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Development of necrotic disease and health condition of trees of selective quality in a systematically tended beech pole-stage stand

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ABSTRACT: We compare the results of observations of bark necrotic disease and defoliation of beech assimilatory organs carried out in 1996 and 2000. A systematically managed, 53-year old beech pole-stage stand in Central Slovakia was chosen as an object of our research. It was found that necrotic disease had an increasing trend. The degree of necrotic disease indicated on trees of selective quality that are the main focus of interest of silvicultural managers was lower than the degree of necrotic disease on the other trees in the same stand layer (trees of unselective quality). The defoliation of assimilatory organs was not influenced by an increasing trend of necrotic disease development. It was confirmed that the method of crown thinnings realised with the aim to support the trees of selective quality, combined with sanitary selection, was reasonable also in beech pole-stage stands affected by necrosis. During the research period in the studied stand we detected four tracheomycotic fungi of *Nectria* (Fr.) Fr. genus and two species of imperfect fungi of the genus *Cylindrocarpon* Wollenw. and *Verticillium* Nees.

Keywords: *Fagus sylvatica* L.; bark necrotic disease; defoliation; beech pole-stage stand; thinnings; Central Slovakia

An increased trend of development of beech (*Fagus sylvatica* L.) bark necrotic disease has been recorded in Europe since the 60s of the 20th century. This disease, caused by several phytopathogenic fungal species, has spread also on American beech trees (*Fagus grandifolia* Ehrh.) in North America. The necrotic disease often has the character of an epiphytotic and is a serious problem for management of such affected stands. The influence of beech necrotic disease on development of beech stands and their management was studied by several authors both in Slovakia and abroad, for example: BOGENSCHÜTZ (1983), BURNS and HOUSTON (1987), CICÁK et al. (1998), GAVIN and PEART (1993), GOVE and HOUSTON (1996), HOUSTON (1975, 1994), KUNCA et al. (2000), MIHÁL et al. (1998), OSTROFSKY and HOUSTON (1989), PERRIN (1977), ŠTEFANČÍK L. (1974, 1978), ŠTEFANČÍK L. and LEONTOVYČ (1966), ŠTEFANČÍK I. and ŠTEFANČÍK L. (1999).

This contribution is a follow-up of discussion about the problems examined by CICÁK et al. (1998) and MIHÁL et al. (1998), who presented the first results of assessment of bark necrotic disease development and health condition (defoliation) of trees in a systematically tended beech pole-stage stand. The aim of this paper was to evaluate the development of necrotic disease and health condition of trees in the same stand after a time period of 4 years that elapsed since the first evaluation in 1996.

MATERIAL AND METHODS

A 53-year old beech stand at the growth stage of pole-stage stand on the Permanent Research Plot (PRP) Štagiar-Zábučie was chosen as an object of our research. The PRP is situated in the southern part of the Kremnické vrchy Mts., in Central Slovakia, 620 m above sea level. The PRP was established in 1984 by research workers of the Forest Research Institute in Zvolen. More details about the plot can be found in the paper by CICÁK et al. (1998).

The research object consists of four partial plots (PP) designated as I, II, III, and IV. Free crown thinnings of different intensity – a method developed in Slovakia, are investigated on the partial plots (ŠTEFANČÍK L. 1984). The area of each PP is 0.25 ha. In the middle of each PP there is a stabilised cross-section strip 10 m in width (overall area 0.05 ha). PP are isolated from each other and also from adjacent stands by 10 m wide isolation strips. All the living trees growing on PP with diameter $d_{1.3}$ larger than 3.6 cm are numbered. Since the establishment of PRP, the trees growing on PP were subjected four times (in 1984, 1989, 1994, and 1999) to standard biometric measurements and to the classification of their characteristics necessary for the evaluation of quantitative and qualitative production aimed at the cultivation of trees of selective quality (TSQ). There are promising and target (crop) trees bearing the qualitative and quantitative production

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of stands. ŠTEFANČÍK L. (1984) summarised these two types under one notion trees of selection quality that are in the focus of interest of silvicultural managers. Along with biometric measurements thinning treatments were also performed. The results were published in ŠTEFANČÍK I. and ŠTEFANČÍK L. (1999).

