Pathological Condition of Introduced Conifers in the Forests of South – Western and Western Lithuania

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Abstract

Tree condition of *Abies*, *Larix*, *Picea*, *Pinus* and *Pseudotsuga* genera was studied in the forests of six forest enterprises and twelve forest districts in the south-western and western Lithuania in 2003 – 2005. Based on our studies, as perspective species for growing in this part of Lithuania could be considered *Larix decidua, L. polonica, Pinus contorta* and *Pseudotsuga menziesii*. Acclimatization success of other tree species: *Abies alba, A. sibirica, A. concolor; Larix laricina, L. sibirica, L. leptolepis; Pinus banksiana, P. peuce, P. strobus; Picea glauca, P. pungens; Pseudotsuga caesia* – is restricted by biotic (disease pathogens and pests) and abiotic (edaphic and climatic conditions) factors.

Key words: introduction, conifers, diseases, pests, condition

Introduction

Plantations of introduced tree species is a good basis for further breeding practice. Introduction is based on breeding methods, first of all, on selection. The most valuable progenies growing in different ecological conditions are selected, while having transfered their offsprings into experimental plantations, the most valuable genotypes and families are chosen.

Growing of introduced trees in forests and solving of related problems in Lithuania has been taking place since the 19th century (Репшис 1961, Навасайтис 1965, Ramanauskas 1973). Still earlier (15th century) introducents were important components of estates, while later - of town parks (Янушкевичюс 1989). They were occupying prevailing positions in towns and settlements, rather frequently they occur in the plantations of roadsides, homesteads and even fields. In all the cases positive features of introducents are revealed sufficiently well – exotic and decorative appearance, specific resistance against adverse edaphic and other conditions in urban territories. These features are characteristic only if the assortment is properly chosen. Moreover, in the run of both organized and elemental introduction, the diversity of introducents from different fields of the world is ever increasing.

A fairly important aspect is higher or complete immunity of some introduced plants to local plant pests and diseases, as compared to local species (Рупайс 1961, 1989).

However, if landscape design and park specialists are satisfied with the mentioned features of woody introducents, then foresters, seeking to establish productive, resistant and producing high-quality timber stands of introduced plants, tend to be more careful. In this case the relationship of forest introducents with harmful organisms plays a very important role. Pathogens may very effectively restrict the spreading of several introduced species producing economically valuable timber (Butin 1983).

Introduction of perspective species is determined by species evolution, biological and economic value of its trees under natural growth conditions, adaptation to new site conditions and climate, amplitude of species adaptability, species genetic diversity which is proportional to the native range and geographical latitude (Schwerdtfeger 1981). Assessment of introduced trees is carried out by the method of experimental plantations which are established in different habitats and natural regions.

Some of the first introducents which were started to be grown in Lithuanian forests in the 19th century are different *Larix* species originated from geographically different regions (Danusevičius 2003). It is thought that practically important may be some *Abies*, *Picea*, *Pinus*, *Pseudotsuga* species. In Lithua-

nia about 20 species of *Pinus*, 20 – *Picea* and 20 – *Abies* were introduced, however, only some of them in forests (Navasaitis 2004).

The condition of woody introducents in Lithuanian forests is insufficiently studied. Introduced trees growing in parks and green town areas are described, their condition is assessed (Januškevičius 2004), while in the forests only trees of local coniferous species have been studied until now (Озолинчюс 1996, Ozolinčius 1998, Navasaitis *et al.* 2003).

The aim of the work is to assess the sanitary state of introduced species of trees into Lithuanian forests, to ascertain the most important damage sources in stands.

Materials and methods

The condition of introduced conifers was assessed in 2003-2005 in the stands of twelve forest districts of six forest enterprises in the western and south-western Lithuania: Alytus Forest Enterprise (Alytus forest district), Dubrava Experimental-Training Forest Enterprise (Vaišvydava, Šilėnai, Kuras, Ežerėlis forest districts), Kazlų Rūda Training Forest Enterprise (Ąžuolų Būda, Jūrė, Višakio Rūda forest districts), Prienai Forest Enterprise (Birštonas, Balbieriškis forest districts), Raseiniai Forest Enterprise (Paliepiai forest district), Šilutė Forest Enterprise (Norkaičiai forest district).

The trees were described according to G. Krūssmann (Krūssmann 1972) and M. Navasaitis (Navasaitis 2004) methods, the taxonomy of plants compiled by M. Navasaitis (Navasaitis 2004) was applied.

Describing precise growing places, forest enterprise, forest district, block number, site number, area, species composition, the age of trees, mean height, mean diameter, stocking level, soil typological group and series of forest types were recorded.

