
Occurrence of *Heterobasidion annosum* (Fr.) Bref. root rot in Scots pine plantations established in the Curonian Spit during the post-war period

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The study has been carried out in Scots pine (*Pinus sylvestris*) plantations that were established in the Curonian Spit: 1) in 1951–1960, on the areas that were burned by forest fires in 1946–1947; 2) in 1961–1970, on the areas in which healthy mountain pine (*Pinus mugo*) plantations were cut out; 3) after 1971, on the areas in which mountain pine was killed by *Heterobasidion annosum*; 4) during all post-war period, on abandoned areas and open squares all over the Lithuanian part of the peninsula. The sanitary state of Scots pine plantations was found satisfactory in all those afforested areas. Only on recently replanted sites, previously attacked by *H. annosum*, single dead and/or diseased pines were found. In older Scots pine plantations, no dead and/or diseased Scots pine trees were detected. Taking into account the high resistance of Scots pine plantations to *H. annosum* observed during the present study on the Curonian Spit, it is recommended to extend the areas in which mature mountain pine should be cut out and replaced by Scots pine.

Key words: *Pinus sylvestris*, *Pinus mugo*, *Heterobasidion annosum*, root rot

INTRODUCTION

On the request of Ministry of Environment, detailed studies have been carried out in mountain pine (*Pinus mugo*) stands in the Curonian Spit: during the year 1997 root rot disease caused by *Rhizina undulata* Fr., and during the year 1998 root rot disease caused by *Heterobasidion annosum* (Fr.) Bref. were investigated. Results of these studies are summarised in reports and published papers [1, 2]. The recommendations that have been suggested are implemented into the practical forestry activities taking place in the Curonian Spit. As a result, damage caused by *R. undulata* was restricted significantly. On the contrary, attacks by *H. annosum* in mountain pine stands continue as previously, causing significant damage.

The dieback of mountain pine during the recent years has been discussed widely in two scientific-practical meetings (April 1999 and June 2000). During those, the decision has been made to diminish gradually the areas under mountain pine in the Curonian Spit by cuttings. The cut out areas were decided to be left as open spaces, or be replanted with Scots pine (*Pinus sylvestris*) and by other plant

species. This decision has to be implemented during the year 2001 within the framework of the Curonian Spit National Park development project, elaborated by the Institute of Forest Management.

Before the planned reconstruction of mountain pine stands is going to take place, it is important to know on which areas Scots pine plantations will be able to grow successfully, and especially whether they will remain healthy when planted on sites where mountain pine was previously infested by *H. annosum* root rot. To answer these questions, the study has been carried out during the second half of the year 2000 with the main objective to evaluate the sanitary state of Scots pine plantations established in the Curonian Spit during the post-war period on the areas burned by forest fires, on areas in which healthy mountain pine plantations had been cut out, on areas in which mountain pine was killed by *H. annosum*, and on abandoned areas and open squares all over the Lithuanian part of the peninsula.

STUDY SITES AND METHODS

Afforestation of sandy dunes on the Curonian Spit started at the beginning of the 19th century. At first,

works were carried out in the southern part of the Spit, between Zelionogradsk (Krantas) and Lesnoje (Sarkau) villages, in the territory of the present Kaliningrad Region. The first stage of afforestation continued until the year 1904. During this time, along the seaside of the Curonian Spit a 98 km long artificial protective dune was created, the moving dunes close to fishermen villages, as well as northern part of the peninsula between the villages of Smiltynė and Juodkrantė were strengthened and afforested.

During the period of Independent Lithuania, between the first and the second world wars, the protective forest plantations of the Curonian Spit were managed by two separate authorities. The Klaipėda Port Enterprise was in charge of the northern end of the Spit (15 km), of all protective dune, and of 100 ha of forest close to Nida. All the rest part of the Curonian Spit was under authority of the Klaipėda City Magistrate. The Magistrate took little care about protective forest plantations of the Spit, and no work was done by its employees either in afforestation or in the strengthening the moving dunes. Only the Klaipėda Port Enterprise was allocating about 60 000 Litas per year for strengthening and afforesting the dunes. These works were carried out by the staff of Dune Inspection under the authority of the Port Enterprise. During ten years (1928–1937), a total of 60 ha of moving sand was afforested with mountain pine.

M. Daujotas (3) reported that also German foresters at first tried to stabilise high and sandy dunes with various mechanic fences, and thereafter only the mountain pine was planted onto such areas. Scots pine was started to be introduced into plantations on the Curonian Spit only after the second world war. Significant numbers of Scots pine were planted on burned mountain pine sites. Those sites were cut out following forest fires that burned about 500 ha of mountain pine in the post-war years (1946–1947). Some Scots pines were also planted during the re-

construction of old mountain pine stands. This afforestation work was started only in 1951. During the years 1951–1955, a total area of 329 ha of burned sites was replanted with the Scots pine, and the remaining area was replanted later.

