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Ovality on trees adjacent to skid road

Z. KARASZEWSKI[1], D. F. GIEFING[1] A. ŁACKA[2], A. NOSKOWIAK[1]

[1]Wood Technology Institute, Wood Science and Application Department.
[2] Department of Mathematical and Statistical Methods, Poznań University of Life Sciences

Abstract: *Ovality on trees adjacent to skid road.* Ovality on trees adjacent to skid road. The implementation of skid roads creates different environmental conditions within a stand. It was assumed that long term tree cultivation next to skid roads has a direct influence on the development of ovality. Trees growing for 25 years next to both 3m and 6m wide roads as well as a control group of trees from deeper within the stand were analysed. Both linear and relative ovality were taken into consideration. The greatest ovality was observed in trees on the right (southern exposure) of the 6m wide skid road. The smallest ovality was recorded in trees growing in areas of denser tree cover. Ovality present in trees growing next to the 3m wide skid road was not significantly different to the degree found in the control group which leads to suggest that currently implemented skid roads do not influence or enhance this particular defect.

Keywords: wood defects, ovality, wood quality, scots pine, skid road

INTRODUCTION

Tree growth leads to a multitude of inherent defects. These defects can be influenced by a tree's location within a stand. The introduction of mandatory skid roads to a stand alters the growing conditions of trees, altering not only soil conditions but also access to sunlight, both of which could lead to structural defects in the wood including ovality. Additionally, the length of time a tree has been exposed to these new, altered conditions as well as the growth time of the tree in general could both be significant in the development of this defect. The aim of this research was to check whether after 25 years of a skid road's presence within a stand, the degree of ovality within trees growing adjacent to the skid road was the same or different to the degree of ovality found in trees growing deeper within the stand. It was also the intention of this research to see whether the width of the skid road played a part in the development of ovality.

MATERIALS AND METHODS

The research was carried out in Forest District Trzcianka in forest compartment 306 c, longitude 53°06'2'N, latitude 16°34'3'E in a 42 year old, class III, pine stand.

Stand composition: Scots pine 10; birch and spruce in places. Moderate density, average diameter at breast height; 12cm, average tree height; 12m, tree cover; 1.2. Timber volume; 189m3/ha. Soil RDb pl (grouper podsolic, loose sand). The trees analysed in this study were growing adjacent to (and on both sides) of skid roads cut out in 1988 measuring 3m and 6m in width. As a control group, trees growing 10m in from the skid roads were measured. The research was carried out on trees from the main wood stand, all of which could be classified as either being I, II or III class according the Kraft scale. Together a total of 179 trees were analysed.

The skid roads were orientated and ran from east to west. The following coding was used to classify tree location:

3L- trees growing to the left of the 3m wide skid road
3R- trees growing to the right of the 3m wide skid road
6L - trees growing to the left of the 6m wide skid road

6R- trees growing to the right of the 6m wide skid road

S- trees growing within the middle of the stand (control group)

Ovality was calculated by taking a double (diagonal)measurement of bark diameter at breast height. The diameter was measured both in an east-west direction and in a north-south direction, in other words along and across the roads. Linear ovality was calculated by calculating the difference between the largest diameter value and the lowest diameter value for a given tree :

$$S=D-d \text{ (cm)}$$

Relative ovality was also calculated in order to measure the influence tree diameter has on the presence of ovality:

$$Sw=\frac{D-d}{D} \text{ [-]}$$

For each of the analysed factors, an analysis of variance (ANOVA) was carried out. The variance analysis was preceded by a Bartlett test. Due to the lack of possibility of carrying out a factor analysis, with the intention of indentifying the significance of interesting factors as well as their interaction, a variance analysis was carried out with the use of 4 base contrasts. A statistical t test was then carried out. In order to describe their factors (Table 1) gmodels were used in the statistical programme R. To compare the researched subjects, Tukey's post hoc test with a significance level of =0.05 was used.

Table 1. Base contrast factors implemented in the analysis of variance

Base contrasts	**Tree Location**				
	3L	**3R**	**6L**	**6R**	**S**
Wood stand	0.05	0.05	0.05	0.05	-0.20
Skid road width	0.25	0.25	-0.25	-0.25	0.00
Skid road side	-0.25	0.25	-0.25	0.25	0.00
Interaction	-0.50	0.50	0.50	-0.50	0.00

p-value taken into consideration: *** for $p\in$ [0 - 0.001), ** for $p\in$[0.001 – 0.01), * for $p\in$[0.01 – 0.05) and '.' for $p\in$[0.05 – 0.1).

RESULTS

The results reveal that there was a difference in the degree of linear ovality in trees in relation to their location. The largest average measurement of this defect in trees from both sides of the skid road were 1.17 cm and 0.95 cm respectively (fig 1). The smallest average measurements of ovality were present in trees with a coverage density of -0.58 cm. Convergent results were gained for relative ovality: trees adjacent to the 6m skid road had on average a stem deformation of a maximum of 0.06 whilst trees taken from a cross section from inside the stand had a maximum deformation of 0.04 as measured from the tree circle (fig. 2)

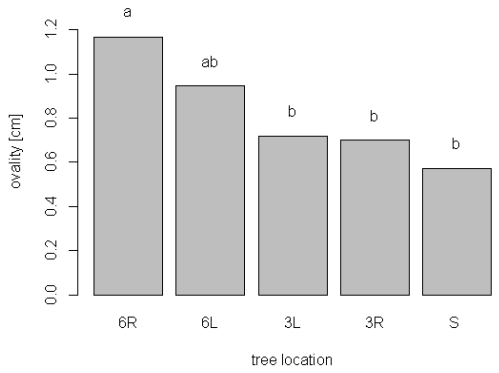

Fig 1. Average linear ovality and the results of Tukey's post hoc test

Statistical analysis confirmed the significantly high influence of growth adjacent to a skid road on trunk deformation namely ovality, both linear and relative (table 2).

