,2	11,4 ± 5,5
6585	‘SPARTAK’	RUS	76,1 ± 5,9	30,2 ± 6,5
6531	‘T-10’	RUS	61,4 ± 6,2	25,0 ± 6,7
6200	‘T-7’	RUS	60,0 ± 5,6	29,7 ± 6,2
6200	‘T-4’	RUS	58,8 ± 5,0	26,8 ± 6,1
6194	‘SMOLENSKIJ 451’	RUS	29,8 ± 4,7	13,3 ± 5,2
5327	‘STACHANOVEC’	RUS	52,6 ± 5,7	21,4 ± 6,1
6187	‘SEVERIANIN’	RUS	72,4 ± 5,8	29,8 ± 6,5
6189	‘I-16’	RUS	23,6 ± 5,5	9,3 ± 4,0
7217	‘Saliut’	RUS	45,2 ± 5,7	23,9 ± 4,8
6599	‘P-359’	RUS	46,6 ± 6,1	25,8 ± 5,2
6597	‘Pskovich’	RUS	56,6 ± 4,9	30,0 ± 6,4
6596	‘STREMUTKA’	RUS	34,4 ± 5,0	14,9 ± 4,7
6813	‘Luch’	RUS	49,4 ± 5,2	17,4 ± 5,0
6147	R-1	RUS	66,1 ± 6,0	29,3 ± 6,1
6148	R-9	RUS	66,4 ± 4,9	25,7 ± 5,2
5983	‘I-9’	RUS	52,0 ± 5,1	13,0 ± 4,8
6764	‘SHOKINSKIJ’	RUS	38,2 ± 6,9	20,4 ± 5,6
5739	‘L-1120’	RUS	43,2 ± 7,8	18,4 ± 3,9
5982	‘I-7’	RUS	79,8 ± 5,6	27,7 ± 6,6
4166	‘806/3’	RUS	36,4 ± 6,7	13,0 ± 4,8
6201	‘T-9’	RUS	76,6 ± 6,2	33,2 ± 6,6
6051	‘1288/12’	RUS	45,6 ± 5,8	18,4 ± 5,1
6584	‘Beriozka’	RUS	59,4 ± 5,1	31,7 ± 6,8
6818	‘Uspech’	RUS	46,8 ± 5,1	31,1 ± 6,0
6655	‘Jade’	FRA	38,7 ± 6,0	18,9 ± 5,7
6653	‘REINA’	FRA	60,9 ± 6,1	26,7 ± 6,3
6654	‘EMMERAUDE’	FRA	35,0 ± 6,5	17,3 ± 5,7
6731	C-391	GBR	25,4 ± 5,2	12,8 ± 6,0
4043	‘DEEP-PINK’	GBR	52,5 ± 4,7	19,7 ± 3,6
6028	‘SOLIDO’	NLD	51,2 ± 6,0	25,3 ± 6,3
6230	‘Diana’	NLD	35,4 ± 6,7	15,9 ± 5,2
6027	‘VIERA’	NLD	58,3 ± 5,9	18,6 ± 5,5
6626	‘FIBRA’	NLD	15,3 ± 4,9	4,8 ± 3,1
6031	‘Tekstilak’	CZE	41,4 ± 5,4	15,4 ± 5,0
6135	‘Modran’	CZE	36,2 ± 6,4	15,9 ± 5,4
7469	‘MIRA’	BEL	26,2 ± 4,9	5,1 ± 5,3
6233	‘Arsen’	BEL	38,9 ± 4,9	16,9 ± 6,1
6674	‘Karnobat’	HUN	55,2 ± 6,0	30,3 ± 5,7
6203	‘LCSD-207’	POL	51,4 ± 6,2	21,4 ± 5,7
6606	‘Banner’	AUS	40,3 ± 4,9	21,2 ± 5,3
6657	‘SVALOF 0228’	SWE	39,5 ± 6,8	18,5 ± 3,9
6824	‘LD-147’	UKR	46,1 ± 6,2	24,1 ± 5,3
6810	‘KOKET’	EST	60,8 ± 5,7	39,1 ± 6,7
	221-A-119	RUS	69,7 ± 6,5	40,7 ± 6,8
	927-1	LTU	39,8 ± 6,7	12,7 ± 4,7
	856-12	LTU	35,4 ± 6,6	14,9 ± 5,0

