СБОРНИК ДОКЛАДИ

ОТ МЕЖДУНАРОДНА НАУЧНА КОНФЕРЕНЦИЯ
"90 ГОДИНИ ИНСТИТУТ ЗА ГОРАТА – ЗА ОБЩЕСТВОТО И ПРИРОДАТА",
24-26 Октомври 2018 г., София

PROCEEDING PAPERS

OF THE INTERNATIONAL SCIENTIFIC CONFERENCE
"90 YEARS FOREST RESEARCH INSTITUTE – FOR THE SOCIETY AND NATURE",
24-26 October 2018, Sofia
СБОРНИК ДОКЛАДИ
ОТ МЕЖДУНАРОДНА НАУЧНА КОНФЕРЕНЦИЯ
„90 ГОДИНИ ИНСТИТУТ ЗА ГОРАТА – ЗА ОБЩЕСТВОТО И ПРИРОДАТА“,
24-26 октомври 2018 г., София

PROCEEDING PAPERS
OF THE INTERNATIONAL SCIENTIFIC CONFERENCE
“90 YEARS FOREST RESEARCH INSTITUTE – FOR THE SOCIETY AND NATURE”,
24-26 October 2018, Sofia

ОРГАНИЗАТОРИ
Институт за гората при Българска академия на науките
Министерство на земеделието, храните и горите на Р България
Съюз на учените в България

ORGANISERS
Forest Research Institute at the Bulgarian Academy of Sciences
Ministry of Agriculture, Food and Forestry of the Republic of Bulgaria
Union of Scientists in Bulgaria
В настоящия сборник са публикувани научни статии на участници в Международната научна конференция „90 години Институт за гората – за обществото и природата“, която се проведе в периода 24-26 октомври 2018 г. в гр. София, като част от поредицата събития, посветени на 90-та годишнина на ИГ-БАН.
В сборника са включени публикации на български и английски език, представляващи интерес за учените и специалистите в областта на горското стопанство и екологията. Публикациите са свързани с основни проблеми и предизвикателства, които стоят пред науката за гората.
Избрана част от изнесените доклади на Международната научна конференция „90 години Институт за гората – за обществото и природата“ ще бъдат публикувани в следващите издания на списанията “Silva balcanica” и “Наука за гората”.

Current proceedings include scientific papers of participants in the International Scientific Conference “90 years Forest Research Institute – for the Society and Nature”, which took place in Sofia on 24-26 October 2018, as part of the consecutions dedicated to the 90-th anniversary of FRI-BAS.
The publications (in Bulgarian and English) are of interest for researchers and specialists in the field of forestry and ecology. They are related to basic problems and challenges of the forest science.
Part of selected papers presented during the International Scientific Conference “90 years Forest Research Institute, BAS – for the Society and Nature” will be published in the next issues of the scientific journals Silva balcanica and Nauka za gorata (Forest Science).
БЛАГОДАРНОСТИ

Организаторите изказват своята признателност на следните институции, които оказаха финансова подкрепа за реализиране на конференцията:

„Северозападно държавно предприятие“ ДП
„Северноцентрално държавно предприятие“ ДП
„Североизточно държавно предприятие“ ДП
„Югозападно държавно предприятие“ ДП
„Южноцентрално държавно предприятие“ ДП
„Югоизточно държавно предприятие“ ДП
Фонд Научни Изследвания към МОН
Посолство на Франция в България
Френски Институт в България
Фирма Rossima SP Ltd.

AKNOWLEDGEMENTS

Organisers express their gratitude to the following institutions for their financial support to the conference:

Northwest State Forest Company
North Central State Forest Company
Northeast State Forest Company
Southwest State Forest Company
South Central State Forest Company
Southeast State Forest Company
Bulgarian National Science Fund at the Ministry of Education and Science
Embassy of the Republic of France in Bulgaria
Institut français de Bulgarie
Rossima SP Ltd.
СЪДЪРЖАНИЕ

ВСТЪПИТЕЛНО СЛОВО (9)
доц. д-р Миглена Жиянски

ЧАСТ I /Доклади на български език с резюме на английски/
PART I (Papers in Bulgarian with English summary)

