Приложение 13

РЕЗЮМЕТА*

на научните трудове за участие в конкурс за заемане на академична длъжност „доцент“ към катедра Дендрология“, област на висше образование 6. Аграрни науки и ветеринарна медицина, професионално направление 6.5. Горско стопанство, научна специалност „Лесовъдство (вкл. Дендрология)“, по дисциплината „Физиология на растенията“

гл. ас. д-р Светослав Младенов Анев

* номерата в горния край на страниците следват списъка на публикациите от приложение 1

Ozone response of young beech trees (*Fagus sylvatica* L.) in the Western Balkan forests (Bulgaria)

Anev, S., Hadjiivanova, C., Tzvetkova, N.

Abstract

The beech forests in the Balkan Mountains are a part of southern board of beech's areal. These forests have the highest productivity in the territory of Bulgaria due not only to the genetics features of different native provenances, but also to the favorable hydrological and thermal conditions in this region. Young beech trees (Fagus sylvatica L.) were investigated at two sites in the Balkan forests during the growing season of 2008. The investigation is a part of a project studying the influence of climate changes and atmospheric pollutants on the health and physiological condition of beech forests in Western Bulgaria. These areas are subjected to air pollution and the local forests have not been systematically studied for air pollution effects. The aim of the study is to determine the influences of surface background ozone concentrations and climatic variables on beech canopy photosynthesis. In Vitinya, for the growth season 2008 the cumulative ozone dose AOT40 was 2.24 times and in Petrohan was 1.23 times above the threshold value for tree plants. At both sites, the rate of photosynthesis in the upper parts of the crowns of beech trees was higher than in the lower. In Petrohan, a reduced gas-exchange was detected in the lower part of the tree crown from June to August in comparison with Vitinya, and as well in the upper part of the beech crown only in July. At both sites, at both canopy levels negative correlation between net photosynthesis from June to August and AOT40 was found. This correlation was slightly better at Vitinya, the site with higher ozone concentrations. The results argue for a seasonal variability in the physiological responses of beech leaves in relation to AOT40.

Rate of transpiration and stomatal conductance of young beech (*Fagus sylvatica* L.) trees at different levels of water supply

Anev, S., Tzvetkova, N.

Abstract

The aim of the study was to determine the seasonal patterns of leaf transpiration (E) and stomatal conductance (gs) of young beech trees in relation to air pollution in two forest sites with different rainfall conditions – Vitinya and Petrohan. There were progressive decreases in E and gs both in sun-exposed and shady leaves from the beginning to the end of the growing season at Vitinya – with 40 % less amount of rainfalls than Petrohan. A similar decrease in both parameters was shown at Petrohan only in summer. Significant non-linear relation was found at Petrohan between gs in sunny leaves and SO2. At this site gs in both sunny and shady leaves were related with NOX and E in two crown positions was in a strong relation with cumulative ozone exposure AOT40.

Еко-физиологичен модел за определяне на нетната първична продуктивност в горски насаждения

Анев, С.

Резюме

Съществуват редица модели, отразяващи светлинната зависимост на фотосинтезата на отделния лист. Целта на настоящото проучване бе да се разработят екофизиологични и аналитични уравнения за вегетационния ход на фотосинтезата и на нетната първична продуктивност на горски насаждения. Тези уравнения са нови по отношение на това, че използват малък брой входни параметри и недеструктивни методи за определянето им. Те комбинират светлинната зависимост на фотосинтезата на листа от слънчевия и от сенчестия биохоризонт на короните с вегетационната динамика на процеса. Така моментната стойност на фотосинтезата се преобразува във вегетационна динамика на нетната първична продуктивност. Информацията за нетната първична продуктивност на горските насаждения може да бъде използвана при инвентаризацията на горите, за прогнозиране на прираста и за други практически цели.

Влияние на факторите на средата върху нетната първична продуктивност на горски насаждения

Анев, С.

Резюме

Направена е оценка на влиянието на някои фактори на средата върху нетната първична продуктивност на млади букови насаждения в района на Западна Стара планина. Вегетационният ход на климатичните фактори е установен чрез пространствена интерполация на публично достъпни данни от съседни метеорологични станции. Радиационният режим на насажденията е определен чрез геофизичен метод. Нетната първична продуктивност е изчислена с използването на екофизиологичен модел. За установяване на степента на влияние на факторите на средата върху нетната първична продуктивност е приложена многофакторна регресия по метода на Фриш-Воу. Установява се, че слънчевата радиация е основен фактор, който влияе върху нетната първична продуктивност през трите години на проучването. На северния склон на планината температурата оказва силно положително влияние, особено в началото на вегетационния период. На южния склон влиянието на температурата е негативно, най-вече след средата на вегетацията.

Еко-физиологични проучвания на обикновен бук (*Fagus sylvatica* L.) в района на Западна Стара планина

Анев, С.