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1	2	3	4	5
	842-14	LTU	28,1 ± 5,7	12,4 ± 5,2
	678-5	LTU	20,4 ± 6,2	11,9 ± 6,1
	782-5	LTU	29,7 ± 6,1	16,3 ± 5,8
	919-4	LTU	27,4 ± 6,9	12,2 ± 4,7
	242-7	LTU	35,1 ± 5,9	16,0 ± 5,5
	921-2	LTU	35,1 ± 6,5	15,7 ± 5,4
	791-8	LTU	28,7 ± 7,1	13,2 ± 6,2

Experimental findings showed that in the conditions of artificial background resistance of individual varieties and specimen to fusarium was revealed. Two standard varieties were sown – resistant to fusarium 'I-7' and susceptible to fusarium – 'Svetoch'. Results of resistance some varieties of our collection are presented in Table 2. The plants of susceptible varieties were fusarium-affected (up to 35%) already before flax flowering. The varieties 'Kristina', 'Banga 2' were very severely disease-affected (disease severity was 50,3 - 87,7 %). Varieties 'L-1120', ''Mirnyj', 'Shayene', 'Redwood', 'Cree' et al. and mutants D-5-374-3; C-3-242-6; G-3-113-1; A-4-39-3; A-2-41-1 were resistant to fusarium (disease severity was 0,6 - 2,7 %) (Table 2). All fusarium resistant flax collection samples are a valuable initial material for the development of new fibre flax varieties.

Table 2.

Resistance of fibre flax varieties, breeding lines and mutants to *Fusarium spp.* (2 – 3 years' averaged data)

№ of the VIR Catalogue	Variety, breeding line, mutant	Country of origin	Infected plants, %	The disease severity %
1	**2**	**3**	**4**	**5**
5333	*'Svetoch' - standard (susceptible)*	RUS	*91,4 ± 3,4*	*45,9 ± 7,0*
5982	*'I – 7' - standard (resistant)*	*RUS*	*2,8 ± 2,3*	*0,9 ± 0,8*
7235	'Banga 2'	LTU	87,7 ± 3,4	45,9 ± 3,1
5739	'L-1120'	RUS	9,5 ± 4,2	2,7 ± 1,9
7479	'T – 13'	RUS	18,2 ± 5,6	9,1 ± 4,4
7671	'Mirnyj'	RUS	7,2 ± 3,5	2,8 ± 2,3
7225	'Torzhokskij'	RUS	6,8 ± 3,7	2,8 ± 2,2
7242	'Vympel'	RUS	17,6 ± 5,3	8,9 ± 3,8
6515	'Kubanskij 1'	RUS	14,7 ± 5,0	7,1 ± 3,5
6194	'Smolenskij 1051'	RUS	20,5 ± 5,6	13,6 ± 4,9
7234	'Viatich'	RUS	20,4 ± 5,7	10,3 ± 4,1
7780	R-1037	RUS	11,6 ± 4,5	5,3 ± 3,2
7216	'Linotta'	USA	15,6 ± 8,1	7,2 ± 3,6
6942	'Lord'	USA	6,9 ± 4,6	2,4 ± 2,2
6943	'Wonder'	USA	8,7 ± 3,9	3,9 ± 2,7
6305	'Shayenne'	USA	4,1 ± 2,8	1,2 ± 1,5
6128	'Redwood'	USA	3,5 ± 2,6	0,5 ± 0,5
7248	'Dvina'	BLR	10,4 ± 4,2	3,9 ± 2,7
7696	'Rodnik'	BLR	13,5 ± 4,7	7,2 ± 3,6
7697	'Dashkovskij'	BLR	11,4 ± 4,4	6,0 ± 3,5
6861	'Cascad'	DEU	8,7 ± 4,0	2,4 ± 2,1