ИСТОРИЯ НА ИНСТИТУТА ЗА ГОР АТА – БАН
С ПОГЛЕД КЪМ НЕГОВОТО СТОЛЕТИЕ (12)
Александър Х. Александров
HISTORY OF THE FOREST RESEARCH INSTITUTE – BULGARIAN ACADEMY OF SCIENCES WITH A VIEW OF THE 100th ANNIVERSARY (24)
Alexander H. Alexandrov

Миглена Жиянски, Маргарита Георгиева
Miglena Zhiyanski, Margarita Georgieva

ПРОУЧВАНИЯ НА НЕДЪРВЕСНИТЕ (СТРАНИЧНИ, СПЕЦИАЛНИ) ПОЛЗВАНИЯ В ИНСТИТУТА ЗА ГОР АТА ПРИ БАН (45)
Мария Стоянова
NON–WOOD FOREST PRODUCTS IN THE FOREST RESEARCH INSTITUTE (52)
Maria Stoyanova

ПРОУЧВАНИЯ НА ВАЖНИ ЗА ГОРСКОТО СТОПАНСТВО НАСЕКОМНИ ВРЕДИТЕЛИ В СЕКЦИЯ „ГОРСКА ЕНТОМОЛОГИЯ, ФИТОПАТОЛОГИЯ И ЛОВНА ФАУНА“ В ИНСТИТУТА ЗА ГОР АТА (53)
Георги Цанков, Пламен Мирчев, Георги Георгиев
STUDIES ON SIGNIFICANT INSECT PESTS TO FORESTRY IN THE DEPARTMENT OF FOREST ENTOMOLOGY, PHYTOPATHOLOGY AND GAME FAUNA IN THE FOREST RESEARCH INSTITUTE (60)
Georgi Tsankov, Plamen Mirchev, Georgi Georgiev

РАЗПРОСТРАНЕНИЕ И ПОВРЕДИ ОТ ИНВАЗИВНИЯ ПАТОГЕН DIPLODIA SAPINEA ПО PINUS NIGRA ARN. В БЪЛГАРИЯ (61)
Сианна Хлебарска, Маргарита Георгиева
DISTRIBUTION OF THE INVASIVE PATHOGEN DIPLODIA SAPINEA ON PINUS NIGRA SPP. IN BULGARIA (70)
Sianna Hlebarska, Margarita Georgieva

5
ВЪЗРАСТ ЗА ДОСТИГАНЕ НА РАЗЛИЧНА ВИСОЧИНА ПРИ ОБИКНОВЕНИЯ СМЪРЧ (PIECEA ABIES (L.) KARST) В БЪЛГАРИЯ (71)
Николай Цветанов, Момчил Панайтов
AGE OF REACHING DIFFERENT HEIGHT OF NORWAY SPRUCE (PIECEA ABIES (L.) KARST. (81)
Nickolay Tsvetanov, Momchil Panayotov

СТРОЕЖ И РАСТЕЖ НА КУЛТУРИ ОТ БЯЛА МУРА (PINUS PEUCE GRISEB.) НА ВИТОША (83)
Христо Цаков, Ангел Ферезлиев, Александър Делков, Христина Христова
THICKNESS STRUCTURE OF MACEDONIAN PINE (PINUS PEUCE GRISEB.) PLANTATIONS GROWING IN THE VITOSHA MOUNTAIN (90)
Hristo Tsakov, Angel Ferezliev, Alexander Delkov, Hristina Hristova

КЛОНОВИ РАЗЛИЧИЯ НА КОРЕНОВАТА БИОМАСА НА ХИБРИДИ ОТ ЧЕРНА ТОПОЛА (91)
Веселка Гюлева, Миглена Жиянски, Татяна Станкова, Мария Глушкова, Екатерина Андонова
CLONE DIFFERENCES IN THE ROOT BIOMETRY OF HYBRID BLACK POPLAR (104)
Veselka Gyuleva, Miglena Zhiyanski, Tatiana Stankova, Maria Glushkova, Ekaterina Andonova