Резюме

Екофизиологичните методи са съвременен инструментариум за изследване на влиянието на факторите на средата върху продуктивността на горите. Физиологичната активност на отделните дървесни индивиди е мостът между наличието на ресурси, необходими за растежа и тяхното превръщане в биомаса. Ето защо изследването на физиологичните процеси на дървесните растения и тяхната динамика през растежния период дава първичната информация за потенциала за натрупване на биомаса. Тази информация може да бъде използвана като аргумент при избора на система от лесовъдски мероприятия за стопанисване на горите. Целта на настоящата дисертация е да се проучи физиологичната активност на млади букови индивиди за установяване на ефекта на отделните фактори на средата върху нетната първична продуктивност (NPP) на насажденията. За постигането на тази цел беше разработен екофизиологичен модел за определяне на нетната първична продуктивност, който беше изпитан при млади букови насаждения. Определени са границите на влияние на факторите на средата върху елементите на газообмена. Резултатите показват, че в района на Западна Стара планина, букът притежава потенциал за увеличаване на биологичната си продуктивност. В началото на растежния период лимитиращият фактор на средата са ниските температури, а през летните месеци – недостигът на вода. Въпреки това не беше установено статистически значимо влияние на количеството на валежите върху NPP. Установената за обектите на проучването ефективност на използване на въглерода е по-висока от същата определена в млади букови гори в Северна Франция и Северна Италия.

Dynamics of air pollutants in the region of ecological station Vitinya during the vegetation period of 2007 and 2008

Anev, S., Tzvetkova, N.

Abstract

Estimation was made of the levels of the main air pollutants – SO2, NOX, and O3 in the ecological station Vitinya during the growth periods of 2007 and 2008. Station Vitinia is situated in the West Balkan mountain at 1000 m a.s.l. and is a typical habitat of common beech forests. Its location is near to the big sources of air pollution – metal works “Kremikovtzi”, copper plant Pirdop-Zlatica, Sofia city, and high road “Hemus”. Data used for the estimation of the pollution levels were collected during the continuously monitoring of air pollutants concentrations along with the main climatic factors. Annual, monthly and daily means were presented and accumulated ozone dose AOT40 was given for the vegetation periods. Comparative estimation was made on the potential role of different sources of precursors in ozone formation and its dynamics during the growth period of vegetation – in relation with specific course of climatic factors and a potential threat for beech forests.

Foliar water loss of Fagus sylvatica trees under ozone impact in urban and mountain areas

Tzvetkova, N., Parvanova, P., **Anev, S.**

Abstract

The influence of urban and mountain background ozone concentration on the rate of transpiration and stomatal conductance was examined in sun-exposed and shady leaves of adult European beech trees, grown in the Dendrarium of the University of Forestry, Sofia and in the Plana Mountain. Data for the air pollution and climatic parameters were taken from the automatic monitoring stations nearby to the experimental sites. Daily and monthly mean O3 concentrations were calculated along with the cumulative exposure index AOT40 for the vegetation season of 2009. Gas exchange was measured in the middle and in the end of the growth period (July and September) on fully expended leaves. Results suggested that exposure to elevated O3 concentrations common over a whole growing season (April-September) in the two experimental sites had an adverse effect on the water regime and the ability of trees to cope with summer drought.

Експериментални методи за изследване на ефекта от тропосферния озон върху горските екосистеми

Първанова, П., Цветкова, Н., Братанова-Дончева, С., Фикова, Р., **Анев, С.**

Резюме

Направен е преглед на най-прилаганите експериментални методи и съоръжения за мониторинг и изследване на влиянието на тропосферния озон върху горски екосистеми при контролирани, полу-контролирани и полеви условия. Описани са предимствата и недостатъците на използваните в световната практика опитни постановки. Изброени са някои от най-популярните биоиндикаторни видове за действието на озона. Коментирани са факторите на околната среда, които повлияват реакцията на растенията към действието на озона. Направени са препоръки относно необходимостта от системен подход за екологичните изследвания в горски екосистеми.

Water Regime of Common Beech (*Fagus sylvatica* L.) in Drained Terrains

Tzvetkova, N., **Anev, S.**

Abstract

The beech forests in the region of the West Balkan Mountain have the highest productivity for the territory of Bulgaria. This is based not only on the genetics features of the different native provenances, but also on the good hydrological and thermal conditions in this region. A cascade of installations was built up in the medium of the last century for catching of the water flow. These installations drain the great part of the woody stands in this region. As a consequence, the water regime of trees is worsened. The higher water deficit of the soil substrata makes more similar the physiological parameters of the leaves from the different part of the crowns. In order to find out this phenomenon, the rate of leaf transpiration and stomatal conductance were measured in two crown positions of young beech trees by infrared gas analysis. The results obtained were estimated in relation to the peculiarities of sunny and shady leaves.

Effect of temperature regime on phenological phases and duration of vegetation period of young beech (*Fagus sylvatica* L.) stands in the West Balkan mountain

Anev, S., Tzvetkova, N.

Abstract

The initiation of phenological phases and duration of the growth period at young beech stands in the region of West Balkan mountain were observed. Stands grow at specific temperature regime, determined by altitude, exposure and orography of the terrains. Significant differences among the stands in the duration of growth period at different temperature regimes were found. During dry and warm years phenological phases were longer and the transition from one to other phase was smooth, while during more humid, especially cold years the phenological phases and the entire vegetation period were shortened. A remarkable delay in the timing of budburst, the narrowest inter-year differences relevant to spring phenological phases and a much shorter vegetation period were established in the location at higher altitude. A high negative correlation with both spring and autumn average air temperature concerned the timing of spring phenology. Average autumn temperatures positively correlated with the early autumn phenological events, causing a delay in leaf discoloration. Values of the correlation coefficients for leaf falling phase were much lower and non-significant. The sum of temperatures above and below 10 °C explained a smaller part of phenological variability. Only the onset of leaf falling was positively correlated with the sum of temperature exceeding 10 °C. Leaf fall was defined mainly by the first day with negative temperatures and by the sum of temperatures below 10 °C. The entire length of the growth period was significantly and positively influenced by the annual average temperature and also by the mean autumn temperature.