The research programme on PP has been designed as follows:

PP I – method of promising trees (PT) with free crown thinning applied on the whole area. With each thinning treatment the crowns of promising trees are released to 50–75% of the crown girth,

PP II – method of target trees (TT) with free crown thinning applied within the growth space of target trees. With each thinning treatment the crowns of target trees are released to 75–100%,

PP III – method of promising trees (PT) on circular areas, each with 3 m in diameter and 8m distance between the centres. Free crown thinning is not applied on the whole area, only on the circular areas of promising trees. With each thinning treatment the crowns of promising trees are released to 50–75% of the crown girth,

PP IV – combined selection method. The first treatment consists of moderate thinning from below and simultaneous whole-area crown positive thinning according to the method of target trees. The other treatments are carried out by the method of target trees on the whole area of free crown thinning. The crowns of target trees are released to 50–75% of the crown girth.

The bark necrotic disease on beech stems was evaluated using our original 5-point classification scale (CICÁK, MIHÁL 1997). The first classification was performed in autumn 1996, the second in autumn 2000. Based on the numbers of trees recorded in the individual necrotic damage classes we calculated the index of stem necrotisation (I_{NK}). The reasoning and advantages of I_{NK} were already published (CICÁK, MIHÁL 1998).

The assessment of assimilatory organ defoliation in 1996 and 2000 was performed according to the method of the International Cooperative Programme on assessment and monitoring of air pollution effects on forests (UN/ECE, ICP Forests, 1994). We evaluated dominant and co-dominant trees (tree classes 1 and 2 according to the KRAFT system).

The evaluated trees on each PP were divided into two categories. The first category comprised trees of selective quality (trees of the crown level belonging to the 1st and 2nd tree class, with a high proportion of trees belonging to the 1st tree class). This category of trees is of key importance for further development of forest stands. The trees of selective quality were evaluated over the whole area of each PP. The second category included all other trees of the crown level (belonging to the 1st and 2nd tree class, with a high proportion of trees belonging to the 2nd tree class). We called these trees trees of unselective quality. These trees were evaluated only on 10m wide cross-section strips on each PP. The number of selective and unselective quality trees evaluated in year 2000 was the same as in 1996 (Fig. 2).

In the stands on the individual PP the species diversity of macromycetes was continually observed since 1996. Several species of phytopathogenic fungi causing the necrotic disease on beech trees were determined by *in vivo* and *in vitro* methods (det. Juhásová). We used the diagnostic literature by BRANDENBURGER (1985), BREITENBACH and KRÄNZLIN (1986), HARTMANN et al. (1995), STROUTS and WINTER (1994) for their determination.

RESULTS AND DISCUSSION

Necrotic disease of trees of selective (TSQ) and unselective (TUQ) quality

The values of necrotic disease of TSQ and TUQ, expressed by I_{NK}, were higher in 2000 compared with 1996 on each PP (Fig. 1). An increase in I_{NK} was more evident in 2000 for TUQ. The results of one-way analysis of variance ($P < 0.05$) confirmed that the differences in the values of index I_{NK} between TSQ and TUQ were significant only on PP II (in 1996 and 2000) and on PP III (in 2000). In the category TSQ the significance of differences in the values of I_{NK} measured in 1996 and 2000 was confirmed by the results of one-way analysis of variance on PP I and III. In the category TUQ the