In this work, all Scots pine plantations established in the Curonian Spit after the second world war were divided into the following categories: 1) established in 1951–1960 on the areas burned by forest fires in 1946–1947; 2) established in 1961–1970 on the areas in which healthy mountain pine plantations were cut out due to needs of recreation; 3) established after 1971, on the areas in which mountain pine was killed by *H. annosum*; 4) established during the whole post-war period on abandoned areas and open squares all over the Lithuanian part of the peninsula where no mountain pines were growing.

In the course of the present study, the sanitary state of Scots pine plantations was evaluated by a detailed external survey of each growing tree within forest sites. In total, over 400 forest sites have been examined. In cases when within a site even a single pine was found to be attacked by *H. annosum*, such site has been classified as damaged by the fungus. Special efforts were directed to plantations in which *H. annosum* attacks were noted in 1983.

RESULTS AND DISCUSSION

More detailed studies on *H. annosum* in Scots pine stands of the Curonian Spit started in 1979. At that time, attention was primarily directed to the incidence of the fungus in forest plantations established on healthy and diseased glades of mountain pine. Results of this work have been published [2] and are summarised in Table 1.

As is shown in Table 1, during those years a detailed survey was carried out in 17 forest sites with the total area of 40.9 ha. On those sites in

Table 1. Occurrence of *Heterobasidion annosum* and *Rhizina undulata* in Scots pine plantations on the Curonian Spit

Planting year	Study year	Sites studied						Damaged sites (%)		Distribution of damaged plantations by disease agent							
		all		healthy		damaged				<i>Heterobasidion annosum</i>				<i>Rhizina undulata</i>			
		No.	ha	No.	ha	No.	ha	sites		area		sites		area			
		No.	ha	No.	ha	No.	ha	No.	%	ha	%	No.	%	ha	%		
Cleared sites of healthy mountain pine																	
1961–1970	1983	17	40.9	17	40.9	–	–	–	–	–	–	–	–	–	–		
1961–1970	2000	15	35.0	15	35.0	–	–	–	–	–	–	–	–	–	–		
Cleared sites of <i>Heterobasidion annosum</i> damaged mountain pine																	
1971–1980	1983	89	127.7	62	89.2	27	38.5	30.3	30.2	23	25.8	34.8	27.3	4	4.5	3.7	2.9
1971–1980	2000	80	110.0	79	87.0	1	2.0	1.2	1.8	1	1.2	2.0	1.8	–	–	–	–

Table 2. Occurrence of *Heterobasidion annosum* in Scots pine plantations according to land history site on the Curonian spit

Planting year	Total area, ha	Occurrence of <i>Heterobasidion annosum</i> in Scots pine plantations established on												
		burned sites			healthy cleared sites			<i>H. annosum</i> damaged sites			squares, non-forest sites			
		all area, ha	studied, No.	diseased, No.	all area, ha	studied, No.	diseased, No.	all area, ha	studied, No.	diseased, No. (%)	all area, ha	studied, No.	diseased	
1951–1955	327	318	20	0	–	–	–	–	–	–	–	9	–	–
1956–1960	447	307	20	0	2	–	–	–	–	–	–	138	20	0
1961–1965	593	192	20	0	16	5	0	–	–	–	–	385	20	0
1966–1970	283	28	10	0	25	10	0	–	–	–	–	230	20	0
1971–1975	168	18	10	0	–	–	–	80	40	0 (0)	–	70	20	0
1976–1980	86	2	–	–	–	–	–	54	40	1 (2.5)	–	30	20	0
1981–1985	88	0	–	–	–	–	–	66	20	5 (2.5)	–	22	10	0
1986–1990	65	3	–	–	–	–	–	53	20	11 (55)	–	9	5	0
1991–1995	37	1	–	–	–	–	–	26	20	15 (75)	–	10	5	0
1996–2000	47	32	5	0	–	–	–	14	10	6 (60)	–	1	–	–
In total	2141	901	85	0	43	15	0	293	150	38 (25)	–	904	120	0

1961–1970 Scots pine was planted after healthy mountain pine had been cut out. Almost all of those sites (15 out of 17) were examined during the year 2000. As is shown in Tables 1 and 2, not a single attack of *H. annosum* was recorded in the mentioned plantations.

The data of Table 2 show that trees attacked by *H. annosum* were absent also in Scots pine plantations established in 1951–1960 on burned areas and open squares and spaces that previously were not covered by forest. Special attention was directed towards plantations of initially very high plantation density (15–20 thousands of seedlings planted per ha). Those were thinned repeatedly, and no treatment of freshly cut stump surfaces was done, either with chemicals nor with biological substances. However, from the point of view of *H. annosum*, those plantations appeared to be completely healthy (Table 2). It is hard to say what factors restricted *H. annosum* infections in such areas.