Observed and assessed genera and species of introduced trees:

1. *Abies alba* Mill. in Vaišvydava forest district (Block 132, site 1, 0.5 ha), Kuras forest district (Block 2, site 10, 0.5 ha), Šilėnai forest district (Block 80, site 6, 0.25 ha and site 7, 0.25 ha).

2. *A. concolor* (Gord. et Glend) Lindl. ex Hildebr. in Alytus forest district (Block 46).

3. *A. sibirica* Ledeb. in Vaišvydava forest district (Block 18, site 2, 0.3 ha).

4. *Larix decidua* Mill., 5. *L. laricina* (Du Roi) K. Koch, 6. *L. polonica* Racib., 7. *L. sibirica* Ledeb. and **8. *L. leptolepis* (Siebold et Zucc.) Gord**. in Balbieriškis forest district (Block 29, The Degsnė larch stand 2.3 ha), L. decidua and L. leptolepis seed orchards in: Birštonas forest district (Block 48, object code of seed basis – 15 MSP 03, established in 1968 – 1969, covers 6.5 ha); Balbieriškis forest district (Block 27, code of seed basis 15 MSP 09-06-10, established in 1969 – 1971, covers 2.6 ha and Block 29, code of seed basis 15 MSP 07, established in 1976, covers 3.5 ha). Experimental plantations in: Vaišvydava forest district (Block 52, site 9, 0.7 ha; site 26, 0.6 ha, Block 17, site 9, 0.8 ha, site 10, 0.7 ha); Kuras forest district (Block 6, site 20, 1.0 ha; Block 50, site 19, 2.5 ha). Ežerėlis forest district (Block 51, site 18, 4.0 ha). Šilėnai forest district (Block 58, site 13, 1.3 ha; Block 59, site 10, 1.0 ha; Block 60, site 4, 0.8 ha; Block 61, site 14, 1.4 ha; Block 63, site 9, 1.2 ha; Block 27, site 7, 1.2 ha). Paliepiai forest district (Block 113, site 7, 2.6 ha). Birštonas forest district (Block 37, site 15, 0.9 ha; Block 70, site 8, 3.2 ha; Block 71, site 7, 6.0 ha).

9. *Pinus banksiana* Lamb. in: Vaišvydava forest district (Block 52, site 11, l0.8 ha), Ežerėlis forest district (Block 51, site 17, 1.3 ha), Kuras forest district (Block 6, site 20).

10. *P. contorta* Douglas ex Loudon in Ežerėlis forest district (Block 51, site 19, 0.3 ha and site 20, 1.6 ha) and in plantations: Ąžuolų Būda forest district (Block 70, established in 1996, 1.3 ha. The origins of P. contorta (natural growth place) was from Canada Gasparad Creek, (1185 m above sea level) and Ontario province (300 – 500 m above sea level); Kazlų Rūda forest district (Block 53, established in 1985, 1 ha. The origins of P. contorta: was from Canada Gasparad Creek and Fallentimber Creek (1650 m above sea level); Jūrė forest district (Block 226 was established in 1995, area 1.3 ha. To establish the plantation, 46 families of free-pollination from Rokai Kelmynas and Ežerėlis experimental plantations were used. These plantations are of Ontario (Canada) origin).

11. *P. peuce* Griseb. in Kazlų Rūda forest district (Block 41, 0.7 ha). Planting material for the plantation – families of P. peuce from Dubrava arboretum (origin from the Balkan peninsular).

12. *P. strobus* L. in Kuras forest district (Block 2, site 10), Norkaičiai forest district (Stand of about 130 years, pine trees of over 30 m in height. *P. strobus* grows together with *Fagus sylvatica* L.).

13. *Picea glauca* (Moench) Voss and

14. *P. pungens* Engelm. in Šilėnai forest district (Block 80, site 6,7, 0.5 ha).

15. *Pseudotsuga caesia* (Schwer.) Flous, 16. *P. menziesii* (Mirb.) Franco and 17. *P. menziesii* (Mirb.) Franco var. *glauca* (Beissn.) Franco in: Alytus forest district (Block 46, established in 1966. Parent trees were selected in Lithuania and Karaliaučius region. Shoots from the selected trees were grafted into scions grown in the nursery, which had originated from locally gathered seeds); Kuras forest district (Block 1, site 2, 0.8

ha); Vaišvydava forest district (Block 17 between 8 and 9 sites, 3.0 ha plantation was established in 1976 –1977); Norkaičiai forest district (about 130-year-old Pseudotsuga trees grow).

