

The black pine health condition in the Zoborské vrchy Mts

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Abstract

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The introduced black pine (*Pinus nigra* Arnold) has been planted for its resistance to pollution and biotic harmful factors. However, nowadays the species appears drying up. The object of this paper is to assess the measure of damage, to identify the reason for its injury and to estimate the measure of the influence of the black pine stands in the Zoborské vrchy Mts in the years 2007 and 2008. An occurrence of the *Rhyacionia buoliana* (Denis & Schiffermüller), was identified on a tree shoot. On each spot, there have been assessed the degree of damage to the trees by all relevant harmful factors and intensity of infestation by the *Rhyacionia buoliana*. It has been found out, that the spots have different degree of damage by all harmful factors, as well as the intensity of infestation by the *Rhyacionia buoliana*.

Keywords

degree of damage, harmful factors, black pine, *Rhyacionia buoliana*

Introduction

The black pine (*Pinus nigra* Arnold) was introduced from the Mediterranean region. The introduction started in the 18th century. The first record of its presence is from the year 1769, when a seed from Lower Austria was sown in the Kremnica forests (NOŽIČKA, 1969). The species is one of the most intensively utilised introduced woody plants in Slovakia (TOKÁR and KREKULOVÁ, 2005). The black pine has primarily found use as an ameliorative woody plant in reforestation of erosion-exposed sites, deserted soils and infertile pastures. It was mostly planted as monoculture (KUNCA et al., 2005). The survey of the species in the Malé Karpaty Mts revealed that for higher production and higher stem quality in black pine, it is essential to grow it in two-storey and three-storey mixed stands (TOKÁR 1985a, b, 1991). Recently, the black pine has suffered from new

harmful factors causing premature drying up of the needles, terminal shoots and entire trees (ADAMČIKOVÁ and JUHÁ-SOVÁ, 2005). Unsuitable stand conditions are significant predisposition factors. A quantity of plants are grown out of their natural habitats, eventually they display the effects of stress factors as the pollution, and changes in water and wind regime (JANKOVSKÝ, 2005). Black pine trees lose their dark green colour and begin darkening. The degraded tree health state is caused by weather fluctuations. Pine trees weakened in this manner become attractive for insect pests causing to them mortal damage. The needle litter change soil properties, and cause dieback of rare plants growing under the pines and overall changes in the vegetation. The black pine drying up becomes a problem primarily in old ornamental out plantings, but also in reforestation (JANKOVSKÝ et al., 2000; JANKOVSKÝ, 2005). The aim of this paper was to evaluate the black pine health condition in

the selected spots in the Zoborské vrchy Mts, to find out the causes of its drying up, to assess degrees of damage and to compare them between the spots.

Material and methods

The issue was studied in black pine in four spots selected in the Zoborské vrchy Mts. The spots differed in orientation towards the world sides, in stand age and stand density.

1. Spot – Zoborská lesostep (forest-steppe): The spot is situated on a south-west facing slope of Zoborské vrchy, at 300–460 m a.s.l. The vegetation consists of xerotherm meadowlands bordered by thermophilic oak forests and oak-hornbeam forests (*Quercus-Fagetia*). The soil is shallow, stony. The climate is the warmest and driest in this area. The soil-forming substrate is limestone in superincumbent beds. The stand age is 110 years; the stand is under-stocked in the southern part and well-stocked in the north.
2. Spot – The pine growth near the church of St. Michael by Dražovce: The spot is situated on the northwest facing slope, at 180–240 m a.s.l. The soil is sporadically shallow and stony. The substratum is limestone in superincumbent beds. The stand age is approximately 35 years; the stand is well-stocked (*Opis porastov a plán hospodárskych opatrení*, 2003).
3. Spot – Surroundings of a moor near Žirany: The spot is situated on a northeast facing slope of Vápeník. The vegetation consists of meadowlands and pastures growing on quartzite substrate (HREŠKO et al., 2006). The soil is shallow, stony. The altitude is 300–360 m a.s.l. The stand age is about 20 years. The stand is well-stocked.
4. Spot – Koliňanský vrch: This spot is situated on a west facing slope, at 260–300 m a.s.l. covered with thermophilic shrubbery on limestone substratum. The soil is shallow, rocky, the stand is well-stocked. The stand age is approximately 110 years. The spot is situated close to a lime-pit and a stationary drill field of the Slovak Armed Forces.