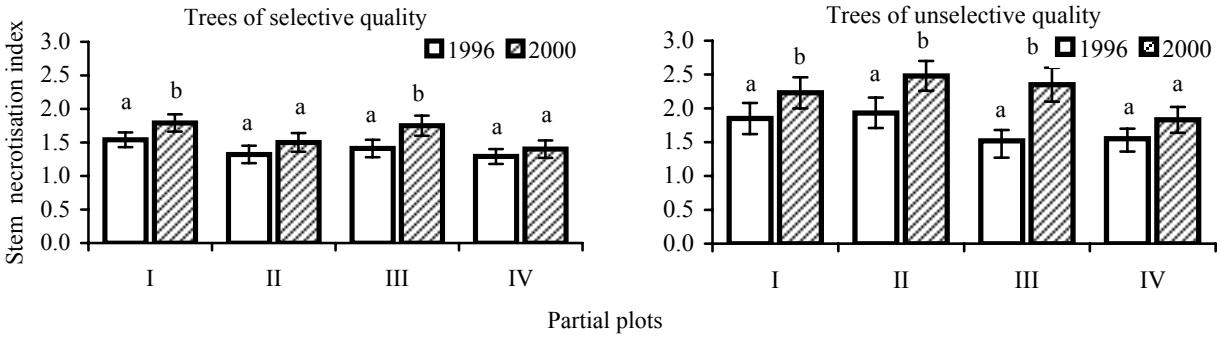

Fig. 1. Index of stem necrotisation (I_{NK}) for selective and unselective quality trees (average and standard error)
Note: The homogeneity of values for I_{NK} is marked by *a* and *b*. Differences between the values with equal marks are statistically insignificant ($P < 0.05$)