The pathological condition of trees (not less than 50 trees in the account) was assessed being based on methodics by A. Žiogas (Žiogas 1997), R. Ozolinčius (Ozolinčius 1998), A. Juodvalkis and A. Vasiliauskas (Juodvalkis and Vasiliauskas 2002) as well as methodics used in the Forest Protection Manual (Žiogas 2000) and applied in our studies. Tree condition was assessed in the scale of 5 grades (Table 1).

Mean damage grade was calculated for the studied trees of each tree species based on modified and used in agriculture and forestry methods (Juodvalkis *et al.* 2002, Žurkus and Gaurilčikienė 2002) according to the formula:

Table 1. Tree condition assessment scale

Degree of tree condition	Signs of damage	Grades
Relatively healthy	No signs of damage, crown characteristic of the species, trees have no signs of weakening	1
Weakened	Trees with slight openness of the crown, reduced increment, up to 1/3 of needles are damaged. Individual branches are dry. Small patches of the trunk and branches are dead	2
Weak	Open crown. Strongly reduced or absent increment. Up to 2/3 of needles, branches are damaged or dead. Tree tops are dead. Large damaged areas on the trunk	3
Drying	Strong openness of the crown, light green, yellowing and falling needles. 2/3 of the needles are damaged. Dry tops of trees. There are signs of stem pest attack	4
Freshly dead trees	Trees which died in recent year. Needles are dry and remain on trees or have fallen down. Bark beetles have already left or are staying in the wood	5

$V = \Sigma(n \cdot b) / N$, when

V – mean damage grade,

$\Sigma(n \cdot b)$ – number of plants damaged to the same grade as well as product sum of it and the grade,

N – number of checked plants.

Pathogens were identified according to disease symptoms, cultural and morphological traits of distinguished microorganisms, based on the descriptors (Pileckis *et al.* 1968, Butin 1983, Черемисинов *et al.* 1970, Minkevičius and Ignatavičiūtė 1991, Hartman *et al.* 2005). Pests were described according to (Lampel 1968, Heie 1980, Рупайс 1989, Remaudiere and Remaudiere 1997, Hartman *et al.* 2005).

Results

During the studies, the greatest attention was paid to the condition of the most widespread in Lithuanian forests plants of five genera of introduced coniferous species: *Abies*, *Larix*, *Pinus*, *Picea* and *Pseudotsuga*.

***Abies* Mill.**

A. alba, A. concolor* and *A. sibirica

The data in table 2 show that the condition of *Abies concolor* (average grade of damage 3.31) is worst. The majority of trees are strongly weakened, about 30% - drying out. The bad pathological condition is typical of plantings *A. sibirica* and *A. alba* (average grade – 2.88 – 3.02) where relative healthy first category trees are absent. Exception is *A. alba* plantings in Kuro forest district, which, in comparison with other plantings, are very young (15 years).

Table 2. Condition of *Abies* Mill. in Lithuania in 2003-2005

Forest district (Forest enterprise)	Species	Year	Number of trees by the degree of damage						Average grade of damage
			Total	1	2	3	4	5	
Kuras (Dubrava)	*Abies alba* Mill.	2003	276	170	76	20	10	0	1.51± 0.01
		2004		167	86	10	11	0	
		2005		171	79	16	10	0	
Šilėnai (Dubrava)	*Abies alba* Mill.	2003	263	0	62	180	20	1	2.88 ± 0.00
		2004		0	58	180	23	2	
		2005		0	60	168	33	2	
Vaišvydava (Dubrava)	*Abies alba* Mill.	2003	261						2.93 ± 0.00
		2004		0	57	170	33	2	
		2005		0	55	172	32	3	
				0	56	174	27	3	
Alytus (Alytus)	*Abies concolor* (Gord. et Glend) Lindl. ex Hildebr.	2003	74						3.31 ± 0.01
		2004		0	4	47	20	3	
		2005		0	3	50	19	2	
				0	2	45	25	2	
Vaišvydava (Dubrava)	*Abies sibirica* Ledeb	2003	213	0	20	172	20	1	3.02 ± 0.00
		2004		0	19	180	13	1	
		2005		0	15	168	27	2	

Abies trees of all species growing in Alytus, Vaišvydava and Kuras forest districts are damaged by *Aphrastasia pectinatae* (Cholodkovsky 1888) (Hemiptera, Adelgidae) the abundance of which, due to a localized stand situation, increases with increasing age of trees. *A. pectinatae* cause mass defoliation, heavily worsen the condition of the whole plant, while 30-40-year-old trees are sentenced to death.

On *Abies concolor* and *A. sibirica* in Vaišvydava forest district a large outbreak of *Dreyfusia piceae* (Ratzeburg 1844) (Hemiptera, Adelgidae) occupying the whole stand was recorded. Damaged *Abies* are characterized by abundant defoliation and drying of branches. Larvae feeding on the bark of *Abies* damage the cambium and lead to the formation of large necrotic areas. Splits and cup-shakes appear on the bark. In 6-8 years trees, damaged by the pest, die (Heie 1980).