Damage assessment

The damage to pine trees was assessed in the years 2007 and 2008. The primary method for assessment of the black pine health conditions was field examination. Two items were evaluated: the total tree habitus (degrees of damage) and the intensity of infestation (categories) by the pest *Rhyacionia buoliana* (Denis & Schiffermüller, 1775).

Total degree of damage

The degree of damage was evaluated in the field. Thirty trees were selected for observing changes in colour, occurrence of dry and damaged branches and evaluation of the overall tree habitus. The damage degrees in Table 1 summarize all pathogens because their influences are not possible to separate.

Rhyacionia buoliana intensity of infestation evaluation

A special method was used for evaluating the attack on shoots of *P. nigra* by the pest *R. buoliana*. On each of the 30 selected trees, number of damaged shoots was counted on 5 selected branches. The damage was classified into 6 categories according to the intensity of infestation (Table 2). The intensity of infestation was calculated with using the Towsendo-Heuberger formula:

$$P = \frac{(n \cdot V) \cdot 100}{6 \cdot N}$$

where P is the degree of damage (%), n is the number of category within a six-point scale, v is the numeric value of the damage category, N is the total number of branches, and \sum is the total number of trees. Towsendo-Heuberger formula is used for determining the damage intensity to the leaves. In our case, the original formula has been modified to be used for shoots.

Table 1. Grading of six damage degrees used in total damage degree evaluation of the black pine

Degree of damage	Damage measure	Crown damage [%]
0	Undamaged tree	0
1	Slightly damaged tree	1–25
2	Moderately damaged tree	26–50
3	Heavily damaged tree	51–75
4	Caducous tree	76–99
5	Dried tree	100

Table 2. The grading of damage categories according that the branches damage caused by *Rhyacionia buoliana* was evaluated

Categories of infestation	Number of attacked shoots
0	0– no damaged shoot
1	1–5 damaged shoots
2	6–10 damaged shoots
3	11–15 damaged shoots
4	16–20 damaged shoots
5	More than 20 damaged shoots

Results

The total degree of damage on the studied spots

The evaluated spots were found different in the tree damage. The most intensive damage was the damage to the black pines on the spot Koliňanský vrch where no tree could be classified with the degree of damage 0 (healthy or undamaged trees), and 10% of the evaluated trees were dry or dead (damage degree 5) (Table 3). Most trees were damaged more than 50% (Fig. 1).

Similarly, there were no healthy trees in Dražovce and Zoborská lesostep. The trees in Dražovce were damaged to a slightly lower damage degree. The lowest degree of damage was found on the spot near the moor in Žirany, where no trees were classified in the degrees of damage 4 and 5, and 10% of the evaluated trees were found healthy (Table 3). In Žirany, the number of trees damaged to 50% and more was lower in both years. It was the only spot with occurrence of healthy trees (Fig. 1). On each spot, the damage degree in the year 2008 was found higher compared to the year 2007.

Intensity of infestation by *Rhyacionia buoliana*

Figure 2 illustrates the intensity of infestation (in percent). At the spot Koliňanský vrch the highest intensity of infestation was noted, almost 60% of shoots were attacked. Very similar figures were obtained for the pots Dražovce and Zoborská lesostep, where the damage intensity was nearly 58% and 59%, respectively. At the spot Žirany was found a moderate infestation. Approximately 33% of shoots were infested. At all four spots a slight decrease in the attack intensity in the year 2008 was observed.