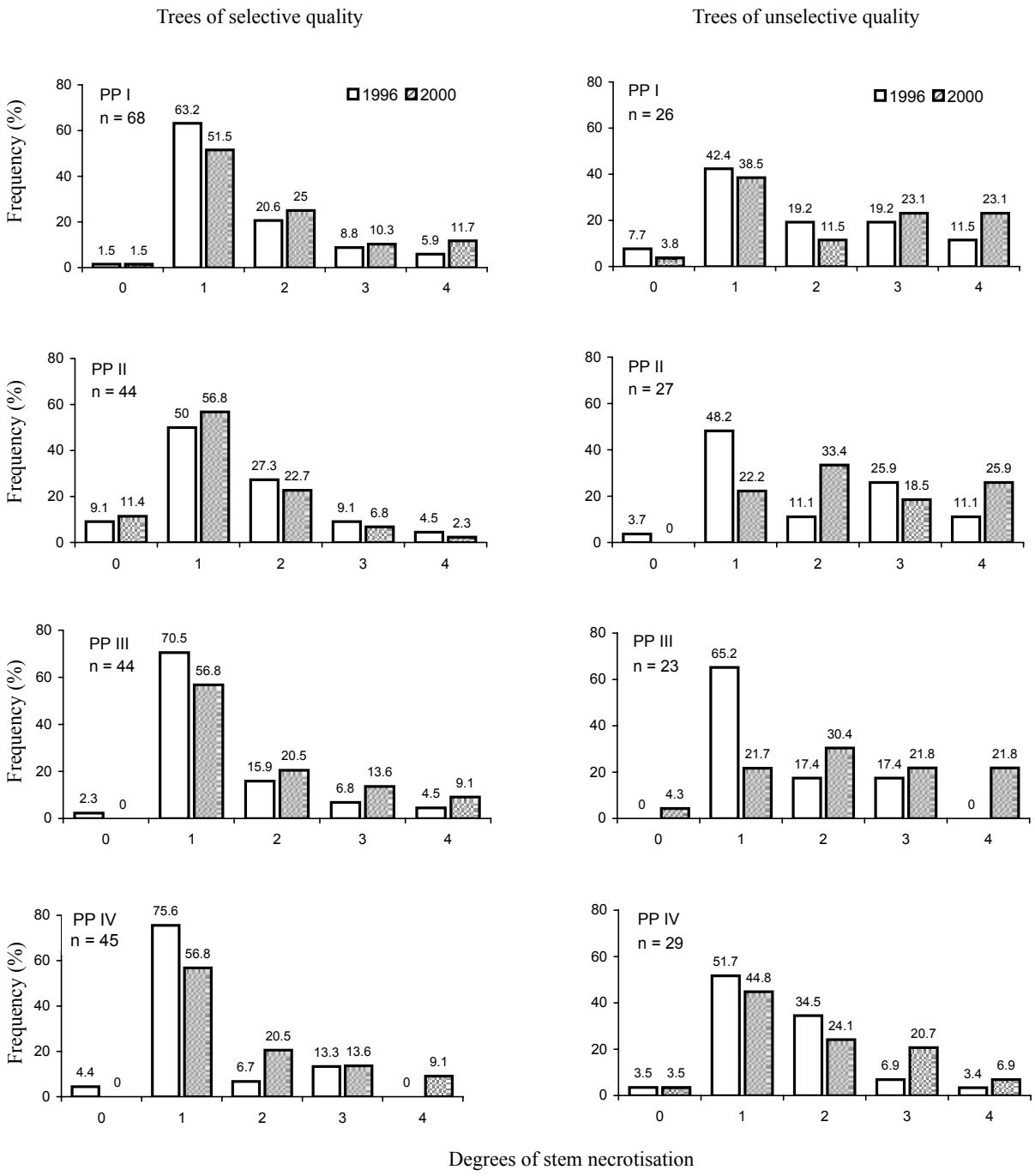

Fig. 2. Frequency of trees of selective and unselective quality in individual degrees of stem necrotisation

differences were significant on all PP, with the exception of PP IV.

The question why the values of I_{NK} were lowest on PP IV for both TSQ and TUQ was answered by ŠTEFANČÍK I. and ŠTEFANČÍK L. (1999). We can see from the results of development of mensurational characteristics of the stands on the individual PP reported by the cited authors that in the first year of treatment (1984) only plot IV was subjected to moderate thinning from below. The intensity of this thinning expressed by the number of cut trees was 2,517 individuals per hectare (48.6%); and the intensity of the free crown thinning was 150 individuals per hectare (2.9%). The number of trees left after the first cutting in the stand on PP IV was only 2,508 individuals per hectare whereas on the other plots this number ranged from 4,536 to 5,140 individuals per hectare. The lowest values of I_{NK} and the lowest value of stand density on PP IV compared with the other PP are consistent with PERRIN (1977) according to whom more dense stands are exposed to higher risks of necrotic disease.

The values of I_{NK} measured on TSQ and TUQ both in 1996 and 2000 were very well balanced on all PP (Fig. 1). The results of one-way analysis of variance ($P < 0.05$) did not confirm any significant differences in I_{NK} values

Table 1. Silvicultural analysis of free crown thinning (felling of living trees) on the Permanent Research Plot Štagiar-Zábučie

Partial plot	Treatment No.	Selection				Other decrease (%)	Thinning treatment intensity (%)
		positive		negative			
		at crown level (%)	at suppressed level (%)	decrease (%)	sanitary (%)		
I	1	40.9	45.3	10.3	3.5	–	15.2
	2	62.3	29.2	2.8	5.7	–	9.5
	3	22.8	43.4	18.1	12.6	3.1	13.5
	4	51.6	9.7	–	16.1	22.6	4.6
II	1	56.9	32.1	5.5	5.5	–	7.9
	2	88.7	2.5	–	6.5	2.5	6.3
	3	59.5	4.5	10.8	20.7	4.5	10.4
	4	52.0	8.0	2.0	32.0	6.0	6.4
III	1	83.4	12.1	3.0	1.5	–	5.5
	2	64.5	17.7	9.7	8.1	–	5.5
	3	50.0	14.3	11.9	14.3	9.5	4.4
	4	72.9	10.4	–	4.2	12.5	6.3
IV	1	97.2	–	–	2.8	–	2.9
	2	72.0	13.5	13.5	1.0	–	16.3
	3	66.8	12.6	5.0	11.1	4.5	12.9
	4	75.6	4.9	2.5	14.6	2.4	9.5

between the individual PP in any year. That means different intensity of crown thinnings applied on the different PP had no significant influence on the degree of necrotic damage either on TSQ or on TUQ. This status is only temporary and it is probably influenced by the young age of the stands. We cannot exclude in advance a potential change owing to increasing age and development of the stands.