All the data show that because of the damage caused by this pest *Abies* are non-perspective introducents in our forests. It is a better solution to try to grow in some places a slightly more resistant to *Abies nordmanniana* (Steven) Spach needle pest (*Dreyfusia piceae)* (Juronis 2002).

***Picea* A. Dietr.**

P. pungens* and *P. glauca

Trees of both these *Picea* species were observed in Alytus and Šilėnai forest districts where they grow together (80% of the *P. pungens*). In Šilėnai forest

district the same sites contain also *Abies* and other local tree species. In Birštonas forest district grow only individual trees of the *P. pungens*. On all growth sites *P. pungens* are damaged by *Oligonychus unnunguis* Jackobi, 1905 (Acari, Tetranychidae) especially heavily in Alytus forest district where young trees grow poorly in an open area. In Šilėnai forest district *Picea* trees are older and more damaged by stem pests. In all the places increment is low, while defoliation is increased.

The worst condition of *Picea pungens* trees in Alytus and Šilėnai forest areas (average grade – 3.18 and 2.97) (Table 3). About 30% in Alytus forest district and 15% in Šilėnai forest district are damaged by *Dendroctonus micans Kug*. (Scolytidae (Ipidae) Coleoptera). 60 70% of the trees are damaged strongly or dry out.

Table 3. Condition of the *P. pungens* Engelm. in Lithuania in 2003-2005

Forest district (Forest enterprise)	Year	Number of trees by the degree of damage						Average grade of damage
		Total	1	2	3	4	5	
Alytus (Alytus)	2003	168	0	20	102	38	8	3.18± 0.01
	2004		0	21	98	47	2	
	2005		0	22	99	44	3	
Birštonas (Prienai)	2003	74	0	51	20	3	0	2.36 ± 0.02
	2004		0	48	23	3	0	
	2005		0	50	22	2	0	
Šilėnai (Dubrava)	2003	307	0	15	280	10	2	2.97 ± 0.00
	2004		0	21	276	7	3	
	2005		0	30	268	5	4	

***Pseudotsuga* Carr.**

P. caesia, P. menziesii* and *P. menziesii* var. *glauca

In all forest districts, where *Pseudotsuga* are grown, remains only a small portion of healthy trees, while the average damage grade is rather high (from 2.14 to 3.28) (Table 4).

Table 4. Condition of *Pseudotsuga* Carr. in Lithuania in 2003-2005

Forest district (Forest enterprise)	Year	Number of trees by the degree of damage						Average grade of damage
		Total	1	2	3	4	5	
Alytus (Alytus)	2003	160	0	10	96	48	6	3.28± 0.01
	2004		0	9	105	44	2	
	2005		0	9	100	50	1	
Birštonas (Prienai)	2003	87	0	19	40	28	0	3.10 ± 0.01
	2004		0	18	42	27	0	
	2005		0	20	40	27	0	
Kuras (Dubrava)	2003	191	3	88	60	39	1	2.70 ± 0.00
	2004		2	90	66	33	0	
	2005		2	90	64	33	2	
Norkaičiai (Šilutė)	2003	364	30	260	54	20	0	2.14 ± 0.00
	2004		30	274	49	11	0	
	2005		29	270	52	13	0	

Due to improper ecological conditions (too heavy soil, high density) the trees are weakened. The crowns are open also due to damages by *Phaeocryptopus gaeumannii* (Rohde) Petrak (Pleosporales, Venturiaceae) and *Rhabdoclinae pseudotsugae* Sydow (Ascomycetes, Helotiales) needlecasts. Following infection by *Phaeocryptopus gaeumannii Pseudotsuga* cast their needles in 1-3 years. Manifestation of the disease and its spreading rate depends on the general condition of plants: it may become an epidemic if trees are weak (Butin 1983). In all observation places trees of all *Pseudotsuga* species and varieties were damaged by this pathogen (the damage comprised 3-4 grades in Vaišvydava forest district, while in other forest districts the condition was slightly better).

Rhabdoclinae pseudotsugae of *Pseudotsuga* appears not every year and spreads more under more significant precipitation amount in spring (Stephan 1981). Maybe due to *Rhabdoclinae pseudotsugae*. *Pseudotsuga* in Vaišvydava forest district pertain rather open crowns. Although disease pathogens were not abundant in 2003-2005 (up to 2 grades) and the needles of recent years are almost undamaged. However, 3-4 years ago defoliation was extremely intensive. *Pseudotsuga* of different varieties differ in their resistance to this pathogen: less resistant – *P. caesia* and *P. menziesii* var. *glauca,* more resistant – *P. menziesii* (Butin 1983, Manter *et al.* 2003).