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1	2	3	4	5
6890	'Daros 1'	DEU	9,4 ± 4,1	3,5 ± 2,6
6908	4-980	ARG	10,2 ± 4,0	4,1 ± 3,0
6899	407-6	ARG	8,9 ± 3,9	3,3 ± 2,5
6103	'Flanders'	ARG	12,7 ± 4,6	5,2 ± 3,1
6871	'Kerandi'	ARG	19,0 ± 5,8	9,6 ± 4,0
6906	4-911-4-14	ARG	18,2 ± 5,6	8,3 ± 3,8
6901	3-159	ARG	10,3 ± 4,1	4,2 ± 3,3
6959	'Mapun L-8'	ARG	9,2 ± 4,3	3,7 ± 2,4
7010	363-4	ARG	17,4 ± 5,4	8,2 ± 3,7
4043	'Deep pink'	GBR	10,9 ± 4,4	5,1 ± 3,1
6732	C – 332	GBR	18,7 ± 5,5	8,4 ± 3,9
5484	nameless	EST	14,0 ± 5,2	6,6 ± 3,7
6824	'LD-147'	UKR	6,7 ± 3,5	3,0 ± 2,6
6582	'Cree'	CAN	4,3 ± 1,9	1,3 ± 1,4
6746	'Aoyagi'	JPN	9,9 ± 4,0	3,8 ± 2,4
6608	'Currong'	AUS	12,5 ± 4,7	2,1 ± 2,0
6178	'Kristina'	SWE	89,2 ± 4,4	50,3 ± 7,1
	103	LTU	9,5 ± 4,3	4,8 ± 3,0
	997-2	LTU	5,7 ± 3,2	2,2 ± 2,1
	1085-13	LTU	13,5 ± 4,7	7,0 ± 3,4
	1617-3	LTU	15,8 ± 5,0	7,0 ± 3,5
	A-2-41-1	LTU	12,6 ± 6,4	2,1 ± 5,8
	A-4-39-3	LTU	15,1 ± 5,4	2,5 ± 5,7
	C-3-242-6	LTU	7,1 ± 4,0	0,7 ± 7,1
	D-5-374-3	LTU	6,3 ± 7,4	0,6 ± 7,2
	E-2-246-1	LTU	16,7 ± 6,3	7,9 ± 6,7
	E-4-205-1	LTU	15,8 ± 5,9	2,1 ± 5,0
	F-6-274-1	LTU	19,0 ± 5,5	11,0 ± 4,5
	G-3-113-1	LTU	9,9 ± 5,6	1,0 ± 4,1

All the tested varieties, growing in the rust infected background were compared with the varieties – standards ('T-10' susceptible to *Melampsora lini* Desm. and 'Belinka' – resistant). Resistant to rust flax varieties, breeding lines and mutants are valuable as a breeding material for creating new fibre flax varieties. Less affected were varieties and mutants 777; B-20, 'VNIIL-2', 'L-1120', 'Saskia', ' F-5-80-1, F-5-431-1 et al. (Table 3)

Table 3.

Resistance of fibre flax varieties and breeding lines to flax rust (*Melampsora lini* Desm) (three years' averaged data)

№ of the VIR Catalogue	Variety, breeding line, mutant	Country of origin	Infected plants, %	The disease severity %
1	**2**	**3**	**4**	**5**
6531	*'T-10' - standard susceptible*	RUS	*95,2 ± 1,7*	*80,7 ± 3,3*
7456	*'Belinka'- standard resistant*	NLD	*14,7 ± 2,6*	*2,1 ± 1,2*
7612	777	LTU	9,9 ± 5,6	1,0 ± 4,1
7624	B-20	LTU	7,1 ± 2,2	1,0 ± 0,9