Ozone load on beech forest stands in the Western Balkan mountain of Bulgaria

Tzvetkova, N., **Anev, S.**, Parvanova, P.

Abstract

The concentrations of ozone were established for the region of the Western Balkan Mountain. This region is the most common habitat of beech (Fagus sylvatica L.) forest in Bulgaria. Data were measured by the automatic monitoring station. Temporal variation of month ozone load AOT40 (ozone concentrations accumulated over a threshold of 40 ppb during daylight hours) and climatic parameters were defined for the growth season (April – September) of 2003 – 2010. The effects of temperature regime, air humidity, and amount of precipitations on the ozone exposure during the vegetation period were estimated by correlation analysis. The values of total ozone exposure for the growth season exceeded the threshold values of 5 ppm.h during the entire 8-year period of study, showing that beech forests in the region of the Western Balkan Mountain are threatened by elevated ozone concentrations. Temperature regime had stronger positive effect on maximal ozone concentrations, compared to the average month values of ozone. Our study revealed that in wet years the effect of temperature on ozone concentrations strongly weakened. During the relatively cold years a lack of significant effect of temperatures on month mean ozone concentrations was found, but this tendency was not observed in relation to maximal ozone values.

Ozone monitoring in some urban and mountain regions of Bulgaria and the effect of ozone on tree vegetation

Tzvetkova, N., Parvanova, P., **Anev, S.**, Donev, E.

Abstract

The dynamics of tropospheric ozone levels were assessed in urban (Sofia city), suburban (Plana Mountain) and remote mountain (Western Balkan Mountain) regions in Bulgaria. On the basis of data measured by automatic monitoring stations, temporal and spatial variation of ozone concentrations and climatic parameters were defined during the growth period April to September of 2009. The occurrence of elevated ozone episodes in urban and mountain areas was studied. An assessment was made of the ozone effect on tree plants on the basis of photosynthetic activity. The ozone profile is typical for the study area, given the local traffic flow, density of vegetation and intercontinental transport links. The strongest negative effect on the photosynthetic activity of beech trees was detected in the urban region during the summer when high ozone levels are combined with drought stress.

Физиологична активност и нетна първична продуктивност на млади букови гори

Цветкова, Н., **Анев, С.**

Резюме

Разработен е екофизиологичен модел за определяне на нетната първична продуктивност и е приложен при конкретен дървесен вид. Направена е оценка на степента на влияние на отделните екологични фактори върху продуктивността на обикновения бук (*Fagus sylvatica* L.) в години с различни климатични условия. Допълнена е информацията за биологичните особености и за екологичните потребности на бука в млада възраст. В района на Западна Стара планина младите букови насаждения показват потенциал за повишаване на продуктивността. Това е свързано с установените резерви по отношение на ефективността на усвояване на въглерода в насаждения със сходни лесовъдско-таксационни показатели. В началото на вегетационния период най-силно въздействие върху нетната първична продуктивност на бука оказват ниските пролетни температури, а в средата на вегетацията – атмосферната влажност. Липсата на силно изразено влияние на количеството на валежите показва, че този фактор не е лимитиращ за продуктивността на бука в Западна Стара планина. Недостигът на топлина в периода на най-интензивен растеж води до ясно изразена тенденция за намаляване на нетната първична продуктивност с увеличаване на надморската височина. Установена е по-висока ефективност на използване на въглерода от буковите гори в Западна Стара планина в сравнение с тази в Северна Франция и Северна Италия и съпоставима с тази за някои райони на Централна Европа.

Phenological observations of young common beech stands from a representative site in Bulgaria

Tzvetkova, N., **Anev, S.**

Abstract

Leaf phenology in young European beech trees (*Fagus sylvatica* L.) was studied at a typical forest site in the West Balkan Mountain within a five years period (2008 – 2012). The number of days of the year (*DOY*) of bud-burst (BB), leaf unfolding (LU), autumn coloring (UC) and leaf falling (LF) were related to the average temperature on the date of the separate phenological occurrence. The specific limiting conditions were established for the leaf phenology of the young stands from different altitudes within the monitoring period. At higher altitude, the effect of heat lack was more pronounced. At the optimal altitude for the European beech trees leaf phenology was influenced by more than one factor. Significant negative correlations (r = -0.575 and r = -0.637 respectively) were detected between the timing of BB and LU, on the one side, and air temperature in the day of AC, on the other. The date of LU was positively correlated (r = 0.550) to the number of days between July 1 and the occurrence of LF with T < 5 °C, thus indicating the crucial role of autumn temperatures in the triggering of spring phenological events. Statistical evidence was received for the high sensitivity of the leaf falling date to the number of days with T > 20 °C (r = 0.726). The number of days between July1 and the LF with T < 10 °C had the strongest positive effect (r = 0.687) on the length of the BB-LU period. The linear regression slope of the temperature values, recorded between January 1 and the BB was positively correlated to the leaf falling date and the duration of the LF-AC period (r = 0.619 and r = 0.759, respectively). Significant negative correlation (-0.831) was established between the linear regression slope of the recorded temperature between July 1 and the date of leaf falling. This slope was in a negative correlation with the duration of the LU-AC period (-0.619). The possible impacts of future climate warming on beech phenology are discussed as well.