The age of *Pseudotsuga* needles on their natural growth sites comprises 6-8 years (Earle 2002). Thus needlecasts of both types in the years of mass infestation cause long-term losses and weaken trees not only in the disease years.

In some places of the neighbouring Poland *Pseudotsuga* wolly aphid *Gilletteella cooleyi* (Gillete 1907) (*Hemiptera, Adelgidae*) (Labanowski *et al.* 2001) is detected, which should be considered a potentially dangerous pest.

In Karaliaučius region there are *Pseudotsuga* stands which at the age of 59 years reach 30 m in height and 53 cm in diameter, producing 900 m^3ha^{-1}, while at the age of 76 years – 34 m; 48 cm; 1050 m^3/ha respectively. In Alytus *Pseudotsuga* seed orchard grow both species (*P. caesia* and *P. menziesii*) as well as trees of the *P. menziesii* var. *glauca* grow. It was found that in this place the *P. menziesii* grows best, followed by *P. caesia*, while the *P. menziesii* var. *glauca* grows poorest. *Pseudotsuga* (especially the *P. menziesii*) should be grown in the coastal forest plantations of Lithuania, mixing them with *Picea,* which would protect against more considerable windbreaks. The most valuable stands and genotypes should be looked for in the adapted to Europe plantations: Lithuania, Latvia, Belarus, Poland and East Prussia.

***Larix* Mill.**

L. decidua. L. laricina. L. polonica. L. sibirica* and *L. leptolepis

Reproduction of *Larix* due to its fast growth and durable wood has been of great concern to Lithuanian foresters since old times. At present it is clear that *L. sibirica*, having reached the age of 30 years, under Lithuanian conditions stops growing and dies. Poorly grows *L. dahurica* Lawson, slightly better – *L. archangelica* Lawson (Navasaitis 2004). A well-growing *L. leptolepis*, however, is characterized by high ramification and tapering. The best growth is characteristic of the *L. decidua* and *L. polonica*.

Productive growth of the *L. decidua* and especially *L. polonica* as well as their good adaptation in Lithuania may be explained by the northern range border of the mentioned *Larix* species, which in the 14th century went from the West to the East along the Nemunas down to Kaunas, while further – from Kaunas through Aukštadvaris towards Lyda. In the 19th century *Larix* was growing naturally in small groves in Kalvarija and Marijampolė environs. as well as around Prienai and Vištytis and other places (Bulat 1962).

The best and most productive hybrids are obtained by crossbreeding *L. decidua* and *L. leptolepis* thus seed orchards are usually established using these two species.

The condition of *Larix* trees in study places was highly dependant on growth conditions and on the species. In fertile soils, where planting density is not too high (Šilėnai and Paliepiai forest districts), trees are practically healthy (V = 1.20 and 1.78), while small damages have no significant influence on the condition of plants. Worse condition of *Larix* trees is observed in places where stand density is too high (Ežerėlis forest district, V = 3.68), or canker-damaged (the Siponiai forest, V = 2.74) (Table 5).

Lachnellula willkommii (Hartig) Dennis (Helotiales, Hyaloscyphaceae) – the pathogen of *Larix* canker firstly develops as a saprotroph on dry branches and in broken places. In the first year of development, oval resinous pits appear in damaged branches and on trunks. *Larix* damaged in this way were observed in the Degsnė seed orchard, the Siponiai forest. Damaged places increase every year and become open-layered wounds. Healthy tissues around the wounds receive more nutrients, therefore, trunks and branches