Lower values of I_{NK} obtained in the category TSQ compared with TUQ can be explained by the fact that TSQ were trees of the highest quality and vitality, with regularly developed, appropriately large crowns. These trees were subjected to a special silvicultural care at each treatment (ŠTEFANČÍK I., ŠTEFANČÍK L. 1999). More favourable parameters of necrotic disease development on TSQ compared with TUQ were also confirmed by the relative numbers of trees with the particular degrees of necrotisation recorded in 2000 compared with the corresponding values recorded in 1996 (Fig. 2). This state was most probably reflected on the tree frequency values in classes with the highest necrotisation degrees (3–4). In the case of TSQ the frequency values on the partial plots measured in 1996 ranged between 11.3–14.7%, in 2000 between 9.1–22.7%. On the other hand, the respective values measured on TUQ were 10.3–37.0% in 1996 and 27.6–46.2% in 2000. So we demonstrated that the degree of necrotic disease on beech stems was significantly influenced by the tree sociological position in the stand (CICÁK, MIHÁL 2002). A more favourable status of development of beech bark necrotic disease was detected on all partial plots of TSQ thanks to higher relative numbers of trees belonging to the first tree class (88.6–91.2%). On each partial plot, the remarkably lower percentage of trees belonging to the 1st tree class was found in the category TUQ (7.4–7.8%).

The hitherto accomplished research on thinnings in beech stands damaged by necrotic disease has led to similar results. ŠTEFANČÍK L. (1974) found that the rate of the disease progress was higher in thinned stands compared with unthinned ones. However, the author points to the fact that the study period was somewhat short to obtain a final, generally valid conclusion. After having analyzed the results of numerous experiments, PERRIN (1977) also reported the unfavourable influence of sanitary thinnings on necrotic disease in the stand. HOUSTON (1994) published a similar opinion. According to this author, the young succession to an infected parent stand in which no interventions were executed can reach so called "adaptation phase". Damage to the parent stand by cutting interventions can trigger a mechanism that increases the sensitivity of the young stand to necrotic disease. During our research on the PRP Štagiar we obtained the same result; after the first thinning we could detect a remarkable increase in the frequency of relict traces of the T-disease. The increase in frequency was detected repeatedly after each thinning treatment (CICÁK, MIHÁL 2001).

Most authors recommend to carry out consistent sanitary selection and/or to remove the attacked trees (BURNS, HOUSTON 1987; KUNCA et al. 2000; ŠTEFANČÍK L. 1974). It is very important to point out that the influence of thinnings on further stand development also depends on the degree of necrotic disease in the stand. ŠTEFANČÍK L. (1974) recommended to apply less intensive thinning

treatments in the case of greater necrotic damage to the stand and vice-versa to apply stronger thinning treatments in the case of lower necrotic damage. The author also reported a positive influence of thinnings performed in a damaged stand on the quality of stand production, but, on the other hand, a less positive influence on volume production. PARKER (1974) et LUNDERSTÄDT and VON WERDER (1993) did not find any influence of thinnings on the extent and degree of infestation by the beech scale – a vector of beech necrotic disease. PERRIN (1977) concluded that the risk of disease outbreak was higher in denser stands, which agrees with our findings when the bark necrotisation indices in both years of study were higher on partial plots with higher tree numbers. MIHÁL et al. (1998) found that even in the case when the attack in a beech pole-stage stand was an epiphytotic, it was possible to reach satisfactory results from the silvicultural aspect. According to the authors, crown thinning aimed to support TSQ in combination with sanitary selection is reasonable in such stands.

The results of the silvicultural analysis of all treatments accomplished on the PRP Štagiar until now showed that the sanitary selection had an increasing trend on all PP since their establishment (Table 1). That means the necrotic disease had an increasing trend, too. The lowest percentage of trees in terms of sanitary selection was on PP III where the interventions were not performed on the whole area and on PP IV where the subdominant layer of the stand was removed by the first intervention.

Health condition of the trees of selective (TSQ) and unselective (TUQ) quality

The differences in the values of defoliation between TSQ and TUQ obtained in 2000 and in 1996 were very low on all partial plots (Fig. 3). The results of one-way analysis of variance ($P < 0.05$) confirmed that these differences were insignificant on most PP. Significant were only the differences on PP I (2000) and PP IV (1996 and 2000). In the category TSQ significant differences in defoliation values measured in 1996 and 2000 were confirmed by one-way analysis of variance only on PP II. In the category TUQ no significant differences were detected. Based on the results obtained by one-way analysis of variance ($P < 0.05$), the significance of differences between the values measured on the individual PP was confirmed only in the case of TSQ in 1996.

