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Relationship of necrotic disease of beech trunks to the sociological position of trees in the stand

A. CICÁK, I. MIHÁL

Institute of Forest Ecology of the Slovak Academy of Sciences, Zvolen, Slovak Republic

ABSTRACT: The authors analyse the results of investigations into the degree of necrotic damage of beech bark carried out in the whole territory of the Slovak Republic. The aim of these analyses is to answer a question about the relationship between the degree of necrotic damage of beech trunks and sociological position of trees in the stands studied. In the years 1995–2001, the degree of necrotic damage by tracheomycotic type to 6,579 beech trunks was evaluated in 54 selected localities in 33 orographic units. The lowest frequency (4.3%) of trees showing the 3rd and 4th degree of necrotic damage was found in the 1st tree age class. The frequency of damaged trees increased proportionally with the worsening sociological position of trees. The values of the index of trunk necrotisation (I_{NK}) increased from 0.71 in the 1st tree age class to 2.14 in the 5th tree age class. It also corresponded with dynamics of disease frequency in the tree age classes. The authors found that the extent of necrotic disease of beech trunks expressed by I_{NK} was significantly influenced by the sociological position of individual trees in the stand. They conclude that strongly infected trees of the 4th and 5th tree age class left in the stands is problematic from the phytopathological point of view. Such trees left in the stands may cause a serious epiphytotic because these trees are one of the infection sources ot the necrotic disease.

Keywords: *Fagus sylvatica* L.; necrotic disease; sociological position of trees

The tracheomycotic type of necrotic disease of beeches has occurred in the Slovak Republic as well as in other European countries in recent years (CHIRA, CHIRA 1997; JANČAŘÍK 1992; KLEIN 1997; GAJEVAJA et al. 1995). In Slovakia, this disease locally has the character of epiphytotic (SUROVEC 1992; MIHÁL et al. 1998). This disease spreads in beech stands not only spatially (i.e. dispersion within the distribution area of beech, e.g. HOUSTON 1994) but also within the vertical structure of stands that is characterised by the sociological position of trees.

The relationships between the necrotic disease of beeches and sociological position of trees in forest stands were studied for example by TWERY and PATTERSON (1983) in the USA, CHIRA and CHIRA (1997) in Romania, LUNDERSTÄDT (1992) and WUJCIAK (1976) in Germany. In Slovakia this problem was studied by ŠTEFANČÍK (1974), ŠTEFANČÍK and LEONTOVYČ (1966). Some authors evaluated the necrotic disease in relation to the tree age (LUNDERSTÄDT 1990; GRÄGGEN, SCHWEINGRUBER 1986). The aim of this contribution is a detailed analysis of the degree of necrotic damage of beech bark in the whole territory of Slovakia and an answer to the question whether the necrotic disease depends on the sociological position of trees in the stand.

MATERIAL AND METHODS

In 1995–2001 the degree of necrotic damage of beech trunk bark by tracheomycotic type of the disease was evaluated in 54 selected localities in 33 orographic units of Slovakia (Fig. 1). Our own 5-degree classification scale was used for the evaluation (CICÁK, MIHÁL 1997). We evaluated trees of the 1st–5th age class (according to Kraft) in order to characterise the whole vertical profile of stands. In each stand 100 trees were evaluated, except the stands on permanent study plots (in 5 localities). In these stands, the number of evaluated trees was equal to the number of trees marked on the individual study plot. We evaluated stands situated at altitudes from 300 to 1,250 m and showing different quantitative representation of beeches. The stands in the selected localities belonged to the category of commercial stands, special- purpose and protective stands, and they involved all growth stages from pole stands to mature stands. A detailed description of the localities is given by CICÁK and MIHÁL (2002).