КАЧЕСТВО НА ДЪРВЕСИНАТА НА БЯЛАТА АКАЦИЯ (106)
Панайот Панайотов, Кънчо Калмуков, Момчил Панайтов
QUALITY OF LOCUST TREE WOOD (ROBINIA PSEUDOACACIA L. VAR. RECTISSIMA RABER.) (116)
Panayot Panayotov, Kancho Kalmukov, Momchil Panayotov

РАЗВИТИЕ И ПОСТИЖЕНИЯ НА ГОРСКАТА ФИТОПАТОЛОГИЯ В ИНСТИТУТ ЗА ГОРНАТА ПРИ БАН (117)
Петър Петков, Маргарита Георгиева
DEVELOPMENT AND ACHIEVEMENTS OF FOREST PHYTOPATHOLOGY AT THE FOREST RESEARCH INSTITUTE – BAS (123)
Petar Petkov, Margarita Georgieva

ЕТЕРИЧНИ МАСЛА ОТ ИГЛОЛИСТНИ ВИДОВЕ В БЪЛГАРИЯ (124)
Мария Стоянова
ESSENTIAL OILS FROM CONIFEROUS SPECIES IN BULGARIA (130)
Maria Stoyanova

ФРАКЦИОНЕН СЪСТАВ И КАЧЕСТВО НА ТЕХНОЛОГИЧНИТЕ ТРЕСКИ ОТ БЯЛБОРОВА (PINUS SYLVESTRIS L.) ДЪРВЕСИНА, ДОБИТИ С МОБИЛНИ СЕКАЧНИ МАШИНЫ (131)
Димитър Пеев
PARTICLE SIZE AND QUALITY OF WOOD CHIPS FROM SCOTS PINE (PINUS SYLVESTRIS L.) WOOD, YIELDED WITH MOBILE CHIPPERS (150)
Dimitar Peev

СВОЙСТВА НА ДЪРВЕСИНАТА НА АТЛАСКИЯ КЕДЪР (151)
Панайот Панайотов, Кънчо Калмуков, Тодор Петков

PROPERTIES OF CEDRUS ATLANTICA MAN. WOOD (154)
Panayot Panayotov, Kuncho Kalmukov, Todor Petkov

ИЗСЛЕДВАНЕ РАБОТАТА НА МАЛКИ СЕКАЧНИ МАШИНИ ЗА ДОБИВ НА БИОМЫСА В ГРАДСКИ УСЛОВИЯ (155)
Сотир Глушков, Емилия Велизарова, Стефан Стоянов, Васил Чакъров, Ивайло Марков, Ваня Тринговска

CHIPPING OF BIOMASS FROM URBAN AREAS WITH SMALL WOOD CHIPPERS (167)
Sotir Glushkov, Emilia Velizarova, Stefan Stoyanov, Vassil Chakarov, Ivailo Markoff, Vanya Tringovska

ЧАСТ II /Доклади на английски език /
PART II (Papers in English)

SOIL EROSION IN MOUNTAIN REGIONS OF BULGARIA: PERMANENT FIELD RESEARCHES AND RISK ASSESSMENT (168)
Ivan Ts. Marinov

TOTAL CHLOROPHYLL CONTENT AND NORMALIZED DIFFERENCE VEGETATION INDEX OF TWO POPULUS X EUROAMERICANA CLONES (‘AGATHE‘ AND ‘GUARDI’) LEAF CHARACTERISTICS OF TWO POPLAR CLONES (191)
Svetoslav Anev, Sonya Damyanova, Violeta Kotova, Adelina Stoeva, Nikolina Tzvetkova, Veselka Gyuleva, Tatiana Stankova

ROOT BIOMASS AND ROOT DISTRIBUTION IN TWO DIFFERENT FOREST ECOSYSTEMS IN BULGARIA (197)
Lyudmila Lozanova, Miglena Zhiyanski, Elena Vangelova, Svetla Doncheva, Angel Ferezliev

RESULTS OF SOIL MONITORING IN THE WESTERN BALKAN MOUNTAIN (207)
Ludmila Malinova, Kameliya Petrova, Plamena Karmazova