Table 5. Condition of *Larix* Mill. in Lithuania in 2003-2005

Forest district (Forest enterprise)	Species	Year	Number of trees by the degree of damage						Average grade of damage
			Total	1	2	3	4	5	
Balbieriškis (Prienai), Degsnė larch stand	*Larix decidua* Mill.	2003	86	38	41	7	0	0	1.62± 0.02
		2004		40	40	6	0	0	
		2005		40	38	8	0	0	
Balbieriškis (Prienai), Degsnė seed orchard	*Larix decidua* Mill.	2003	118	27	51	32	8	0	2.98 ± 0.01
		2004		28	49	35	6	0	
		2005		27	50	34	7	0	
Birštonas (Prienai), Siponiai seed orchard	*Larix decidua* Mill.	2003	47	14	22	8	3	0	1.99 ± 0.03
		2004		15	21	9	2	0	
		2005		14	22	8	3	0	
Šilėnai (Dubrava)	*Larix decidua* Mill.	2003	100	79	21	0	0	0	1.20 ± 0.02
		2004		80	20	0	0	0	
		2005		80	20	0	0	0	
Balbieriškis (Prienai), Degsnė larch stand	*Larix leptolepis* (Siebold et Zucc.) Gord.	2003	74	26	42	6	0	0	1.71 ± 0.02
		2004		27	42	5	0	0	
		2005		26	44	4	0	0	
Birštonas (Prienai) Siponiai seed orchard	*Larix leptolepis* (Siebold et Zucc.) Gord.	2003	45	6	30	18	1	0	2.74 ± 0.02
		2004		7	29	17	2	0	
		2005		8	28	18	1	0	
Kuras (Dubrava)	*L. polonica Racib.*	2003	100	4	67	27	2	0	2.73 ± 0.01
		2004		3	68	28	1	0	
		2005		3	68	27	2	0	
Vaišvydava (Dubrava)	mixed	2003	100	17	81	1	1	0	1.84 ± 0.01
		2004		20	78	2	0	0	
		2005		18	80	2	0	0	
Ežerėlis (Dubrava)	mixed	2003	100	0	2	54	33	11	3.68 ± 0.01
		2004		0	1	55	34	10	
		2005		0	2	53	34	11	
Jonava (Jonava)	mixed	2003	100	24	65	11	0	0	1.90 ± 0.01
		2004		25	64	8	3	0	
		2005		23	64	10	3	0	
Užusaliai (Jonava)	mixed	2003	100	9	51	12	26	2	2.63 ± 0.01
		2004		10	50	10	28	2	
		2005		8	52	10	27	3	
Paliepiai (Raseiniai)	mixed	2003	100	37	51	9	3	0	1.78 ± 0.01
		2004		36	52	10	2	0	
		2005		38	50	9	3	0	

in the damaged places become observably thicker (Черемисинов *et al.* 1970. Hartman *et al*. 2005). Damaged trees exude a lot of resin, which covers the wounds. Such wounds are found not only on trunks and thick branches but also on thin twigs. Most often they form in the place of biforcation. On older wounds, which are not covered with resin, and on dry bark appear bowl-type carposomes of 2-4 mm in diameter – apoteci (Hartman *et al.* 2005). Wounds with carposomes were observed only on young trees, the wounds of older trees were resinous and without carposomes.

Canker-infected trees were found among all observed Larix species. L. decidua was more resistant, it was especially obvious in the Siponiai forest, where L. decidua and L. leptolepis grow together. To determine resistance of different species to this diseases in Lithuania, longer lasting observations would be necessary.

Sporadically detected Larix pests: Adelges laricis Vallot 1836, (Hemiptera, Adelgidae) Cholodkovskaya viridana Cholodkovsky 1896, (Hemiptera, Adelgidae). More frequently and more abundant is Coleophora laricella Hübner 1817, (Lepidoptera, Coleophoridae). Its abundance failed to exceed 2 grades in the 5-grade scale. Coleophora laricella is ascribed to potentially harmful agents having negative influence on the condition of highly thinned out Larix stands (Ryan 1983).

***Pinus* L.**

P. peuce

A small stand of this *Pinus* has been established in Kazlų Rūda forest district. *Pinus* grow very unevenly: about 60 % are sufficiently fast growing and of good condition, while the rest grow poorly. Most probably, pines of this species in Lithuania should be grown for decorative purposes but not as stands in the forests.

P. banksiana

Pines of good condition of this species were not found in any of the forest districts (average grade of damage from 3.07 to 3.20). Everywhere the trees had thin, crooked and branchy stems (Table 6).

Disease pathogens or pests were not detected on the pines, most probably their condition was bad due to unfavourable for them edaphic and climatic conditions. After WWII it was attempted to plant this pine in many places in Lithuania, however, it turned out to be unsuitable for growing in the forest, because it grows rather slowly and its wood is of low value.

Table 6. Condition of the *Pinus banksiana* Lamb. in Lithuania in 2003-2005

Forest district (Forest enterprise)	Year	Number of trees by the degree of damage						Average grade of damage
		Total	1	2	3	4	5	
Ežerėlis (Dubrava)	2003	500	0	40	340	100	20	3.20± 0.00
	2004		0	30	350	95	25	
	2005		0	30	360	95	15	
Kuras (Dubrava)	2003	100	0	5	80	14	1	3.12 ± 0.01
	2004		0	6	78	14	2	
	2005		0	5	79	15	1	
Vaišvydava (Dubrava)	2003	300	0	20	240	31	9	3.07± 0.00
	2004		0	18	255	19	8	
	2005		0	19	253	21	7	

Table 7. Condition of *Pinus contorta* Douglas ex Loudon in Lithuania in 2003-2005