We evaluated 6,579 trees from whole Slovakia. The number of trees evaluated in the particular tree age classes was as follows: 1st class 1,451 trees, 2nd class 3,483, 3rd class 804, 4th class 452 and 5th class 389 trees. Data

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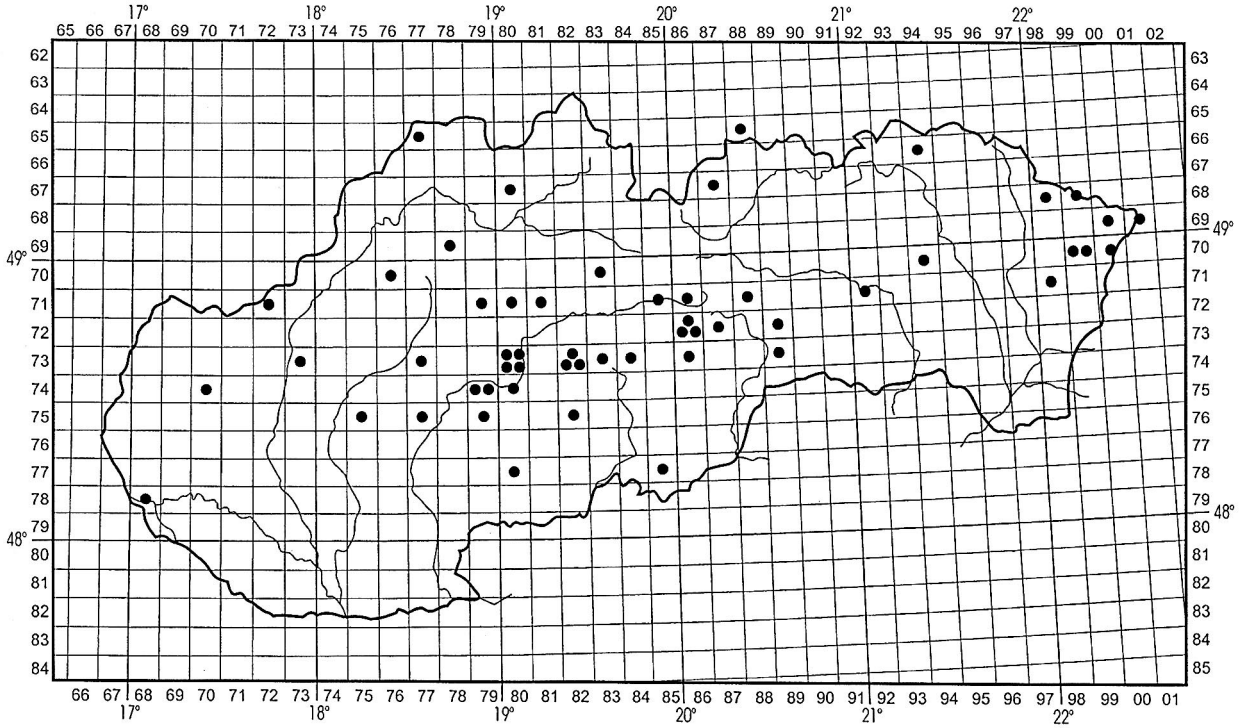

Fig. 1. Position of studied beech stands in a mapping grid of the Database of Fauna of Slovakia

on the degree of necrotic damage of beech trunks in each tree age class and in each stand were evaluated by means of the index of trunk necrotisation (I_{NK}) that makes the interpretation of results easier (CICÁK, MIHÁL 1998). In addition, I_{NK} data on the frequency of trees in particular degrees of necrotisation are also provided.

