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Age-age correlations for wood density components in European Larch

MARCIN KLISZ[1], ANETA MICHALSKA[2]

[1]Forest Research Institute, Department of Silviculture and Genetics, 3 Braci Leśnej Street, Sekocin Stary, 05-090 Raszyn, Poland
[2]Departament of Forest Botany, Warsaw University of Life Sciences, Nowoursynowska 159 Str. 02-776, Poland
Abstract: *Age-age correlations for wood density components in European Larch*. Age-age genetic correlations for ring and wood density parameters were estimated in 25-year-old trees of 8 half-sib families of European Larch growing in seed orchard in northern Poland. The ring width and wood density traits of individual rings were determined by X-ray densitometry. The age-age genetic correlation were calculated between two 8 th and 19 th ring. For all analyzed traits genetic correlations were positive and high (>0,8), only for latewood width was slightly lover (0,58). Similar results were reported on the other studies [3, 6, 7, 8, 9] what suggesting that the wood traits of juvenile wood gives a good indication of mature wood. The strong genetic correlation between young and older ages gives advantages for early selection .

Keywords: European Larch, wood density, age-age correlations,

INTRODUCTION

Wood heterogeneity have the main reason in wood density differences between juvenile and mature wood [14]. The reduction of wood heterogeneity is an important objective of breeding program involving wood properties [4]. Early selection for wood quality traits is used to minimize the generation interval and to increase wood uniformity. Some aspects of wood quality, such as wood density components of mature wood can be predicted with high accuracy and precision based on juvenile wood measurements [1]. The knowledge of genetic correlations between juvenile and mature wood density would help in understanding the genetics of wood density heterogeneity [10]. It is essential to know not only the heritability value of wood properties, but also how that properties are correlated age by age. The main objective of this study was to describe age-age genetic correlations for wood density components of European Larch.

MATERIAL AND METHODS

Wood samples were collected from 8 half-sib families of European larch (*Larix decidua* Mill.) coming from seed orchard established in 1985 in the Forest Ranges Zaporowo in northern Poland. The material submitted to analysis was collected in 2007 at breast height (1.3 m) and obtained by extraction of two increment cores per tree, from pith to bark. From the increment samples wood samples were taken out with uniform thickness [10]. Resins was then chemically extracted from cores with distilled water for 24 hours [5]. The wood samples were dried to 15% moisture content [13]. Intra-ring wood density components and ring width characteristics was obtained using an X-ray densitometry technique [2]. Wood samples were scanned from the pith toward the bark. For each annual rings in the samples, various wood density components were obtained based on densitometric profiles: overall ring density, earlywood density, latewood density, maximum wood density, minimum wood density. The age-age genetic correlation of a trait measured at two different years 1994 and 2005, says a and b, respectively, was calculated by the following formula [12]:

$$r_{Gab} = Cov_{Gab} / (\sigma_{Ga}^2\ \sigma_{Gb}^2)^{1/2}$$

where:

σ_{Ga}^2 – family variance components for year a,

σ_{Gb}^2 – family variance components for year b,

Cov_{Gab} – family covariance components for years a and b.

Variance components for family and covariance components for family were calculated using the MANOVA option of SAS PROC GLM [11].

RESULTS

The age-age genetic correlation were calculated between two different ring ages for years 1994 and 2005. For almoust all analyzed traits age-age genetic cerrelation between 8 th and 19 th ring reached high correlation values (>0,8) (Fig 1). The earlywood percent and latewood percent gives identical result of age-age genetic correlation (0,83). The same situation were observed in earlywood and latewood density (0,91). Genetic correlation estimates for earlywood with are very strong with coeficient of genetic correlation over 1,0. Unexpectedly, the lovest value of age-age genetic correlation were obtained for latewood with (0,58). Family variance component obtained for ring width reached value 0 caused to impossible to estimated age-age genetic correlation for this trait.