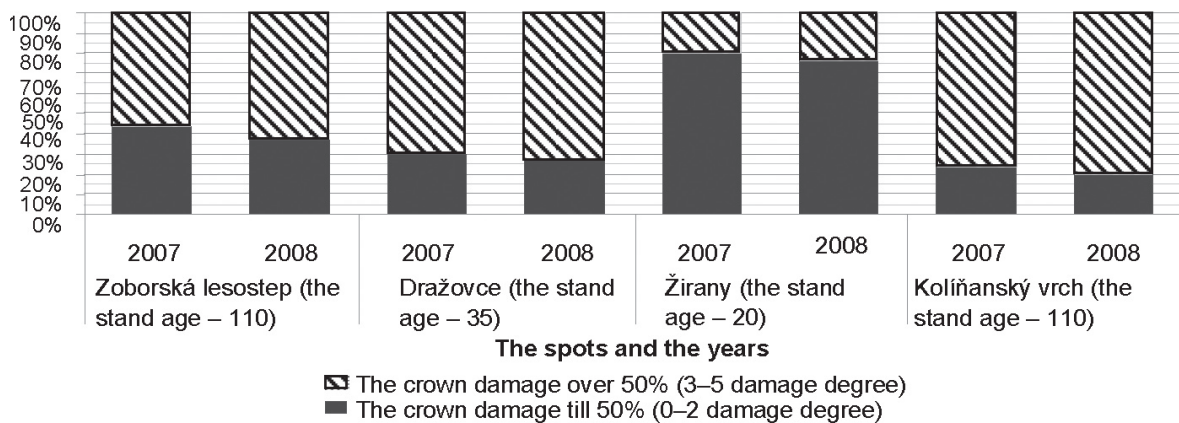


Fig. 1. The tree with the crown damage to 50% (damage degree 0–2) and over 50% (damage degree 3–5) representation on the spots in years 2007 and 2008.

Table 3. Percentual representation of trees in individual damage degree

Spot	Zoborská lesostep		Dražovce		Žirany		Koliňanský vrch	
	2007	2008	2007	2008	2007	2008	2007	2008
Damage degree/ Year	%	%	%	%	%	%	%	%
0	0	0	0	0	10	10	0	0
1	13.33	6.66	3.33	3.33	30	30	10	10
2	30	30	26.66	23.33	40	36.66	13.33	10
3	43.33	50	56.66	56.66	20	23.33	30	30
4	10	10	13.33	16.66	0	0	36.66	40
5	3.33	3.33	0	0	0	0	10	10

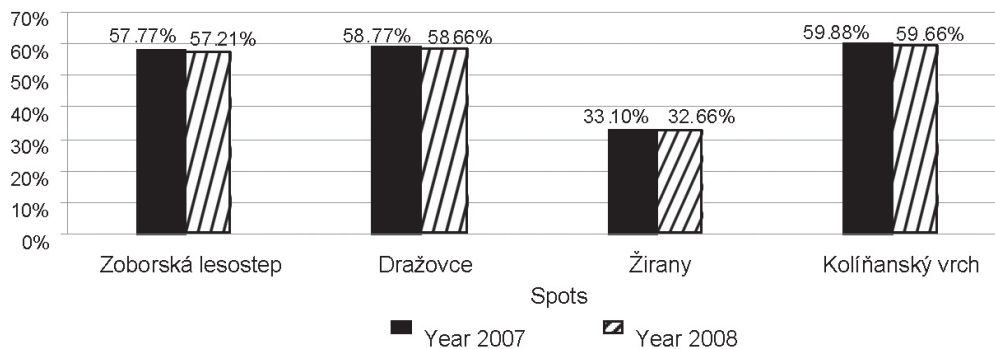


Fig. 2. Evaluation of the attack intensity caused by *Rhyacionia buoliana* in the year 2007 and 2008.