RESULTS AND DISCUSSION

The frequency of trees showing particular degrees of trunk necrotisation within the tree age classes was calculated from the data acquired in 54 localities in Slovakia (Fig. 2). It follows from this figure that the lowest val-

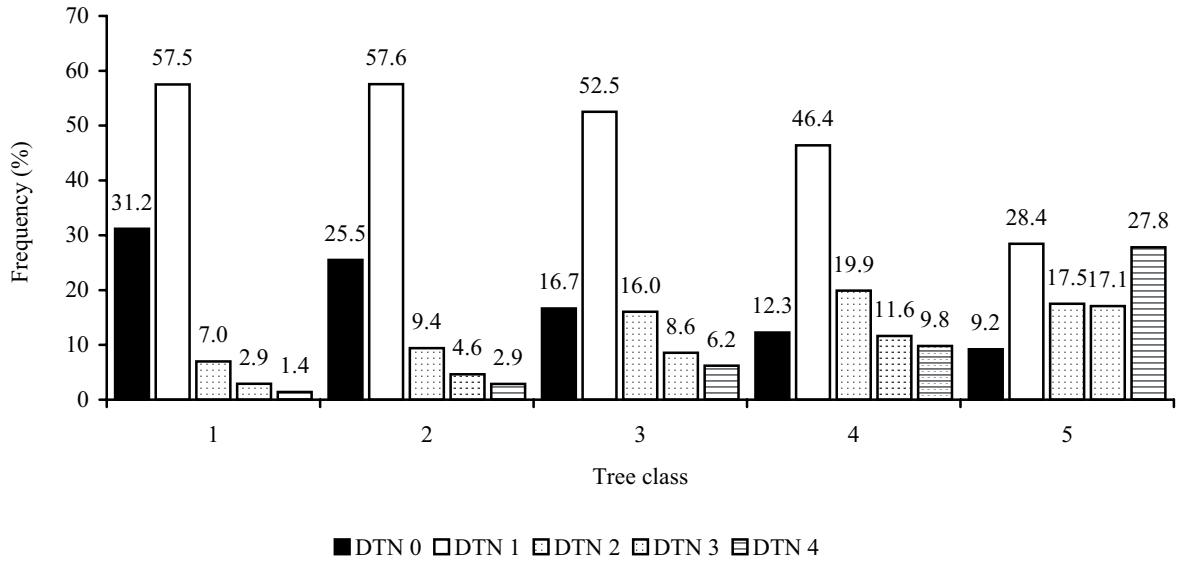

Fig. 2. Frequency of trees showing different degrees of trunk necrotisation in the tree age classes (DTN – degree of trunk necrotisation)