By contrast, the sanitary state of Scots pine plantations established instead of mountain pine stands damaged *H. annosum* differed significantly. As is shown in Table 1, survey of 89 plantation sites established in 1971–1980 (total area 127.7 ha) revealed the incidence of *H. annosum* in 23 of them (or 27.3% of the total area studied). Data presented in Table 2 indicate that of all investigated forest plantations (sites) established in 1981–1985, 25%, in those established in 1986–1990 55%, in 1991–1995 75%, and in those established in 1996–2000 55% were infected by *H. annosum*.

It is easy to notice that Scots pines planted on *H. annosum*-infested glades is especially prone to

the disease during the first decades following planting (Table 2). By contrast, older Scots pine plantations that were also established on infested sites, at present seem to be nearly healthy. Detailed investigations carried out in almost all Scots pine plantations established in 1971–1980 (80 out of 89 sites with a total area of 110 ha), including those 23 in which *H. annosum* was found in 1983, revealed only a single site attacked by the fungus (Table 1).

In general, the data of the present investigation allow to conclude that the sanitary state of Scots pine plantations established on the Curonian Spit in the post-war years is satisfactory in all categories of afforested areas. As is shown by the results of studies accomplished in 1979–1983 and 2000, plantations of Scots pine, even when established in highly *H. annosum*-infested areas, suffer from the disease only during the first decades after planting. Even in this case, only single trees are dying, and no disease foci of any significant size are being formed. We may hypothesise that the occurrence of *H. annosum* in Scots pine plantations on the Curonian Spit is restricted by specific soil and climatic conditions of the region, by a specific anatomical morphological or physiological resistance of planted trees to the disease, or by the genotype of *H. annosum* distributed all over the region and adapted to suppress mountain pine trees only. Especially surprising is the fact that it was not possible to find a Scots pine dying from *H. annosum*, even in spots with immediate contact with active foci of *H. annosum* in which mountain pine trees have been dying out during the last 10–15 years. The practical implication of this might be the following: while diminishing the areas

covered by mountain pine on the Curonian Spit, after cutting out they could be successfully replanted by the Scots pine; there exists only a slight risk that single trees of the latter species will die from the attacks by *H. annosum*.

CONCLUSIONS

1. The sanitary state of nearly all Scots pine plantations established on the Curonian Spit during the post-war period is satisfactory. Only on recently replanted sites, previously attacked by *H. annosum*, single dead and/or diseased pines could be found. In older Scots pine plantations, dead and/or diseased Scots pine trees were not found, even in the areas on which the previous generation of mountain pines was attacked by the fungus.

2. Considering the high resistance of Scots pine plantations to *H. annosum* genotypes distributed on the Curonian Spit, it is recommended to extend the areas in which mature mountain pines should cut out and replaced by Scots pines.

References

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ŠAKNINĖS PINTIES PAPLITIMAS PAGRASIOSIOS PUŠIES ŽELDINIUOSE, ĮVEISTUOSE KURŠIŲ NERIJOJE POKARIO METU

S a n t r a u k a

Išsamiais tyrimais ir rekognostiniu būdu įvertintas šakninės pinties paplitimas paprastosios pušies želdiniuose, įveistuose: 1) 1951–1960 metais 1946–1947 metų degimvietėse; 2) 1961–1970 metų sveikų kalninės pušies medynų kirtavietėse (ten, kur kalninės pušys buvo nukirstos dėl blogos sanitarinės būklės, bet dėl rekreacinių reikmių); 3) 1971-aisiais ir vėlesniais metais šakninės pinties pažeistų kalninės pušies medynų kirtavietėse ir 4) dykvietėse bei aikštėse, kuriose prieš tai neaugo kalninės pušys. Nustatyta, kad beveik visų pokario metais Kuršių nerijoje įveistų paprastosios pušies želdinių sanitarinė būklė yra patenkinama. Tik šakninės pinties pažeistų kalninės pušies medynų kirtavietėse įveistuose paprastosios pušies želdiniuose ir tik pirmaisiais dešimtmečiais galima aptikti vieną kitą dėl šakninės pinties nudžiūvusių arba bedžiūstančią pušį. Vyresnio amžiaus kultūrose, įveistose net šakninės pinties pažeistų kalninės pušies medynų kirtavietėse, nėra nuo šakninės pinties pažeidimų džiūstančių paprastųjų pušų.

Priimant dėmesin akivaizdžiai ryškų paprastosios pušies želdinių atsparumą kalninės pušies medynuose plačiai išplitusiai šakninės pinties formai, siūloma plėsti kalninės pušies medynų rekonstrukciją, keičiant juos paprastųjų pušų želdiniais.

Raktažodžiai: paprastoji pušis, kalninė pušis, šakninė pintis, džiūvimo priežastys