Discussion

The introduced black pine is in general considered as a woody plant with high resistance to pollution (BENČAĽ, 1976), low demands on nutrient content in soil and high tolerance to dryness (KUNCA and LEONTOVYČ, 2005). The species can grow in extreme spots (ADAMČÍKOVÁ and JUHÁSOVÁ, 2005), the number of its pests is very low (KUNCA et al., 2005). It is very popular in out planting for its resistance towards particles, gaseous and aerosol pollution – permanently rising due to industrial production, traffic and fuel burning. In spite of the fact that the black pine has been recognised as resistant against pollution and dust, the highest degree of damage was observed at spots loaded with these factors. The most intensive damage was found at the spot Kolíňanský vrch, affected by several serious stress factors. The first is a lime pit producing dust that cover the assimilatory organs of trees and inhibit the assimilatory and respiration processes. The second is the pollution from the stationary drill field of the Slovak Armed Forces, contaminating plant organs and soil. The trees are similarly affected at the spot Dražovce. This spot is also severely loaded by stress factors influencing the black pine growth. The spot Zoborská lesostep is situated near the town of Nitra. The pollutants from the urban traffic, coupled with a very dry and warm climate with high evaporation and soil water content, are the driving stress factors weakening the black pine trees at this spot. The low degree of damage at the spot Žirany is possible because of the low stand age. At all the observed spots, was found a moderate increase in the intensity of infestation by *R. buoliana* in year 2008. The differences between years could be affected by climatic change – acting as a powerful stress factor. The most significant climatic factors, strongly influencing the health of woody plants are: air temperature, amount of precipitation and light conditions at the site (HRUBÍK and KOLLÁR, 2008). The insufficient precipitation together with the high temperatures causes drought. The

dryness is not the result of limited atmospheric precipitation alone, it is also affected by the precipitation and evaporation ratio of the stand. Moderate winters in the monitored years (Fig. 3) were lacking sufficient snow that means sufficient winter moisture for storing. The major amount of water was evaporated from the soil at the high temperatures (Fig. 3) in early summer through the middle of autumn in 2008. The drought impact was aggravated by high temperatures during the two years and the correct functioning of black pine vegetation organs was impaired and limited. The black pine's resistance to pathogens was weakened and the drought stress facilitated the progress of biotic infections. No control measures were made in the year 2007, so a poorer health state could be expected in the following years. But the infestation caused by the pest *R. buoliana* was slightly lower in 2008. This may be assigned to the temperature being higher in the spring 2007 than in 2008 (Fig. 3). At higher temperatures, the pest starts its activities earlier, and can eat more shoots. JANKOVSKÝ and PALOVČÍKOVÁ (2003) mention that the changing the black pines health state is possible due to the environmental pollution and partly by the climatic extremes or the climatic change.