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1	2	3	4	5
5739	‘L-1120’	RUS	8,4 ± 2,3	1,9 ± 1,2
6192	‘Pskovskij 1’	RUS	14,1 ± 2,8	4,9 ± 1,8
7669	‘Pskovskij 83’	RUS	8,2 ± 2,3	1,6 ± 1,2
6196	‘VNIIL-2’	RUS	6,2 ± 2,0	1,6 ± 1,1
6787	‘VNIIL-11’	RUS	24,1 ± 3,4	8,2 ± 2,6
6765	‘VNIIL-172’	RUS	38,7 ± 3,9	14,6 ± 2,9
6194	‘Smolenskij 1051’	RUS	20,2 ± 3,1	5,9 ± 2,0
6598	‘P-255’	RUS	19,7 ± 3,3	8,9 ± 2,5
7479	‘T-13’	RUS	8,4 ± 2,4	3,0 ± 1,5
6880	‘Kosmos’	RUS	24,2 ± 3,5	12,4 ± 2,7
6815	‘K-6’	RUS	19,4 ± 2,7	6,1 ± 2,0
6763	‘Nadiozhnyj’	RUS	17,2 ± 3,1	4,0 ± 1,7
7156	‘Akkord’	RUS	19,4 ± 3,3	7,7 ± 2,3
7369	‘Kalininskij 5’	RUS	13,9 ± 2,7	2,1 ± 1,3
5333	‘Svetoch’	RUS	87,3 ± 2,7	45,2 ± 4,2
6762	‘Kometa’	RUS	21,7 ± 3,2	5,2 ± 1,8
6806	‘Orshanskij 1’	BLR	17,8 ± 3,0	8,7 ± 2,6
6807	‘Orshanskij 2’	BLR	17,1 ± 3,0	9,2 ± 2,5
7696	‘Rodnik’	BLR	10,2 ± 2,3	4,3 ± 1,9
7697	‘Dashkovskij’	BLR	8,7 ± 2,2	3,1 ± 1,5
6811	‘Vperiod’	BLR	13,4 ± 2,8	3,7 ± 1,6
6601	‘Belorusskij 1’	BLR	14,7 ± 2,9	3,4 ± 1,5
6808	‘Belorusskij 2’	BLR	11,3 ± 2,6	2,9 ± 1,4
5330	T-1340	BLR	29,9 ± 3,7	14,3 ± 2,8
6956	7064-38	ARG	14,3 ± 2,8	3,7 ± 1,7
6103	‘Flanders’	ARG	13,8 ± 2,7	5,4 ± 2,1
6871	‘Kerandi’	ARG	13,2 ± 2,8	2,9 ± 1,3
6099	‘Macovi’	ARG	28,8 ± 3,7	7,9 ± 2,2
6959	‘Marip’	ARG	18,9 ± 2,2	9,2 ± 2,4
6124	‘Lusatia’	DEU	20,9 ± 3,1	8,9 ± 2,5
6890	‘Daros 1’	DEU	17,4 ± 3,1	7,9 ± 2,3
7425	‘Bertelin’	DEU	19,3 ± 3,1	11,2 ± 2,6
7436	‘Kten-C-25’	CZE	10,7 ± 2,2	3,9 ± 1,7
6172	‘Belan’	CZE	21,7 ± 3,3	10,1 ± 3,3
7421	‘Hilda’	CZE	12,9 ± 2,6	2,1 ± 1,2
7730	‘Saskia’	CZE	12,4 ± 2,8	1,1 ± 0,9
6203	‘LCSD-207’	POL	9,1 ± 2,4	2,3 ± 1,3
6204	‘Svadzimski’	POL	20,0 ± 3,2	6,3 ± 2,1
7423	‘Minerva’	POL	13,9 ± 2,7	8,7 ± 2,5
7699	‘Bryta’	POL	29,9 ± 3,6	7,2 ± 2,2
5616	‘Formosa’	NLD	12,3 ± 2,8	5,6 ± 1,8
6936	‘Hera’	NLD	29,9 ± 3,6	12,9 ± 2,7
6655	‘Jade’	FRA	14,7 ± 2,7	7,9 ± 2,3
7587	‘Astella’	FRA	24,1 ± 3,4	3,9 ± 1,8
6627	‘Tekirdag Nolkara’	TUR	18,2 ± 2,1	7,8 ± 2,0
5818	‘Beta 201’	HUN	21,4 ± 3,3	8,4 ± 2,5
6361	‘Primost’	USA	8,7 ± 2,2	2,1 ± 1,3