Физиологични основи на растежа, адаптацията и оцеляемостта

Анев, С.

Резюме

В тази глава са разгледани физиологичните аспекти на растежа при растенията и неговата връзката с факторите на околната среда и са представени данни от последните проучвания в България. Въпросите, свързани с елементите на въглеродния баланс в горите: брутна първична продуктивност (GPP) и нетна първична продуктивност (NPP) (фиг. 3.1.1), дишане на поддържане на растежа и за поддържане на физиологичните процеси, както и връзката им с някои характеристики на гората, като светлинен режим (фиг. 3.1.5), индекс на листната повърхност (LAI) (фиг.3.1.8 и 3.1.9) и възрастта на гората (фиг. 3.1.7) се обсъждат. Анализирани са периода и локализацията на растежа на отделните органи на дърветата, както и особеностите на растежния период в планинските райони (фиг. 3.1.10). Способността на растенията да оцеляват и да се адаптират в планински условия, на фона на прогнозираните промени на климата също са коментирани. Резултатите от наш вегетационен експеримент за потенциала на четири субалпийски дървесни вида (*Picea abies, Pinus mugo, Pinus peuce* and *Pinus heldreichii*) да толерират повишени температури в комбинация с симулирано почвено засушаване са представени и сравнени с потенциала на същите видове, растящи в естествените условия за тези видове (фиг. 3.1.12). Смърчовите фиданки не промениха значимо интензивността на изследваните физиологични процеси в схемите на засушаване, но това доведе до висок отпад. Газообмена при клека беше силно повлиян, особено от схема 3), а оцеляемостта се запази висока. Елементите на газообмена на бялата мура и на черната мура реагираха по силно на схема 3), в която те имаха и много ниска оцеляемост. Ограниченият потенциал на смърча за адаптация и оцеляемост, вероятно ще доведе до стеснябане на ареала му в планинските райони. Бъдещото разпространение на клека вероятно ще се увеличи в посока към по-голяма надморска височина и в същото време няма да бъде потиснат от смърча на долната си граница на разпространение. На фона на прогнозираните климатични промени, очакваме стесняване на физиологичния и екологичен комфорт на бялата и на черната мура в планините на Балканския полуостров. Това поставя двата вида в риск и изисква повишено внимание към техните хабитати и допълнителни проучвания в тях.

Gas-exchange responses of *Schefflera arboricola* (Hayata) Merr. and *Anthurium andreanum* Linden. infested by *Coccus hesperidum* L. (Homoptera: Coccidae)

Anev, S., Tzvetkova, N., Pencheva, A., Kabatliyska, Z.

Abstract

The effect of infestation by the insects *Coccus hesperidum* L. on gas exchange of potted host plants Schefflera arboricola and *Anthurium andreanum* under different intensity of infestation was examined. The study was carried out in June 2013 in the greenhouse of the University of Forestry – Sofia. Statistically significant alterations in the physiological processes were established as a reaction of scale insect feeding. The responses of host plants highly depended on the density of insects. Lightly infested plants showed comparatively higher photosynthesis and water use efficiency, but the strong infestation was manifested by a sharp and permanent suppression in photosynthesis and a worsen water balance. Plant response had some specificity depending on the peculiarities of the host plant. Leaves of *A. andreanum* showed better expressed variation in its physiological activity during the course of infestation, establishing possibly higher susceptibility to feeding by *C. hesperidum* in the conditions of greenhouse.

Статистическа оценка на модели за пространствена интерполация при определяне на валежните количества в планински район

Анев, С., Дамянова, С., Тончев, Т.

Резюме

Направена е статистическа оценка на точността на някои подходи за пространствена интерполация за определяне на валежните количества (P) в планински район. Експериментално измерените PObs. са съпоставени с изчислените PExp. чрез моделите за пространствена интерполация: inverse distance weighting (IDW), ordinary kriging (OK), ordinary co-kriging (OCK), trend ordinary kriging (TOK), многофакторна линейна регресия (MLR), многофакторна полиномна регресия (MPR). За параметризиране на моделите са използвани данни за валежите от намиращите се в близост станции от мрежата на световната метеорологична организация (WMO). При статистическата оценка са сравнявани: средната абсолютна грешка (MAE), средната квадратична грешка (систематична – RMSES и несистематична – RMSEU), коефициента на детерминация (R^2), индекс на приближение (d), сумата от квадратите на разликите (RSS) и отношението на сумата на измерените и сумата на изчислените валежи за изследвания период (W).

Отлагания на базични йони в букови насаждения на различна надморска височина

Дамянова, С., **Анев, С.**, Тончев, Т.