In spite of the evident increase in necrotic disease development, we observed no significant change in the situation in 2000 compared with 1996. So the hypothesis of a possible influence of necrotic disease on the health condition (defoliation) has to be rejected.

Phytopathogenic fungi of tracheomycotic type found on PRP Štagiar

In 1996 we performed the basic mycological inventory on all PP that resulted in determination of 95 macromycete species (CICÁK et al. 1998). In the next years we continued determining other up-to-the time non-identified macromycetes and also several phytopathogenic species. In total, we have determined 156 macromycetes species growing on the PRP Štagiar until now (MIHÁL 2003).

According to several authors (CICÁK et al. 1998; KUNCA et al. 2000; BREITENBACH, KRÄNZLIN 1986; GAVIN, PEART 1993), the fungi of the genus *Nectria* (Fr.) Fr. belong to the most important pathogens causing beech bark necrotic disease. The perithecia of the following fungi were determined *in vivo* in 1998 and 2001 on the bark of beech trees growing on the PRP Štagiar: *Nectria cinnabarina* (Tode) Fr., *N. coccinea* (Pers.) Fr., *N. galligena* Bres. sensu Strasser and *N. punicea* (Schmidt) Fr. In addition, these species were determined in laboratory *in vitro* (det. Juhásová): the non-reproductive phase of *Cylindrocarpon candidum* (Fr.) Wollenw. belonging to the species *Nectria coccinea* and also non-specified species of *Verticillium* Nees genus.

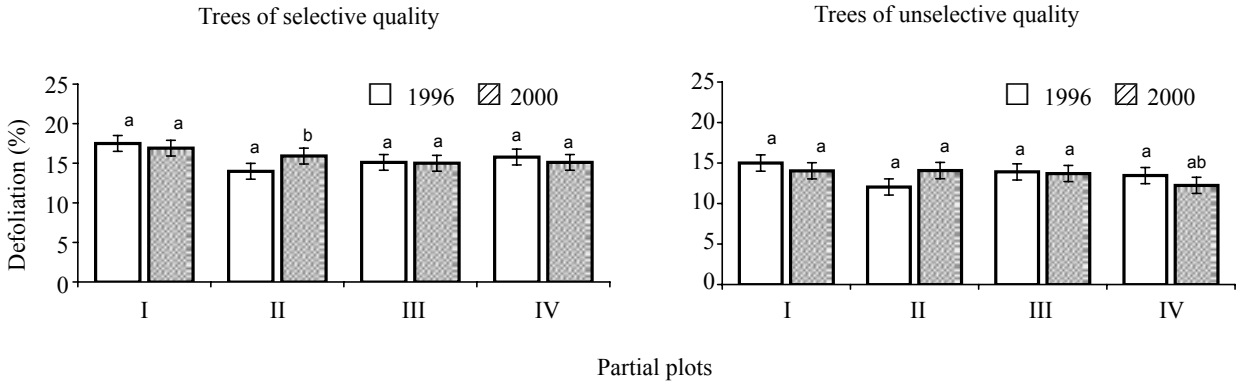

Fig. 3. Defoliation of trees of selective and unselective quality (average and standard error)
Note: The homogeneity of values for defoliation is marked by *a* and *b*. Differences between the values with equal marks are statistically insignificant ($P < 0.05$)

CONCLUSIONS

The analysis of the results of repeated evaluation of necrotic disease development after four years in a 53-year old beech pole-stage stand has revealed that thinning is also reasonable in the stands where the disease reached the phase of an epiphytotic. Systematic, on the silvicultural basis performed thinning treatments can mitigate the unfavourable impacts of necrotic disease to a certain extent.