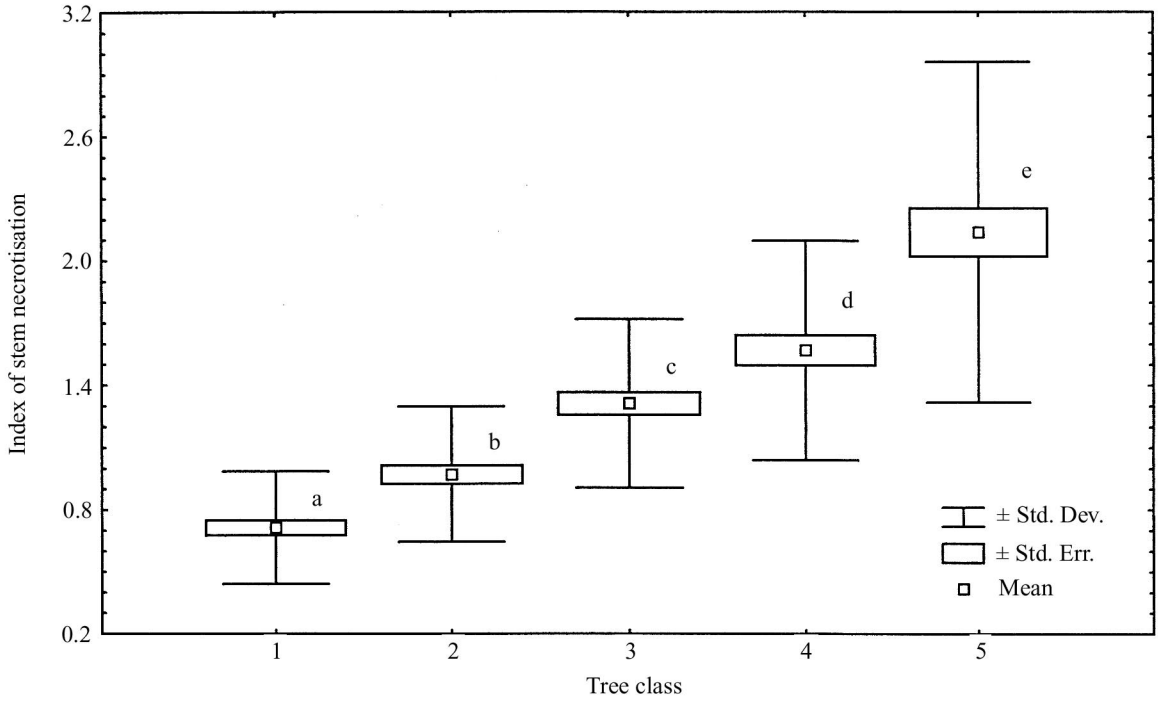

Fig. 3. Average index of trunk necrotisation (I_{NK}) of beech in the tree age classes calculated from I_{NK} found in 54 localities in Slovakia. Indices (a, b, c, d, e) specify the homogeneity of averages tested by Duncan's test ($P < 0.05$)

ues of frequency (4.3%) of trees showing the 3rd and/or 4th degree of necrotic damage were in the 1st age class. The frequency of trees damaged to such degrees increased with the worsening sociological position of trees. In the 2nd age class, the frequency of such trees was approximately twice higher (7.5%) than in the 1st age class, in the 3rd class it was 3 times higher (14.8%), in the 4th class almost 5 times (20.0%) and in the 5th class their frequency was more that 10 times higher (44.9%). The increase in the number of trees showing the 3rd and 4th degree of necrotisation in the particular trees classes was accompanied by a fluent decrease in the proportion of trees showing necrotisation degree 0 (healthy trees, without necrotised trunk bark) or degree 1 (trees showing small necrotic wounds). The highest frequency in all age classes was observed in the trees showing the 1st degree of necrotisation. Their frequency decreased from 57.5% in the 1st age class to 28.4% in the 5th age class. An inverse tendency (increase in the frequency of necrotisation) was recorded in the trees showing the 2nd degree of necrotisation. This tendency continued in the trees exhibiting the 3rd and 4th degree of necrotisation.

Dynamics of the frequency of necrotised trees in the particular age classes also corresponds to dynamics of I_{NK}, which increased from 0.71 in the 1st age class to 2.14 in the 5th age class (Fig. 3). This fact shows that the extent of necrotisation of beech trunks expressed by means of I_{NK} was significantly influenced by the sociological position of the tree in the stand. Duncan's test of homogeneity of I_{NK} values ($P < 0.05$) has unambiguously confirmed that each tree age class represents a separate homogeneous group (Fig. 3).

The problem of relationships between the necrotic disease of beech and sociological position of trees in stands is rarely dealt with in the literature, but the results are often contradictory.

For example, in contrast to our results, TWERY and PATTERSON (1983) found that the most necrotised trees were dominant (6.75%), codominant (3.46%) whereas suppressed trees were less damaged (2.24%). On the contrary, CHIRA and CHIRA (1997) found that in the even-aged trees the highest frequency of necrotisation was in suppressed trees. The intensity of disease decreased from intermediate trees to codominant trees. At the same time, these authors report that the lower layer with young trees in the storeyed stand was the most damaged. Similar results were obtained by WUJCIAK (1976), who found that the supreme and dominant trees were more infected by the necrotic disease than the trees of other classes. LUNDERSTÄDT (1992) studied relationships between the occurrence of the bark louse (*Cryptococcus fagisuga* Lind.) and necrotic disease of beeches. He found that *C. fagisuga* infested mostly the suppressed trees. The abundance of *C. fagisuga* increased from suppressed to codominant trees.