The width of the skid road had a significant influence on linear ovality. However, after a verification of the maximum values of relative ovality of diameter at breast height, only a tendency towards ovality size differentiation was observed. (table 2).

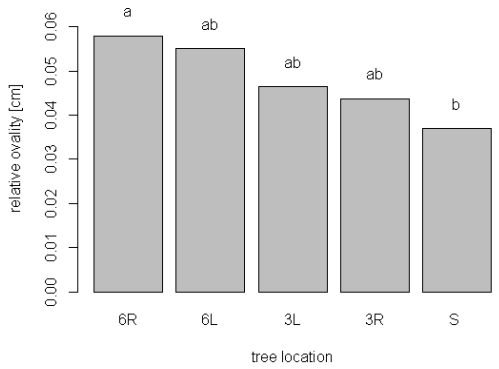

Fig 2. Average relative ovality and the results of Tukey's post hoc test

The obtained results, which indicate an increase in ovality with proximity to a skid road, partly concur with the work of Stempski [1] and [2] where it was observed that 10 years following the implementation of a skid road, an increased presence of ovality was confirmed (on a north- south axis) among trees in the 0-1m zone in the variance of a 3.5 m wide road. The other variants in the study didn't reveal any significant differences. The most probable explanation for the differences is the number of years of growth adjacent to the skid road. It would be expected that with time in both the area analysed in this study as well as that used in Stempski's work, trees would suffer from a greater degree of ovality than that was observed in these studies. Stempski himself was prone to the belief that there was a lack of evidence that skid roads were responsible for ovality, suggesting that prevailing winds were responsible for this defect justifying his premise with studies [3], [4], [5]. This hypothesis is also supported by further research and results [6]. However it is supposed that the influence of skid roads on certain tree features is a complicated assortment of abiotic and biotic factors. The exposure of trees adjacent to a skid road is also an increase in exposure to prevailing winds and greater irregularity in the growth of the tree canopy.

Tab 2. Base contrast values as well as their ANOVA statistical significance for ovality at a height of 1.3m

Base contrasts	Linear Ovality		Relative Ovality	
	F= 5.470 p=0.0004		F= 2.699 p=0.03235	
	Contrast value	t	Contrast value	t
wood stand	1.2405	3.300 **	0.0551	2.708 **
width	-0.6924	-3.171 **	-0.0227	-1.918 .
side	0.1996	0.914	0.0001	0.009
interaction width x side	-0.1206	-1.103	-0.0027	-0.455

The documented presence of increased ovality in trees adjacent to the wider skid roads (6m) suggests that other factors, not connected to wind, are causing the spread of this defect. Tree lean, slope and wind should all be considered [7]. Another significant factor which should be considered is time of tree growth by the skid road. In studies [8] and [9] of the influence of skid roads on selected tree features in coniferous trees, the brevity of the experiments was one of the identified causes of the lack of clear differences.

It emerged that the wider the skid road, the greater the size of ovality, and this was demonstrated by both measurement methods. The trees on the right side of the 6m skid road, those with a southern exposure were the most oval. In accordance with the accepted methodology, ovality was measured at a height of 1.3m. Understanding the character of ovality along the trunk axis of both coniferous [10]and non coniferous [11]trees, it would be highly probable to suggest that ovality is most developed at butt end level and that the degree of ovality in the research areas would at the very least stay the same if not increase with time. Taking into consideration that a cross-sectional leaning away from the centre of its stem has a negative impact on for example calculating stem volume estimation [12] as well as the fact that during the processing of wood the lowest section of the butt end is considered to be the most valuable, any defects within this section of the stem must be considered as being disadvantageous.

CONCLUSIONS

The growth of trees adjacent to skid roads with a width of 6m revealed an increase in the presence of trunk deformation, namely ovality in comparison to trees from other locations in the stand. The influence of skid roads of 3m width on the development of ovality is less discernible. After 25 years of co-existence and interaction with adjacent trees, 3m wide skid roads can be considered as not significantly worsening the quality of round wood in terms of ovality and therefore not affecting its later use, commercial or other. Similarly attention should be drawn to possible future changes in the growth of ovality with time and stand maturity.

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Streszczenie: *Wielkość spłaszczenia drzew przylegających do szlaków zrywkowych.*
Wykonywanie szlaków zrywkowych powoduje tworzenie odmiennych warunków środowiskowych w drzewostanie. Założono, że długoletni wzrost drzew przy szlakach wpływa na powstawanie spłaszczenia. Zbadano drzewa po 25 latach rośnięcia przy szlakach o szer. 3 m i 6 m oraz drzewa kontrolne z wnętrza drzewostanu. Pod uwagę wzięto spłaszczenie liniowe i względne.
Największe spłaszczenie stwierdzono na drzewach z prawej strony (południowa wystawa) 6m szlaku, najmniejsze zaś na drzewach rosnących w zwarciu. Spłaszczenie drzew ze szlaków 3 nie było istotnie różne od drzew kontrolnych, co sugeruje że obecnie wykonywane szlaki zrywkowe nie wpływają na rozwój ocenianej wady kształtu.

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CORRESPONDING AUTHOR:

Zbigniew Karaszewski
Wood Technology Institute
Winiarska Street, no. 1, 60-654 Poznań

E-mail address: z_karaszewski@itd.poznan.pl