Резюме

Изследвани са две планински букови насаждения, разположени на различна надморска височина в Западна Стара планина. Едното е постоянна пробна площ за дългосрочен мониторинг и част от българската и европейска мрежа LTER (Long Term Ecosystems Research). Установена е по-висока концентрация на базични йони във валежите под склопа на нискоразположената пробна площ, в сравнение с тази на по-голяма надморска височина. Вероятната причина е по-значителен йонен обмен с листната повърност. Изключение правят Ca^{2+} йони, за които е установена по-висока концентрация във валежа на открито на по-високата пробна площ. Отлаганията на базични йони са близки, поради по-големите количества валеж на по-високопланинския обект.

Основни хранителни елементи в дървесината на млади букови индивиди

Дамянова, С., Тончев, Т., **Анев, С.**, Димитрова, В.

Резюме

Изследванията са проведени в Западна Стара планина в три обекта с различни надморски височини. Проучван е обикновеният бук (*Fagus sylvatica* L.), като основен представител на растителността в района. Избрани са млади индивиди със средна възраст между 16 и 18 години с различна диференциация в съобществата. Най-висока концентрация на основни хранителни елементи е определена за пробна площ Гаванещица, разположена на 1086 m надморска височина, а най-ниска – за Петрохан. Буковите индивиди от различните социални класове проявяват индивидуално поведение при усвояване на хранителни елементи. Тенденция за повишаване на концентрацията от подчинени към доминиращи дървета е установена само за органичния въглерод.

Response of subalpine saplings to different drought stress

Ivanova, A., **Anev, S.**

Abstract

The expectations for increasing periods of drought are becoming larger according to numerous authors. The susceptibility of subalpine tree species to drought provoke our interest to try to understand what will be their reaction to this natural climate change. For this purpose it is set experiment to determine the reaction of drought to 4 subalpine species – Norway spruce (*Picea abies* L.), Mountain pine (*Pinus mugo* Turra), Macedonian pine (*Pinus peuce* Grisebach) and Bosnian pine (*Pinus heldreichii* H . Christ). Different requirements are observed to imitate field conditions as close as possible. The saplings are taken from terrain with no disturbed soil substrate. The plants were placed in a 15 l container and at the beginning of the vegetation were situated in a specially built greenhouse. Precipitation regime is controlled by the irrigation system. The indicators for precipitation levels (for a drought from June to July and August scheme) were taken from the two previous real years, who had a significant influence on the species. Precipitation norm for control is taken from subalpine zone of Rila. To determine the reaction of all the groups of saplings subjected to various circuits, at the end of the year is recorded the survivors.

Transmittance coefficient of leaves from different crown parts of young beech (*Fagus sylvatica* L.) trees

Anev, S., Damyanova, S., Tonchev, T., Tzvetkova, N.

Abstract

An experiment was carried out for determining of the transmittance coefficient τ for photosynthetically active radiation (PAR) of leaves, taken from lighted and shaded crown parts of dominant, co-dominant and suppressed common beech (*Fagus sylvatica* L.) trees during two vegetation periods. It varied among seasons, altitudes and social classes. With the increasing in altitude τ increased as well during the all of vegetation period. At the same time for higher altitudes the minimal leaf transmittance was reached later during the year. The differences in τ among the social classes were larger than the differences between the lighted and the shaded parts of crown within a separate class. Its values were increased for dominant trees and were reduced for suppressed trees. A decrease in differences of τ between the upper and lower parts of the beech crown was established with an increase in altitudes.

Effect of beech weevil (*Orchestes fagi* L.) infestation on photosynthesis and water regime of common beech (*Fagus sylvatica* L.) leaves

Anev, S., Georgieva, S., Dimitrova-Mateva, P., Chaneva, G.

Abstract

The rate of photosynthesis (An), the transpiration rate (E) and the values of water use efficiency (WUE) of infested leaves are sensitive indicators for the level of stress in plants. The negative impact of impaired carbon and water regime affects the overall condition of the plant. This study aimed to establish the effect of beech weevil (*Orchestes fagi* L.) infestation on photosynthesis and water regime of common beech (*Fagus sylvatica* L.) leaves. The eco-physiological measurements on leaves with different level of infestation were conducted during the period of attack by larvae in first instar. The results showed that the photosynthetic rate increased strongly with an increase of infestation. The transpiration rate was statistically significantly lower in the leaves with a low level of infestation compared to the more infested ones. The water use efficiency did not vary significantly among leaves with different level of infestation. Impaired carbon and water regime can worsen whole plant sustainability and productivity.

Influence of salt stress on stomatal, biochemical and morphological factors limiting photosynthetic gas exchange in *Paulownia elongata* × *fortunei*

Ivanova, K., **Anev, S.**, Tzvetkova, N., Georgieva, T., Markovska, Y.