ENVIRONMENTAL MONITORING AT THE INSTITUTE FOR NUCLEAR RESEARCH AND NUCLEAR ENERGY EXPERIMENTAL BASES SITUATED IN SOFIA AND RILA MOUNTAIN (217)
Nina Nikolova, Dimitar Tonev, Tzetanu Nonova, Elena Geleva, Ivanka Ravnachka, Damyan Ivanov
CARBON STORAGE IN SOILS FROM PLEVEN DISTRICT REGARDING THE LEVEL OF ANTHROPOGENIC PRESSURE (225)
Miglena Zhiyanski

PRODUCTIVITY OF THE FOREST LANDSCAPES IN THE REGION OF KRAISHTE BETWEEN RIVERS BISTRITSA AND KONSKA (239)
Aleksander Todorov, Georgi Zhelezov

WOODY BIOMASS ESTIMATION OF COPPIED PLANTS FROM OPEN POLLINATED PROGENIES OF TWO SELECTED BLACK LOCUST CLONES (251)
Tatiana Stankova, Veselka Gyuleva, Kancho Kalmukov, Dimitar N. Dimitrov, Emil Popov, Maria Glushkova, Proletka Dimitrova, Hristina Hristova

STUDY OF SPATIAL AUTOCORRELATION IN NATURAL POPULATIONS OF PLATANUS ORIENTALIS L. IN BULGARIA (267)
Mira Georgieva

PINEMANAGE TOOL – A SOFTWARE FOR ESTIMATION OF GROWTH, YIELD AND TREE SIZE DISTRIBUTION, AND FOR SIMULATING THINNING ALTERNATIVES FOR SCOTS PINE PLANTATIONS IN BULGARIA (276)
Tatiana Stankova, Ulises Diéguez-Aranda, Veselin Hristov

REGENERATIVE AND ADAPTIVE POTENTIAL OF ORIENTAL BEECH (FAGUS ORIENTALIS LIPSKY) FORESTS IN STRANDZHA MOUNTAIN (288)
Gergana Georgieva, Nesho Chipev

COMPARATIVE ANALYSES ON SOME SOIL CHARACTERISTICS IN DIFFERENT LAND USES FROM CENTRAL BALKAN MOUNTAINS (304)
Lora Kirova
TOTAL CHLOROPHYLL CONTENT AND NORMALIZED DIFFERENCE VEGETATION INDEX OF TWO *POPULUS X EUROAMERICANA* CLONES (‘AGATHE’ AND ‘GUARDI’)

LEAF CHARACTERISTICS OF TWO POPLAR CLONES

Svetoslav Anev†*, Sonya Damyanova¹, Violeta Kotova¹, Adelina Stoeva¹, Nikolina Tzvetkova¹, Veselka Gyuleva², Tatiana Stankova²

¹University of Forestry, Sofia
²Forest Research Institute – Bulgarian Academy of Sciences, Sofia

INTRODUCTION

Growing space in forest plantations is an important factor, which can affect the physiological efficiency of resources uptake and its transformation to new biomass (Goldberg, 1990). The importance of resource-use efficiency in determining forest productivity is expressed in competition at both the belowground and aboveground levels (Kelty, 1992), clearly demonstrated in monocultures (Evans, 2009). Such competitions are especially strongest in plantations with a short rotation (e.g. from poplar) because the individual trees used resources too intensively (Makeschin, 1999). Trees may respond to the enhancement of competition for site resources by increasing uptake rate, reducing losses or improving the efficiency of their internal morphological and physiological apparatus to produce new biomass (Larocque, 1999). Previous studies in poplar monocultures have shown great variability in growth responses to inter- or intra-clonal competition (DeBell et al., 1996; Fang et al., 1999), but the morphological and physiological plasticity of the crowns is still insufficiently studied.

Crown architecture, leaf morphological and physiological acclimatization, associated with growing space, plays a crucial role in an intensive biomass production (Wu, Stettler, 1997). Crown architecture and leaf characteristics vary widely among poplar species and their hybrids (Benomar et al., 2011; Gielen et al., 2002), but the variation in canopy light conditions probably can neutralize these differentiations.

The condition of photosynthetic pigment complex is widely used criteria in the eco-physiological research due to the possible use of non-destructive, fast to implement and therefore easily replicable methods. Some of the measured parameters (e.g. total chlorophyll content and normalized difference vegetation index) are strongly related to net CO₂-exchange and growth capacity of trees (Field et al., 1995; Nabity et al., 2009; Novichonok et al., 2016).