Forest district (Forest enterprise)	Year	Number of trees by the degree of damage						Average grade of damage
		Total	1	2	3	4	5	
Ąžuolų Būda (Kazlų Rūda)	2003	50	11	23	10	6	0	2.19± 0.02
	2004		13	20	10	7	0	
	2005		12	24	9	5	0	
Ežerėlis (Dubrava)	2003	100	0	11	41	40	8	3.40 ± 0.01
	2004		0	10	50	33	7	
	2005		0	9	51	34	6	
Jūrė (Kazlų Rūda)	2003	50	29	17	4	0	0	1.56 ± 0.03
	2004		28	16	3	3	0	
	2005		29	15	5	1	0	
Višakio Rūda (Kazlų Rūda)	2003	50	17	17	10	3	3	2.14 ± 0.02
	2004		18	17	9	3	3	
	2005		17	18	9	3	3	

P. contorta

Main damages – yellowing of needles and dead branches (Table 7).

About 30% of yellowing needles contain the carposomes of *Lophodermium seditiosum* Minter, Staley and Millar (Rhytismales, Rhytismaceae). The outbreak of damaged by this pest pines is found in Jūrė forest district.

In all observed *Pinus contorta* growth sites 3% of the pines were damaged by *Melampsora pinitorqua* (D By) Rostr. (*Uredinales, Melampsoraceae*). Both crooked, bent trunks and branches of differing thickness. This disease causes damage on many *Pinus* species but among observed by us the most damaged was *P. contorta.* Literature sources point that the most attacked is local *Pinus* species - *P. sylvestris* L. (Minkevičius and Ignatavičiūtė 1991) but we have detected only individual damaged trees of *P. sylvestris*, while damages in the stand of *P. contorta*, which is located in Višakio Rūda forest district, comprised 15%. Our studies were carried out in forests, while in nurseries the spreading of this parasitic fungi may vary.

In Ežerėlis forest district pines are planted rather densely, they have many dead branches. On the sites of *P. contorta* no trees with the signs of *Heterobasidion annosum* (Fr.) Bref. (Aphyllophorales, Polyporaceae) were found – may be pines of this species could have escaped from infection because there were no summer thinnings.

P. strobus

There are no major stands of this *Pinus* species in Lithuania. The reason for this is spreading of the

fungal pathogen - *Cronartium ribicola* J. C. Fischer (*Uredinales. Cronartiaceae*) in all growth sites of *P. strobus*. We observed *P. strobus* in Kuras and Norkaičiai forest districts. Their condition in these places differs – in Kuras forest district pines are damaged by *Cronartium ribicola* and their V = 3.32 (Table 8).

Table 8. Condition of *Pinus strobus* L. in Lithuania in 2003-2005

Forest district (Forest enterprise)	Year	Number of trees by the degree of damage						Average grade of damage
		Total	1	2	3	4	5	
Kuras (Dubrava)	2003	80	0	3	50	22	5	3.32± 0.01
	2004		0	4	55	15	6	
	2005		0	3	53	20	4	
Norkaičiai (Šilutė)	2003	60	50	10	0	0	0	1.13 ± 0.03
	2004		55	5	0	0	0	
	2005		52	8	0	0	0	

Damaged pines were not observed in Norkaičiai forest district, where the stand of P. strobus was established 130 years ago. Here pines grow in a mixed stand with *Fagus sylvatica* L. There may be several reasons for the good condition of trees: 1) the most irresistable to Cronartium ribicola are 20-30-year-old trees. Part of trees of this age could have died. while the rest were growing further; 2) when the pines were young, Cronartium ribicola might have not yet been present in Lithuania. It is believed that this disease was detected around 1905 (Репшис 1961).

Discussion

Although in the western and south-western part of Lithuania the conditions for most of the introducents should be rather favourable (Янушкявичюс. Будрюнас 1987), the condition of introduced in the forests coniferous trees varies.

Species diversity of the pests and diseases of trees-introducents, their abundance, distribution and harmfulness in different stands observably differs and depends on many factors. Their harmfulness to a great extent depends on how well ecological requirements of the species coincide with the conditions of growth site. For instance, *Larix* trees growing in good conditions (Paliepiai, Šilėnai forest districts) are of much better condition than trees growing in low and moist areas.

Many harmful agents (pests and diseases) of introducents are imported as well as the plants themselves. Very often they concentrate locally, therefore, the character of damages becomes chronic and it is necessary to give up the idea of using valuable tree species on a wider scale. Growing of most *Abies* species in the forests becomes impossible due to the spreading of *Aphrastasia pectinatae* and *Dreifusia piceae*, while *Pinus strobus* – due to *Cronartium ribicola*.