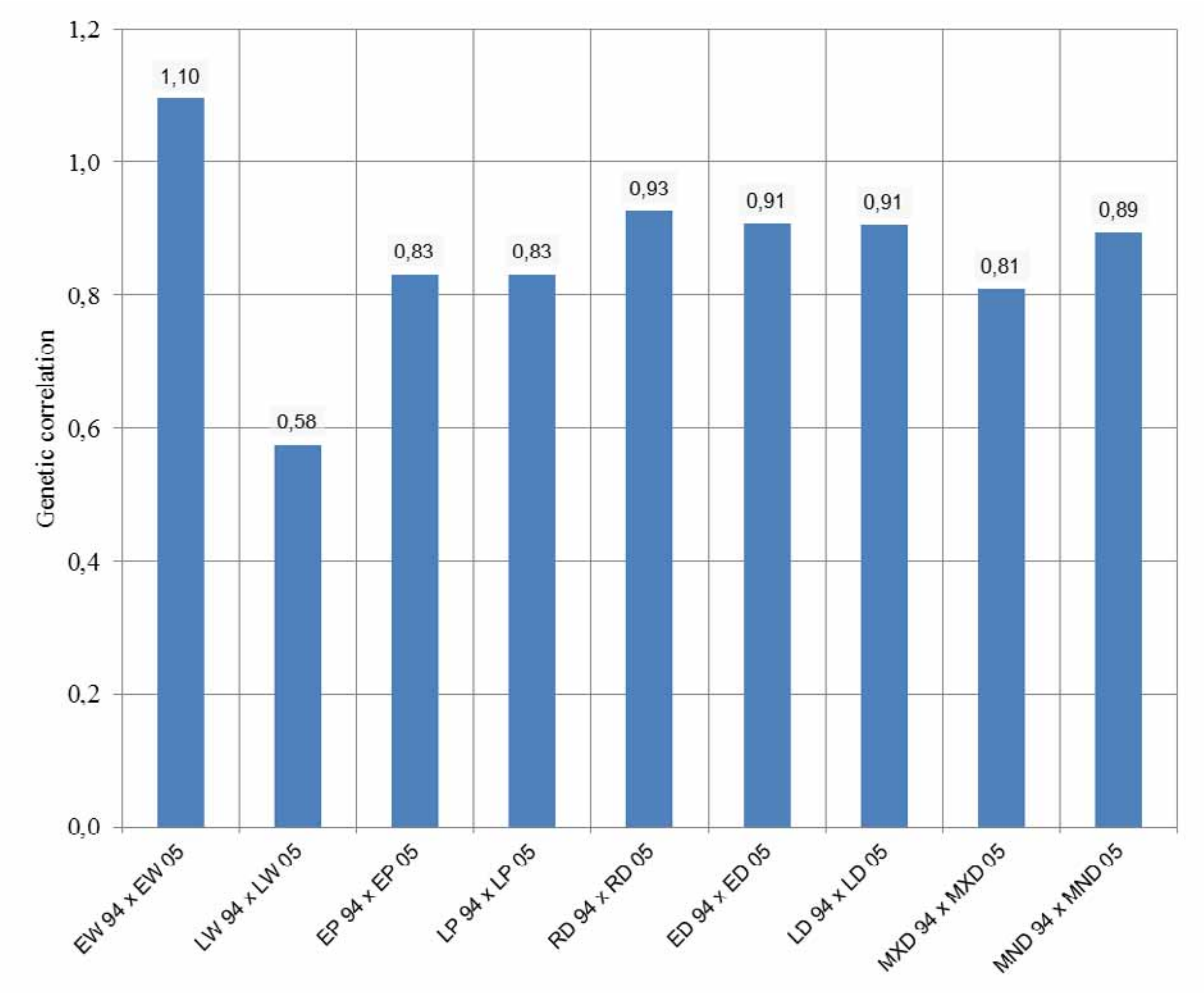

Fig 1 Age-age genetic correlation between two different ring ages: 1994 and 2005 for: earlywood width (EW), latewood width (LW), earlywood percent (EP), latewood percent (LP), overall ring density (RD), earlywood density (ED), latewood density (LD), maximum wood density (MAX), minimum wood density (MIN).

CONCLUSIONS

The age-age genetic correlation were generally high for ring and wood density components, suggesting that the wood density of juvenile wood gives a good indication of mature wood density. Fujimoto et al. [3] observed that genetic correlation between juvenile and mature wood in hybrid larch reached even 1,0 value. Hylen [8] reported strong age-age correlation for wood density components of Norway spruce. Studies on the other species also indicate that age-age genetic correlations for wood density traits tend to be high [6, 7]. Kumar and Lee [9] reported lover genetic correlation for earlywood percent of 30-years old *Pinus radiata* than obtained in this study for European Larch. The high genetic correlation between young and older ages makes it possible to select at a very young cambial ages. This is a very important result regarding the advantages of early selection. The main advantages to early selection in breeding are shortened generation interval and genetic information from early testing which can be used to enhance selection efficiency at mature age.

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Streszczenie: *Genetyczne autokorelacje komponentów gęstości drewna Modrzewia europejskiego.* Dla 8 pół-rodów 25-letnich drzew modrzewia europejskiego z plantacyjnej uprawy nasiennej z północnej Polski obliczono genetyczne autokorelacje cech gęstości drewna. Wartości cech słoja rocznego określono z wykorzystaniem rentgenograficznej metody pomiarowej. Autokorelacje genetyczne obliczono pomiędzy 8 i 19 słojem rocznym. Dla większości analizowanych cech otrzymano wysokie, pozytywne wartości współczynników korelacji genotypowych (>0,8), jedynie dla szerokości drewna wczesnego uzyskano nieznacznie niższe wartości (0,58). Podobne rezultaty uzyskano w badaniach nad innymi gatunkami drzew [3, 6, 7, 8, 9], wyniki te wskazują na możliwość przewidywania wartości cech gęstości drewna dojrzałego w oparciu o wyniki uzyskane dla drewna młodocianego. Silna, pozytywna korelacja pomiędzy młodocianym i dojrzałym okresem rozwojowym uzasadnia prowadzenie selekcji we wczesnym okresie rozwojowym.

Corresponding author:

Marcin Klisz
Forest Research Institute,
Department of Silviculture and Genetics,
3 Braci Leśnej Street,
Sękocin Stary, 05-090 Raszyn, Poland
E-mail address: kliszm@ibles.waw.pl