Abstract

The effect of salt stress on Paulownia elongata × fortunei seedlings grown ex vitro as hydroponic culture at three levels of salinity – 100 mM l^{-1}, 200 mM mM l^{-1}, 300 mM l^{-1} sodium chloride (NaCl) solution was investigated. The results showed that growth parameters like ratios fresh/dry biomass (FM/DM) and total leaf area (LA) were enhanced under middle salinity level (200 mM mM l^{-1} NaCl). Net photosynthetic rate (P_N), transpiration rate (E) and stomatal conductance (gs) decreased gradually, but total respiration rate (Rd) increased under low and middle salinity level (200 and 300 mM l^{-1} NaCl). With increasing salinity the values of the intrinsic components of photosynthesis were reduced – $V_{c\,max}$ (from 13.25 to 11.81 μmol m^{-2} s^{-1}), J_{max} (from 11.11 to 9.07 μmol photons m^{-2} s^{-1}), and V_{TPU} (from 2.39 to 2.11 μmol m^{-2} s^{-1}), and the differences were statistically signiffcant. Stomatal limitation to gas exchange conductance (S_L) increased from 11.22% to 21.24% and 15.88% at 100 and 200 mM l^{-1} NaCl. Water use effciency (WUE) was subsequently enhanced from 3.12 for the control plants to 30.60 for 300 mM l^{-1} NaCl treatment. It is concluded that salinity causes a decline in photosynthetic gas exchange in Paulownia elongata × fortunei leaves through its intrinsic and stomatal components, and that the apparent plasticity represented by the leaf area modulation is unlikely to be the mechanism by which this species avoids salt stress.

IF: 0.233 (2015)

Growth and adaptability of year-old saplings of Black poplar (*Populus nigra* L.)

Kalaidzhiev, I., **Anev, S.**, Guleva, V., Tzvetkova, N.

Abstract

The objective of this study was to evaluate the impact of cultivation medium on the growth rate and gas exchange of mature cuttings from one *Populus nigra* L. clone during the first growing season (June-September). In the first half of the season it produced different stem phenotypes on different variants of cultivating medium. The best growth response was observed in the variant sand:soil_50% . The mean height difference of *P. nigra* reached 28.67 cm and 2.27 cm during the first and the second half of growing season, respectively. On the same variant the mean height difference of *P.* × *euroamericana* Guardi reached 35.43 cm and 12.77 cm, respectively. The mean stem base diameter increased slowly ‑ with 3.36 cm and 4 cm in *P. nigra* and *P.* × *euroamericana* Guardi, respectively. Net photosynthesis was positively correlated with base stem diameter of *P. nigra* (R^2 = 0.603, Sign.= 0.030). Our findings indicated that cultivation medium can have important effects on growth and assimilation, though there were few effects on the transpiration and water resource conservation (water use efficiency). The obtained results confirm that variation in shoot diameter will have a greater impact on growth performance as a response to cultivating medium.

Gas-exchange dynamics within the crown of Norway spruce

Anev, S.

Abstract

The balance between CO_2 income during photosynthesis and H_2O release during transpiration is strongly influenced by differentiation of leaves within the canopy. Gas-exchange and water use efficiency (WUE) were studied in respect to branch position in the crown of 37-year-old Norway spruce [*Picea abies* (L.) Karst.] tree, growing in the Western Stara Planina. The needles of the middle-crown branches had significantly highest rate of net photosynthesis compared to the upper and lower crown. The rate of transpiration and vapour pressure deficit gradually decreased to the upper-crown branches. The highest water use efficiency was established for the needles in the top of the crown. The lowest photosynthesis and WUE, along with the highest transpiration and vapour pressure deficit of the branches in the crown base of the tree are indicative for the diminished adaptive capacity. The study results could contribute to better understanding of the physiological mechanisms of branch self-pruning.

Stomatal control on photosynthesis in drought-treated subalpine pine saplings

Anev, S., Ivanova, A., Tzvetkova, N., Panayotov, M., Yurukov, S.

Abstract

Stomata have a key role in the balance of gas exchange parameters. Stomatal closure limits transpiration under conditions of water deficit. It also suppresses photosynthesis due to limited CO_2-uptake. We examined the levels of stomatal control on the photosynthesis of *Pinus mugo* Turra, *Pinus peuce* Griseb. and *Pinus heldreichii* Christ. saplings during a twoyear drought experiment. Plants were exposed to three different irrigation regimes (according to the annual course of precipitation): typical for the natural area of the species; for years with extremely dry periods during July as well as for years with drought during August. A species specific stomatal control on the rate of photosynthesis (An) under different irrigation regimes was observed. *P. mugo* saplings showed great resistance to drought, they kept similar An under the different irrigation schemes and increased intrinsic water-use efficiency (iWUE) under drought conditions. *P. peuce* saplings had reduced stomatal control on An, especially in the situation with late summer drought and unchanged iWUE. *P. heldreichii* saplings had very low An and stomatal conductance under all irrigation schemes accompanied by an increase in iWUE during early summer drought and a decrease in late summer drought. The relationships between photosynthesis and stomatal conductance under the three irrigation schemes were close to linear – photosynthesis did not reach asymptote in this species. These differences in the reaction of photosynthesis to stomatal conductance could be used as a good indicator for the adaptability of the studied species to summer drought.

Ecophysiological method for assessment of Orchestes fagi L. infestation on Common beech trees

Dimitrova-Mateva, P., **Anev, S.**, Georgieva, S., Chaneva, G., Tzvetkova, N.

Abstract

The paper presents an applicable method for investigation and assessment of the damage caused by beech weevil (*Orchestes fagi* L.) on the leaves of Common beech (*Fagus sylvatica* L.). Selecting of appropriate ecophysiological approaches is a workable tool for an assessment of leafminers' effects as these methods can be applied for leaves with a gradient of damaged area. Thus, it can be established a tendency in the attack effect and determined the limits of the plant protective system. This methodology was applied successfully and can provide reliable set of data for clarifying the relationship between the mining larvae, developing in the infested leaves, and the host plant. The application of this methodology in other environmental conditions and woody species could contribute to a development of biological means for a control on the leafminers in the forests.