Acknowledgement

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Vývoj nekrotického ochorenia a zdravotného stavu stromov výberovej kvality v systematicky vychovávanej bukovej žrďovine

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ABSTRAKT: V práci sa porovnávajú výsledky stavu nekrotického ochorenia kôry a defoliácie asimilačných orgánov buka v roku 2000 s výsledkami z roku 1996. Objektom výskumu bola systematicky obhospodarovaná 53-ročná bukovú žrďovina na strednom Slovensku. Bolo zistené, že nekrotické ochorenie má stúpajúci trend. Miera nekrotického ochorenia stromov výberovej kvality, ktoré sú hlavným predmetom záujmu pestovateľa, bola menšia ako miera nekrotického ochorenia ostatných stromov z úrovne porastu (stromov nevýberovej kvality). Defoliácia asimilačných orgánov nebola ovplyvnená stúpajúcim trendom nekrotického ochorenia. Potvrdilo sa, že metóda úrovňových prebierok s cieľom podpory stromov výberovej kvality, kombinovaná so zdravotným výberom, má aj v nekrózami napadnutých žrďovinách svoje opodstatnenie. Počas doby výskumu sme v sledovanom poraste zistili štyri druhy tracheomykóznych húb rodu *Nectria* (Fr.) Fr. a dva druhy nedokonalých húb z rodov *Cylindrocarpon* Wollenw. a *Verticillium* Nees.

Kľúčové slová: *Fagus sylvatica* L.; nekrotické ochorenie kôry; defoliácia; buková žrďovina; prebierky; stredné Slovensko

V príspevku sa porovnávajú výsledky stavu nekrotického ochorenia kôry a defoliácie asimilačných orgánov buka v roku 2000 s výsledkami z roku 1996. Objektom výskumu bol 53-ročný bukový porast v rastovej fáze žrďoviny na trvalej výskumnej ploche (TVP) Štagiar-Zábučie. TVP sa nachádza v južnej časti Kremnických vrchov na strednom Slovensku. Výskumný objekt tvoria štyri čiastkové plochy (ČP), označené ako I, II, III a IV. Na ČP sa sledujú rôzne varianty sily úrovňovej voľnej prebierky, ktorá bola vyvinutá na Slovensku. Od založenia TVP sa na ČP vykonali štyri štandardné biometrické merania a klasifikácia znakov (v roku 1984, 1989, 1994 a 1999), ktoré sú potrebné na vyhodnotenie kvantitatívnej a kvalitatívnej produkcie s orientáciou na pestovanie stromov výberovej kvality (SVK). Sú to nádejné a cieľové stromy, ktoré sú nositeľmi kvalitatívnej a kvantitatívnej produkcie porastu a sú hlavným predmetom záujmu pestovateľa.

Nekrotické ochorenie kôry kmeňov buka sme hodnotili pomocou vlastnej 5-bodovej klasifikačnej stupnice. Získané údaje o stupni nekrotického ochorenia sme vyhodnotili pomocou indexu nekrotizácie kmeňov (I_{NK}), ktorý sme doplnili aj hodnotami frekvencie stromov v jednotlivých stupňoch nekrotizácie.

Pri hodnotení defoliácie asimilačných orgánov sme postupovali podľa metodiky Medzinárodného kooperatívneho programu sledovania a monitorovania vplyvov znečistenia ovzdušia na lesy (UN/ECE, ICP Forests, 1994). Hodnotili sme stromy 1. a 2. stromovej triedy (podľa Krafta).

Hodnotené stromy z každej ČP sme rozdelili do dvoch kategórií. Prvú kategóriu tvorili stromy výberovej kvality (stromy porastovej úrovne – 1. a 2. stromovej triedy, s vysokým podielom stromov 1. stromovej triedy). Stromy výberovej kvality sme hodnotili na celej výmere každej ČP. Druhú kategóriu tvorili všetky ostatné stromy porastovej úrovne (1. a 2. stromovej triedy, s vysokým podielom stromov 2. stromovej triedy), ktoré sme označili ako stromy nevýberovej kvality (SNK). Tie sme hodnotili len na 10 m širokých prierezových pásoch každej ČP.

V porastoch jednotlivých ČP sme od roku 1996 priebežne zaznamenávali druhovú diverzitu makromycétov. Metódami *in vivo* a *in vitro* sme determinovali viaceré fytopatologické druhy húb, spôsobujúce nekrotické ochorenie buka.