The normalized difference between reflectance measured in the near-infrared and red wavelengths is termed the normalized difference vegetation index (NDVI). This
index has been shown, both empirically and theoretically, to be related to the fraction of PAR absorbed by the forest canopies (Tucker, Sellers, 1986; Xiao et al., 2004) that is, to the photosynthetic activity of vegetation canopies (Myneni et al., 1995; Myneni et al., 1997). The NDVI is successful as a vegetation measure in that it is sufficiently stable to permit meaningful comparisons of seasonal and inter-annual changes in vegetation growth and activity (Huete et al., 2002).

The main objective of this study is to determine the total chlorophyll content and values of NDVI in leaves of two poplar clones, planted in three growing space schemes.

MATERIAL AND METHODS

Site description
Experimental plantation with coppiced plants of the black poplar (Populus x euramerica) hybrids ‘Agathe’ and ‘Guardi’ was established in March 2013 on the territory of Mikrevo nursery of Strumyani Forestry Estate in South-Western Bulgaria (41° 37’ 59.6” N; 23° 11’ 38.2” E). The nursery is situated in the valley of Struma river at 138 m a.s.l. The climate is transitional Mediterranean with mild, warm winter of average minimum temperatures above 0°C and hot summer of maximum average temperatures, measured in July and August, when they exceed 27°C. The average amount of annual precipitation registered in the last 5 years is around 750 mm, with maximum quantity measured in May (above 90 mm). The soil is arable Fluvisol, of low bulk density and slight alkalinity, characterized by good water permeability (Alexandrov et al., 2004). The plants, used in this study, come from the trial poplar plantation, described in detail by Stankova et al. (2017).

Data collection
Both total chlorophyll content (TTC) and normalized difference vegetation index (NDVI) were measured in June 2017 on 15 fully expanded intact leaves of 9 trees, planted in 1.63, 2.66 and 4.34 m² growing space (3 trees per growing space). The instruments used were an AtLEAF+ (FT Green LLC, Wilmington, DE, USA) for the total chlorophyll and a Plant-Pen NDVI-300 (PSI Corporation, Czech Republic) for the leaf NDVI data collection. The measurements of TTC and NDVI with these devices are based on the ratio of radiation absorption by the leaves at different wavelengths – one wavelength in the red region (corresponds to the spectral range with the maximum chlorophyll activity) and another wavelength in the infrared region (where the chlorophyll absorption is very low for the compensation of the leaf water content and leaf thickness).

Data analysis
For both TTC and NDVI data at each growing space variant the following statistical proceedings were conducted: 1) descriptive statistical analysis and 2) Shapiro-Wilk
test for evaluation of the normal distribution. One Way ANOVA test followed by the All pairwise multiple comparison procedures (Tukey test) were used for tests of significant differences between the means. All statistical calculations were performed with MS Excel (Microsoft Corp., Redmond, WA) and with specially created visual basic user-defined functions.

RESULTS AND DISCUSSION

Total chlorophyll content (TCC) was significantly greater in the leaves of PG than the leaves of PA (P < 0.001). Within each clone, the extension of the growing space did not show any significant effect on the TCC (P = 0.094 for PA and P = 0.376 for PG) (Fig. 1).

Figure 1. Total chlorophyll content (TCC, mg cm\(^{-2}\)) in leaves of Populus Agathe F. (PA) (grey boxes) and Populus Guardi (PG) (white boxes). Mean values are shown with white dots, medians – with lines, 25% and 75% quartiles – with boxes, minimum and maximum – with whiskers. Different letters indicate that the difference of the means is significant at the 0.05 level (Tukey test).

The lack of significant differences in TCC among the variants of growing space in both poplar clones is probably due to greater genetic dependence, than the role of the growing space, on chlorophyll accumulation. Our data showed that the leaves of PG have a higher genetic potential for chlorophyll synthesis, than those of PA. Obviously, at the range of growth spacing in our study, TCC is not a limiting factor for photosynthetically light absorption.