Comparative study on physiological potential of Pinus sylvestris L. and Pinus bungeana Zucc. ex Endl. to grow in Bulgarian urban parks

Anev, S.

Abstract

Pinus bungeana Zucc. ex Endl. is a picturesque multi-trunked pine tree native to northeastern and central China with symmetrical crown and grey-green, mottled, exfoliating bark. This species is already introduced into European urban parks, although there is still limited information about its appearance when full grown. The first *P. bungeana* tree in Bulgaria was planted in the arboretum of the University of Forestry in Sofia. The aim of this study is to compare needle gas exchange in this tree and *Pinus sylvestris* L. Both experimental trees are at similar age and grow out of their natural range of distribution. The net photosynthesis (A_N) in response to various air temperatures and light conditions was analyzed in both *P. bungeana* and *P. sylvestris* needles. Temperature and light responses of photosynthesis obtained in this study show insignificant differences between *P. bungeana* and *P. sylvestris*. The established features are sings for higher tolerance of *P. bungeana* to shade and cold, than *P. sylvestris*. Therefore, it can be assumed that *P. bungeana* has physiological potential to grow in Bulgarian urban parks, similar to *P. sylvestris*.

Non-destructive allometric method for estimation of leaf area in common beech (Fagus sylvatica L.)

Anev, S. Dimitrova-Mateva, P., Lamlom, S., Chaneva, G., Tzvetkova, N.

Abstract

A model for leaf area (L_A) determination in Common beech (*Fagus sylvatica* L.) was developed by using leaves from two different elevation sites. The leaf mass (L_M), lamina width (L_W), lamina length (L_L), and L_A were all measured after excision of leaves from the plants in an open source software ImageJ. Best subsets regression analysis for relations between L_A and different combinations of L_W and L_L was performed. The proposed best-fit L_A-estimation model is: $L_A = 2.40 \cdot L_L + 6.65 \cdot L_W - 23.77$. The established highly significant relation ($R^2 = 0.98$, P-value < 0.001, d.f. = 177) between L_A and leaf width and length allows this mathematical model to be used for simple non-destructive field calculation of L_A in Common beech, which can thus be tremendously time saving without compromising on accuracy.

Changes of the antioxydant stress markers in the beech leaves after *Orchestes fagi* infestation

Lamlom, S., Georgieva, S., Dimitrova-Mateva, P., **Anev, S.**, Tzvetkova, N., Chaneva, G.

Abstract

The present work focused on the influence of leaf-mining weevil (*Orchestes fagi* L.) on the leaves of common beech (*Fagus sylvatica* L.). The study investigated the changes of the oxidative stress markers malone dialdehyde (MDA), total peroxides and free proline in beech trees located at two different altitudes (680 m asl and 1400 m asl) at the Petrohan Training and Experimental Forest Range, Western Balkan Mountains. Levels of infestation as well as the studied parameters were highly dependent on the location. The conditions at low altitude were favorable for the rapid development of *O. fagi* which resulted in significant changes of leaf growth and physiology. The peak of the invasion was reached in May – June, 2015. Malone dialdehyde was the most reliable oxidative marker among the examined parameters. The heavily damaged leaves at 680 m asl contained higher amount of MDA – 24% - 35% more than that in the leaves at the higher altitude. Statistically significant correlation between content of MDA and degree of infestation was established. However, the increased level of lipid peroxidation was not accompanied by the corresponding enhancement of total peroxides. The damage caused by *O. fagi* invasion was also manifested by the increase of free proline content, especially in the leaves at 680 m asl. In general, the herbivory resulted in serious biochemical changes occurring in the leaves, indicating a shift in the oxidative status of the beech trees.

Influence of salt stress on leaf morphology and photosynthetic gas exchange in two Lycium species

Dimitrova, V., Ivanova, K., Petrov, P., **Anev, S.**, Tzvetkova, N., Georgieva, T., Markovska, Y.

Abstract

Lycium barbarum and *Lycium chinense* are two species belonging to the family *Solanaceae* from which the goji berry is harvested. The effect of salt stress on leaf morphology and photosynthesis in these species, grown ex vitro in hydroponic at three levels of salinity, 50 mM, 100 mM, 200 mM sodium chloride (NaCl) solution was evaluated. Application of 50 and 100 mM NaCl caused impairments in leaf anatomy and photosynthetic performance of *Lycium barbarum* and *Lycium chinense*. The results showed that treatment with low and moderate concentrations of NaCl induced variations in leaf, mesophyll and epidermis thickness, but K + homeostasis was maintained and recovery of net phosynthesis and transpiration was observed. The water use efficiency increased in *Lycium barbarum*, while this parameter decreased in *Lycium chinense* with increasing salinity stress.

IF (2016) 0.251

Effect of soil salinity on morphology and gas exchange of two Paulownia hybrids

Ivanova, K., Geneva, M., **Anev, S.**, Georgieva, T., Tzvetkova, N., Stancheva, I., Markovska, Y.