The diversity of harmful agents and their damage depends also on the age of stands. The resistance of old trees ususally decreases, although some diseases are characteristic of young and middle-aged trees. Damage caused to young trees heavily weakens them and is frequently felt during the whole ontogenesis. *Rhabdoclinae pseudotsugae* of *Pseudotsuga* repeated every several years opens their crowns for a long time. Young *Larix* trees infected with *Lachnellula willkommii*. suffer from this disease all their life. Damages caused by shoot distortion remain on the stems and branches of *Pinus* lifelong. Meanwhile. stem pests and other secondary pests and diseases are more characteristic of old trees. weakened due to various unfavourable conditions.

General stand resistance to harmful agents depends on stand composition. In this respect mixed stands are more resistant. because some pests (*Aphrastasia pectinatae* and *Dreifusia piceae*. *Coleophora laricella*) due to a restricted mobility are faced with difficulty to cover long distances. In mixed stands the conditions are usually more favourable to beneficial organisms. Besides, introducents most often increase the resistance of a mixed stand, because they are often rather resistant to local pathogens.

A large number of harmful organisms to introduced trees are also introduced, *i.e*. they came to Lithuania from different geographical regions, got well acclimatized and cause great damage. Thus introduction of plants, planting of new stands should be carried out very carefully, using only healthy plants. Studies on the condition of introduced plants should be carried out permanently, because their condition is changing: there appear and spread new harmful pests. Pathogen *Rhabdoclinae pseudotsugae* was detected in Lithuania in 1975 (Žuklys 1975). *Dreifusia piceae* - in 1992 (Juronis 2003).

The level of damage greatly depends on sanitary-hygienic and silvicultural measures (thinnings, pruning, elimination of the outbreaks of pathogens, protection against forest animals, pests and diseases).

In 2004 the list of invasive species was announced, which included some observed and studied by us plants (Gudžinskas 2004). Namely, *Larix deciduas, Picea glauca, Pinus banksiana and Pseudotsuga menziesii*. We think that inclusion of the species into this list is debatable. especially *Larix deciduas*, which in Lithuania is considered to be a renaturalized species. According to the definition provided by the compilers of the data basis of invasive species – "invasive species is successfully adapted to new natural or seminatural ecosystems and caus-

ing danger to local biological diversity". *Picea glauca*. *Pinus banksiana and Pseudotsuga menziesii* are not widespread and cause no danger to local plant species. While *Larix decidua* by some authors (Polujanski 1854, Bulat 1962) is considered to be local or species of a very close range, and its planting in Lithuania may be considered not as an introduction but rather as a renaturalization.

Conclusions

1.In the forests of south-western and western Lithuania the most perspective introducents are *Larix decidua* and *L. polonica*, which on properly selected sites may grow into trees of a rather good condition.

2. *Pseudotsuga menziesii* should be grown in the Lithuanian coastline, where milder climate is necessary for the species. It is best to grow it in mixed *Pseudotsuga menziesii – Picea* plantations.

3. All the studied *Abies* species, *Pinus banksiana*, *P. peuce* and *P. strobus*, *Picea glauca* and *P. pungens* due to the adverse effect of biotic and abiotic factors under the conditions of Lithuania are not perspective for planting in the forest.

4. In forests of Lithuania main pest agents of introduced coniferous are: *Aphrastasia pectinatae*, *Dreifusia piceae*, *Cronartium ribicola* and *Lachnellula willkommii*.

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ФИТОПАТОЛОГИЧЕСКОЕ СОСТОЯНИЕ ИНТРОДУЦИРОВАННЫХ ХВОЙНЫХ В ЛЕСАХ ЗАПАДНОЙ И ЮГО-ЗАПАДНОЙ ЧАСТИ ЛИТВЫ

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Резюме

В Юго-западной и Западной Литве в лесах двенадцати лесничеств шести лесхозов в 2003-2005 г. исследовано состояние интродуцированных хвойных *Abies, Larix, Picea, Pinus* и *Pseudotsuga*. На основе полученных данных перспективными породами для лесовыращивания в упомянутых частях Литвы являются *Larix decidua, L. polonica, Pinus contorta u Pseudotsuga menziesii*. Другие интродуцированные породы: *Abies alba, A. sibirica, A. concolor; Larix laricina, L. sibirica, L. leptolepis; Pinus banksiana, P. peuce, P. strobus; Picea glauca, P. pungens*; *Pseudotsuga caesia* из-за влияния абиотических (эдафических, климатических) и биотических (вредители, болезни) факторов для лесоразведения нерекомендуются.

Ключевые слова: интродукция, хвойные, болезни, вредители, состояние