Hodnoty nekrotického ochorenia SVK a SNK, vyjadrené pomocou I_{NK}, sa v roku 2000 v porovnaní s rokom 1996 zvýšili na každej ČP (obr. 1). Výraznejšie zvýšenie I_{NK} v roku 2000 sme zaznamenali pri SNK. Výsledky jednofaktorovej analýzy variancie ($P < 0,05$) potvrdili signifikantnosť rozdielov hodnôt I_{NK} medzi SVK a SNK len na ČP II (rok 1996 a rok 2000) a na ČP III (rok 2000). V kategórii SVK sa signifikantnosť rozdielov v hodnotách I_{NK} medzi rokom 1996 a 2000 potvrdila na ČP I a III. V kategórii SNK boli rozdiely signifikantné na všetkých ČP, okrem ČP IV.

Hodnoty I_{NK} SVK a SNK v roku 1996 aj v roku 2000 sú na všetkých ČP veľmi vyrovnané (obr. 1). Ani v jednom roku hodnotenia sa nepotvrdila signifikantnosť rozdielov hodnôt I_{NK} medzi jednotlivými ČP. To znamená, že aplikované varianty sily úrovňovej prebierky na ČP nemajú signifikantný vplyv na mieru nekrotického poškodenia ani SVK, ani SNK.

Nižšie hodnoty I_{NK} kategórie SVK v porovnaní s kategóriou SNK si vysvetľujeme tým, že sú to stromy najkvalitnejšie a najvitálnejšie, s pravidelnou korunou primeranej veľkosti. Týmto stromom sa venuje pestovná starostlivosť pri každom zásahu. Priaznivejšie parametre

vývoja nekrotického ochorenia SVK v porovnaní s SNK potvrdzujú aj hodnoty frekvencie stromov v jednotlivých stupňoch nekrotizácie v roku 2000 v porovnaní s rokom 1996 (obr. 2). Najlepšie to dokumentujú hodnoty frekvencie v najvyšších stupňoch nekrotizácie (3–4).

Zhoršujúce parametre nekrotického ochorenia na TVP Štagiar potvrdzujú aj výsledky pestovnej analýzy všetkých doteraz vykonaných zásahov. Zdravotný výber má na všetkých ČP od založenia TVP stúpajúci trend (tab. 1).

Hodnoty defoliácie SVK a SNK sa na všetkých ČP v roku 2000 v porovnaní s rokom 1996 zmenili minimálne (obr. 3). Výsledky jednofaktorovej analýzy variancie ($P < 0,05$) potvrdili nesignifikantnosť rozdielov hodnôt defoliácie medzi SVK a SNK na väčšine ČP. Signifikantné boli rozdiely len na ČP I (rok 2000) a na ČP IV (rok 1996 a 2000). V kategórii SVK sa signifikantnosť rozdielov v hodnotách defoliácie medzi rokom 1996 a 2000 potvrdila len na ČP II. V kategórii SNK sa nepotvrdila signifikantnosť ani na jednej ČP. Výsledky jednofaktorovej analýzy variancie ($P < 0,05$) potvrdili signifikantnosť rozdielov v hodnotách defoliácie medzi jednotlivými ČP len u SVK v roku 1996. Defoliácia napriek nárastu nekrotického ochorenia sa v roku 2000 v porovnaní s rokom 1996 nezmenila. Predpoklad, že nekrotické ochorenie môže ovplyvniť zdravotný stav (defoliáciu), sa nepotvrdil.

Na TVP Štagiar sme v rokoch 1998 a 2001 metódou *in vivo* zistili na kôre bukov perithécie druhov *Nectria cinnabarina* (Tode) Fr., *N. coccinea* (Pers.) Fr., *N. galligena* Bres. sensu Strasser a *N. punicea* (Schmidt) Fr. Metódou *in vitro* (det. Juhásová) sme zistili nepohlavné štádium *Cylindrocarpon candidum* (Fr.) Wollenw., prináležiace k druhu *Nectria coccinea,* a tiež bližšie nedeterminovaný druh z rodu *Verticillium* Nees.

Výsledky opakovaného hodnotenia nekrotického ochorenia buka po štyroch rokoch v sledovanej 53-ročnej žrďovine ukázali, že aj v epifytócne postihnutých porastoch majú prebierky svoje opodstatnenie. Ich systematické vykonávanie podľa pestovných zásad môže do určitej miery eliminovať nepriaznivé účinky nekrotického ochorenia.

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