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1	2	3	4	5
6878	‘Polesskij 2’	UKR	19,9 ± 3,2	2,1 ± 1,3
6745	‘Nansyo’	JPN	22,1 ± 3,4	8,2 ± 2,5
6279	‘Marta’	SWE	64,3 ± 3,8	31,1 ± 3,7
6659	‘Aino’	FIN	37,1 ± 3,9	12,2 ± 2,6
6085	44215	PRT	31,0 ± 3,9	12,2 ± 2,5
	7741-1	LTU	10,0 ± 2,4	2,9 ± 1,4
	F-5-431-1	LTU	5,9 ± 2,0	1,5 ± 0,4
	F-5-80-1	LTU	3,9 ± 1,7	1,8 ± 1,3
	M-5-154-1	LTU	37,0 ± 4,0	9,4 ± 2,7

Favourable conditions for the spread of pasmo disease were in 2000-2001 year – it was wet and hot in July, and spores of fungus (*Septoria linicola* (Speg.) Gar.) widespread by wind and rain. The pasmo disease infection on fibre flax varieties and breeding lines of the variety competition trials of Upyte Research Station was established in 2001. Less injury of pasmo disease was established on the breeding lines 1827-5; 1790-10; 01032-5; 0877-5 (Table 4).

Table 4.

Resistance of fibre flax varieties and breeding lines to pasmo disease (*Septoria linicola* Speg. Gar.) (Upyte, 2001)

Variety, breeding line	Country of origin	Infected plants, %	The disease severity %
‘Baltuchiai’	LTU	19,2	9,6
‘Banga 2’	LTU	21,4	8,7
‘Belinka’	NLD	31,3	11,4
‘Ariane’	FRA	27,2	9,9
‘Laura’	BEL	26,7	10,1
Alfa-B	LTU	21,0	11,2
0964-12	LTU	18,4	8,7
0877-5	LTU	17,3	6,4
01032-5	LTU	12,4	5,7
01186-6	LTU	16,3	10,0
01186-8	LTU	19,9	7,6
1463-43	LTU	21,4	9,2
1790-10	LTU	18,8	5,4
1826-26	LTU	17,4	6,0
1827-5	LTU	19,7	4,7
1827-30	LTU	31,0	14,8
1910-5	LTU	29,4	13,2
1951-5	LTU	24,5	12,4

Conclusions

1. In the anthracnose-resistance trials on provocative backgrounds no completely resistant varieties were found. The following varieties and breeding lines were slightly less disease-affected: ‘Fibra’, ‘I-16’, 678-5; 777 (affected plants accounted for 15,3 – 23,6 %, and the disease severity was 4,8 – 9,3 %).

2. In the conditions of artificial fusarium infected background the varieties ‘Kristina’, ‘Banga 2’ were very severely disease-affected (disease severity was 50,3 - 87,7 %).

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3. Fusarium resistant flax collection samples were established: varieties ‘L-1120’, ‘’Mirnyj’, ‘Shayene’, ‘Redwood’, ‘Cree’ et al. and mutants D-5-374-3; C-3-242-6; G-3-113-1; A-4-39-3; A-2-41-1.

4. In the rust affected background were sown 100 samples of flax varieties and mutants. Less affected were varieties and mutants 777; B-20, ‘VNIIL-2’, ‘L-1120’, ‘Saskia’, ‘ F-5-80-1, F-5-431-1 et al.

5. The pasmo disease was established on the variety competition trials of Upyte Research Station in 2001. Less injury of pasmo disease was on the breeding lines 1827-5; 1790-10; 01032-5; 0877-5

6. All disease resistant varieties, breeding lines and mutants are a valuable initial material for the development of new fibre flax varieties in Lithuanian conditions.

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ISBN 9984 – 585 – 68 – 9