In Slovakia, this problem was solved by ŠTEFANČÍK and LEONTOVYČ (1966), who stated that the trees most damaged by necroses belonged to the 1st and 2nd tree age class. A similar result was given by ŠTEFANČÍK (1974), who found that in a beech stand at the age of thinning the subdominant trees were less infested that the dominant trees. A generally higher frequency of necrotisation in the trees of the 4th and 5th age classes was observed by CICÁK et al. (1998), CICÁK and MIHÁL (1999) and MIHÁL and

CICÁK (2000) in commercial stands as well as in virgin forests. They stated that the strongly infected trees of the 4th and 5th age class left in the stand were problematic from the phytopathological point of view. Such trees left in the stands can often cause a serious epifytotic because these trees are one of the infection sources (MIHÁL et al. 1998). In contrast, the trees of the 4th and 5th age class showing necrotic disease left in the stand are acceptable from the silvicultural point of view. Another situation is in virgin stands where no silvicultural interventions are applied and where the necrotic disease represents an integral factor of natural succession. KORPEĽ and SANIGA (1995) mention a decrease in the proportion of trees of 4th and 5th age classes in virgin forests, mainly in the fir-beech or spruce vegetation zone. According to our data, this process is caused by the tracheomycotic type of necrotic disease of beech to a large extent.

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Nekrotické ochorenie kmeňov buka vo vzťahu k sociologickému postaveniu stromov v poraste

A. CICÁK, I. MIHÁL

Ústav ekológie lesa SAV, Zvolen, Slovenská republika

ABSTRAKT: Autori v príspevku analyzujú výsledky výskumu stupňa nekrotického ochorenia kôry buka z celého územia Slovenska s cieľom získať odpoveď na otázku, do akej miery je stupeň nekrotického ochorenia kmeňov buka vo vzťahu s jeho sociologickým postavením v poraste. Počas rokov 1995–2001 v bukových porastoch na 54 vybraných lokalitách v rámci 33 orografických celkov Slovenska vyhodnotili stupeň nekrotického ochorenia kôry kmeňov buka tracheomykózneho typu.

Rozsah súboru vyhodnotených stromov bol 6 579. Najnižšiu hodnotu frekvencie stromov (4,3 %) v 3. a 4. stupni nekrotického poškodenia autori zistili v 1. stromovej triede. So zhoršujúcim sa sociologickým postavením stromov v poraste sa hodnoty frekvencie zvyšovali. Zistené hodnoty indexu nekrotizácie kmeňov (I_{NK}) stúpali od 0,71 v 1. stromovej triede do 2,14 v 5. stromovej triede, čomu odpovedá aj dynamika hodnôt frekvencie ochorenia stromov v jednotlivých stromových triedach. Autori zistili, že miera nekrotického ochorenia kmeňov buka, ktorá je reprezentovaná vypočítanou hodnotou I_{NK}, je signifikantne ovplyvňovaná sociologickým postavením stromov v poraste. Na záver konštatujú, že ponechanie silno napadnutých stromov 4. a 5. stromovej triedy v poraste je z fytopatologického hľadiska otázne. Ponechanie takýchto stromov v poraste môže často viesť k vážnej epifytócii, nakoľko tieto stromy sú jedným z infekčných zdrojov ochorenia.

Kľúčové slová: *Fagus sylvatica* L.; nekrotické ochorenie; sociologické postavenie stromov

Nekrotické ochorenie buka tracheomykózneho typu sa v porastoch rozširuje nielen do priestoru, t.j. disperzia ochorenia v rámci areálu jeho výskytu, ale aj v rámci vertikálnej štruktúry porastu, ktorá je charakterizovaná sociologickým postavením stromov. V príspevku analyzujeme výsledky výskumu stupňa nekrotického ochorenia kôry kmeňov buka z celého územia Slovenska s cieľom získať odpoveď na otázku, do akej miery je stupeň nekrotického ochorenia vo vzťahu so sociologickým postavením stromov v poraste.