The mean value of NDVI was significantly higher in the leaves of PG than those of PA (P < 0.001). Remarkable dynamics at narrowing of the growth space was observed in NDVI - with the opposite trend in the two poplar clones. In the leaves of PA this index had significantly higher values at the variant of 4.34 m\(^2\) compared to the closer schemes (F = 11.015, P < 0.001). In the leaves of PG, the expending of growth space was accompanied by a decrease in NDVI (P < 0.001) (Fig. 2).
Figure 2. Normalized difference vegetation index (NDVI) in leaves of *Populus* Agathe F. (PA) (grey boxes) and *Populus* Guardi (PG) (white boxes). Mean values are shown with white dots, medians – with lines, 25% and 75% quartiles – with boxes, minimum and maximum – with whiskers. Different letters indicate that the difference of the means is significant at the 0.05 level (Tukey test).

As potential photosynthetic CO$_2$ fixation under optimal conditions is controlled by the photosynthetic capacity of individual leaves and the spatial organizations of leaves (Field et al., 1995), growth space is a decisive factor for leaf physiological acclimation. Photosynthesis and growth strongly depend on the effectiveness of light absorption as growth drives light absorption (Benomar et al., 2011). At PG the space closing, accompanied with an increase of NDVI, probably led to higher light use efficiency and improved water balance regulation. Such improvement may give an opportunity of PG for better acclimation under the condition of high competition. In two hybrid poplar clones (*Populus balsamifera* L. × *Populus trichocarpa* Torr. & A. Gray and *Populus maximowiczii* A. Henry × *P. balsamifera*) Benomar et al. (2011) have found that the decrease in spacing from 5 m x 5 m to 1 m x 1 m leads to 30% decrease in N on area basis, 20% increase in specific leaf area, and 40% increase in photosynthetic N-use efficiency at the crown level. (Fenghua et al., 2016) have confirmed that leaf NDVI has a high correlation with the canopy NDVI and multisource environmental data. According to Benomar et al. (2012) spacing affected proportions of biomass allocated to stem, leaves, and branches, but allocation to roots did not change.

**CONCLUSIONS**

Our results showed that the growth space had no effect on the chlorophyll amount in the leaves of PA and PG. At each variant, the leaves of PG had more chlorophyll than those of PA. Greater dynamics at narrowing of the growth space was observed in NDVI - with the opposite trend in the two poplar clones. In the leaves of PA the maximal values of NDVI were found under conditions of the largest spacing. In the leaves of PG the narrowing of the growth space was accompanied with an increase in NDVI. The differences between two poplar clones in respect of this indicator raised with the narrowing of growth space – with higher values in PG.
Acknowledgements: This research was supported by a grant DN 06/3 (2016-2019) from the Bulgarian National Science Fund.

REFERENCES


The aim of this study was to determine some physiological criteria for biomass accumulation ability of two poplar clones. The measurements were carried out in an experimental 5-year-old poplar plantation, growing as Nelder’s wheel in Mikrevo (Strumyani-region), Southwestern Bulgaria in June 2017. The sampled trees belong to two poplar clones Populus × euramericana, cv. Agathe F. (PA) and Guardi (PG), and are planted at three growing spaces – 1.63, 2.66, and 4.34 m². Total leaf chlorophyll content was measured nondestructively by using an AtLEAF+ device. Normalized difference vegetation index (NDVI) for leaves was determined by a Plant-Pen NDVI-300. The results of this study indicated that the total chlorophyll content in the leaves of PG was significantly greater than in the leaves of PA at each variant of growing space. In general, leaves of PG had significantly higher NDVI. Remarkable dynamics at narrowing of the growth space was observed in NDVI - with the opposite trend in the two poplar clones. The highest values of NDVI for the leaves of PA were found at the largest space. When expanding the growth space, the leaves of PG tended to decrease this index. Such trend reflects a raised water requirement of better-illuminated leaves. Higher total chlorophyll content and leaf NDVI could be regarded as an evidence of greater growth potential and biomass accumulation capacity of PG compared to PA.

**Keywords:** growing space, NDVI, total chlorophyll, poplar clones

*svetoslav.anev@ltu.bg*