Abstract

A pot experiment was carried out to investigate the effect of salinity on growth, leaf anatomy and gas exchange characteristics in two *Paulownia* hybrid lines (*Paulownia tomentosa* × *fortunei*-TF and *Paulownia elongata* × *elongata*-T4). The distribution of Mg, Ca, Na, K and Fe between water available fractions from non-saline, saline soils, and different organs showed acropetal concentration gradient for metal accumulation, excepting Ca. Selective uptake of K over Na was enhanced slightly with increasing salinity, where K/Na ratio was reduced in *Paulownia elongata* × *elongata*-T4 and rose in *Paulownia tomentosa* × *fortunei*-TF. The reduction in the total plant leaf area and in the values of the intrinsic components of photosynthesis-maximal Rubisco catalyzed carboxylation velocity, maximal electron transport rate and triose phosphate utilization rate was observed only in *Paulownia tomentosa* × *fortunei*-TF. The CO_2 compensation point rose to *Paulownia tomentosa* × *fortunei*-TF and declined in *Paulownia elongata* × *elongata*-T4, while the stomatal factor values were enhanced in both hybrid lines. Under saline conditions, the stomatal component was more limiting to photosynthesis than its biochemical components. It was concluded that *Paulownia elongata* × *elongata*-T4 was more resistant to salinity because its growth and gas exchange characteristics were less affected in comparison with *Paulownia tomentosa* × *fortunei*-TF.

IF (2016) 1.170

Drought stress in four subalpine species: gas exchange response and survivorship

Anev, S., Tzvetkova, N.

Abstract

An assessment of adaptability of saplings of four evergreen species (*Picea abies* Karst., *Pinus mugo* Turra, *Pinus peuce* Grisb. and *Pinus heldreichii* H. Christ.), native for Bulgarian treeline zone, was made on the basis of leaf gas exchange and survivability in artificially induced drought stress. The established low sensitivity of gas exchange to summer drought and the highest mortality of *P. abies* may be regarded as an evidence for a narrow zone of tolerance. *P. peuce* and *P. heldreichii* have low survivorship under drought conditions, regardless of the variable effect of soil moisture on the gas exchange parameters. The better survivability and significant reduction of gas exchange in response to soil water deficit of *P. mugo* probably will give him an advantage in future adaptation to climate change and in competition with other subalpine species. We conclude that the expected trends in climate change will most likely lead to a further narrowing of the ecological and physiological comfortable zone for two investigated endemic species.

IF (2016) 0.430

IN PRESS

Влияние на стопанската дейност върху устойчивото развитие на популацията от глухар (*Tetrao urogallus* L.) в Западни Родопи

Бончев, Л., **Анев, С.**, Йорданов, Й., Клементов, А.

Резюме

Целта на настоящото проучване беше да се установи ефекта на лесовъдски мероприятия, като сеч и залесяване, върху популацията на глухара в Западните Родопи. Изследването е проведено на територията на държавно ловно стопанство "Борово", в бял борови насаждения, в които са проведени различни по вид и интензивност сечи. Оценено е и влиянието на изкуствено създадения втори етаж от смърч върху присъствието и навиците на глухара. Определени са "хранителните" дървета в отделните токовища и е направена оценка на степента на обезлистване, в следствие от храненето на глухара. Резултатите показват, че безпокойството е фактор с временно действие върху присъствието на глухари на една територия. Водещите фактори са структурата и видовия състав на насажденията, както и орографията на терена. Не беше установено изсъхване на дървета в следствие от хранителните навици на глухара.

Относно необходимостта от икономическо оценяване на здравословното състояние на буковите гори, засегнати от листоминиращи насекоми

Димитрова-Матева, П., Георгиева, С., **Анев, С.**, Цветкова, Н., Чанева, Г.

Резюме

Настоящият анализ има за цел да покаже необходимостта от разработване на методика за икономическа оценка на влиянието на листоминиращия хоботник *Orchestes fagi* в горите от обикновен бук у нас. Изборът на дървесен вид е обусловен от важното икономическо, екологично и рекреационно значение на буковите гори в България. Предстои част от тях да бъдат включени в Конвенцията за световно , културно и природно наследство на ЮНЕСКО. Буковият скокльо е разпространен повсеместно и е вид, включен в ежегодните лесопатологични обследвания в горите. Общоприетите методики за установяване на степента на нападение на листата не показват значителни повреди от комплекса листоминиращи насекоми по бука, тъй като не причиняват видимо обезлистване. Наши биохимични анализи потвърждават силен стрес и реакция от страна на растението-гостоприемник. Това обуславя търсенето на алтернативни начини за оценяване на състоянието на буковите гори, засегнати от листоминиращи насекоми.

Ръководство за упражненията по физиология на растенията

Цветкова, Н., **Анев, С.**

Резюме

Настоящето учебно помагало е предназначено за студенти от Лесотехническия университет и е съобразено с учебните програми по дисциплините: „Физиология на дървесните растения“ за студентите от специалност „Горско стопанство“, „Екологична физиология на растенията“ за студентите от специалност „Екология и опазване на околната среда“, „Физиология на растенията“ за студентите от специалност „Ландшафтна архитектура“ и „Физиология и биохимия“ за студентите от специалности „Агрономство“ и „Растителна защита“. При различните специалности се набляга на приложните аспекти на експериментите, като се подбират специфични растителни видове, методи за провеждане на опитите и въпроси за анализ и интерпретация на получените резултати.