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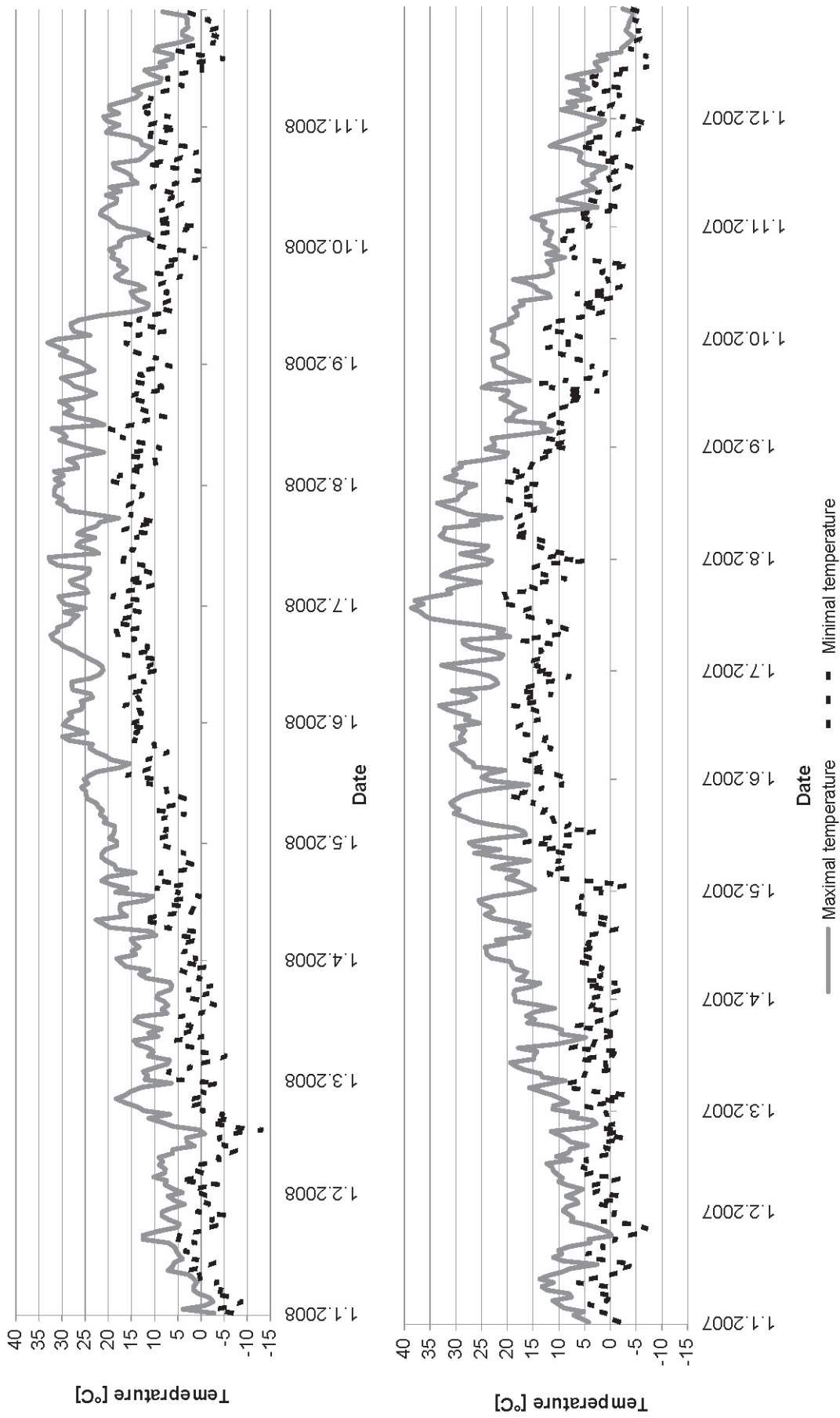


Fig. 3. Maximal and minimal daily temperatures in the years 2007 and 2008 (Source: Slovak Hydrometeorological Institute, meteorological station Nitra – Veľké Janíkovce).

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Zdravotný stav borovice čiernej v Zoborských vrchoch

Súhrn

Introdukovaná borovica čierna (*Pinus nigra* Arnold) sa začala pestovať ako veľmi odolná drevina voči imisiám a škodcom. Avšak v súčasnosti sa začalo objavovať jej usychanie. Cieľom bolo zmapovať rozsah jej poškodenia, zhodnotiť dôvod jej poškodenia a pokúsiť zistiť mieru vplyvu stanovištných podmienok na zdravotný stav v rokoch 2007 a 2008 v Zoborských vrchoch. Na výhonkoch bol zistený výskyt húseníc *Rhyacionia buoliana* Denis & Schiffermüller. Na každej lokalite bol určený stupeň poškodenia stromov a rozsah napadnutia živočíšnym škodcom *Rhyacionia buoliana*. Zistilo sa, že lokality majú rôznu stupeň poškodenia, ako aj rozsah napadnutia *Rhyacionia buoliana*. Najviac poškodenou v oboch hodnoteniach je lokalita Koliňanský vrch, najmenej okolie vresoviska pri Žiranoch. Počas roku 2008 došlo k miernemu zvýšeniu poškodenia stromov, avšak napadnutie škodcom *Rhyacionia buoliana* sa mierne znížilo.

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