Počas rokov 1995–2001 sme v bukových porastoch na 54 vybraných lokalitách v rámci 33 orografických celkov Slovenska (obr. 1) hodnotili stupeň nekrotického ochorenia kôry kmeňov buka. Pri hodnotení sme použili vlastnú 5-bodovú klasifikačnú stupnicu. Hodnotili sme stromy 1. až 5. stromovej triedy (podľa Krafta). Na celom území Slovenska sme vyhodnotili 6 579 stromov. Rozsah súborov stromov hodnotených v jednotlivých stromových triedach bol nasledovný: v 1. stromovej triede 1 451 stromov, v 2. triede 3 483, v 3. triede 804, vo 4. triede 452 a v 5. stromovej triede 389 stromov.

Údaje o stupni nekrotizácie kmeňov buka za každú stromovú triedu a za každý porast sme vyhodnotili pomocou indexu nekrotizácie kmeňov (I_{NK}). Hodnoty I_{NK} sme doplnili aj údajmi o frekvencii stromov v jednotlivých stupňoch nekrotizácie. Výsledky frekvencie stromov v jednotlivých stupňoch nekrotizácie kmeňov podľa stromových tried uvádzame v obr. 2. Najnižšie hodnoty frekvencie stromov (4,3 %) v 3. a 4. stupni nekrotického poškodenia sú v 1. stromovej triede. So zhoršujúcim sa sociologickým postavením stromov v poraste sa hodnoty frekvencie zvyšujú. V 2. stromovej triede je frekvencia v porovnaní s 1. stromovou triedou približne 2-násobne vyššia (7,5 %), v 3. triede viac ako 3-násobne (14,8 %), vo 4. triede približne 5-násobne (20,0 %) a v 5. stromovej triede je frekvencia stromov v 3. a 4. stupni nekrotizácie viac ako 10-násobne vyššia (44,9 %). Nárast frekvencie stromov v 3. a 4. stupni nekrotizácie v jednotlivých stromových triedach je sprevádzaný plynulým poklesom podielu stromov zaradených do stupňa 0 (stromy bez nekrotického poškodenia kmeňa) a 1. stupňa (kmene s malými nekrotickými ranami). Najvyššie hodnoty frekvencie vo všetkých stromových triedach majú stromy zaradené do 1. stupňa nekrotizácie, ktoré postupne klesajú (od 57,5 % v 1. stromovej triede po 28,4 % v 5. stromovej triede). K opačnému trendu – stúpaniu hodnôt frekvencie – dochádza až pri stromoch zaradených do 2. stupňa a pokračuje v 3. aj 4. stupni nekrotizácie. Dynamike hodnôt frekvencie poškodenia stromov v jednotlivých stromových triedach odpovedá aj dynamika hodnôt I_{NK} (obr. 3). Tento fakt poukazuje na to, že miera nekrotického poškodenia kmeňov buka, ktorá je reprezentovaná vypočítanou hodnotou I_{NK}, je signifikantne ovplyvňovaná sociologickým postavením stromov v poraste. Výsledky testu homogenity hodnôt I_{NK} podľa Duncana ($P < 0,05$) jednoznačne potvrdili, že každá stromová trieda je samostatnou homogénnou skupinou (obr. 3).

Ponechanie silno napadnutých stromov 4. a 5. stromovej triedy v poraste považujeme z fytopatologického hľadiska za otázne. Ponechanie takýchto stromov v poraste môže často viesť k vážnej epifytócii, nakoľko tieto stromy sú jedným z infekčných zdrojov ochorenia. Naproti tomu z pestovateľského hľadiska sa považuje ponechanie stromov 4. a 5. stromovej triedy s nekrotickým ochorením v poraste za prijateľné.

Corresponding author:

Ing. ALOJZ CICÁK, CSc., Ústav ekológie lesa SAV, Štúrova 2, 960 53 Zvolen, Slovenská republika
tel.: + 421 45 533 09 14, fax: + 421 45 547 94 85, e-mail: cicak@sav.savzv.sk