Mendel University in Brno

ABSTRACT AND PAPER PROCEEDINGS

Innovations in Professional Practice within Forestry & Arboriculture

6–7th September 2016

Brno, Czech Republic

Zuzana Špinlerová (Ed.)

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Key words: Tree Biology, Tree Vitality, Tree Inspection, Tree Health, Tree Risk Assessment, Forest Worker Safety, Forest Worker Training, Forest Harvesting Techniques, Tree Inspection

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CONTENTS:

ATTACHMENTS

FOREWORD

I am very happy to welcome you to Brno, Czech Republic for this 1st International Joint Forestry and Arboriculture Conference with a focus on new and recent innovative practices within the respective disciplines. The dedicated conference team consisting of representatives from ABA International and Mendel University in Brno with the support of other partners within the Erasmus project 'Vet-Safety' have brought together an excellent scientific and social programme.

The programme schedule has endeavoured to bring together the two distinct but yet overlapping fields of tree care and forest management under one roof therefore providing an opportunity to view forestry and arboriculture from a truly holistic perspective. At the same time, ensuring scope for possible new friendships (as well as old ones renewed) or acquaintances to develop and discuss possible future innovations or new ideas.

Furthermore, the specific conference theme INPROFA (Innovations in Professional Practice) is a novel aim in itself by encompassing both worlds of academia and practicality. This is highlighted by the quality of the papers presented at this conference and included in these proceedings. The conference is structured in a way to ensure a comprehensive theoretical grasp is provided on the first day which is subsequently followed up and supported by practical demonstrations on the second day.

On behalf of ABA International and our partners, we thank all the individuals and organisations who have helped to support and promote the meeting and special thanks to all the presenters for their willingness to share their latest research, innovations and ideas. We wish the conference success and hope that you enjoy Brno.

William Robb

President

ABA International

ABSTRACTS AND PAPERS OF SPEAKERS

WHAT'S NEW IN MODERN ARBORICULTURE?

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A deep knowledge of biology is necessary to properly take care of our trees. Thanks to Shigo's research, our comprehension of the whole tree biology environment totally changed: the reaction of the tree tissues against wounds, the energy that a tree could accumulate and the relationship that can exist between a tree and its associates are the basis of our approach in arboriculture.

In our cities the average life of a tree is 8 years. This fact has consequences both for environments and landscape; it causes economic losses too. There are many reasons for the short life in urban conditions, but it is evident that a new approach to tree biology and tree care is strongly requested.

Trees are not just pieces of dead wood, that can tolerate everything, as many people believe; they are living organisms that use and produce energy. Understanding the concept of the different level of energy is a key for the comprehension of the answer of trees to the environment and to the situations occurring in our cities (wounds, deteriorated soils, incorrect practice, ...).

A comprehensive knowledge of the anatomy of trees, their differences and their physiology is another key factor for a new approach, that has to be consider not expected.

Moreover, the tree should be thought as a part of a complex system, that involved its associates (fungi, bacteria,...) and the interactions with other elements, as soil.

Many situations occurring in our cities are due to a poor knowledge of tree biology and anatomy. Only with direct experience (*Touch Trees*!) in the field can we employ a proper approach in the context of modern arboriculture.

New technologies, as bio-control, IT systems and advanced technologies in evaluating tree stability, could help us in preservation of trees within the urban environment.

Key words: arboriculture, Shigo, tree biology, tree anatomy, technologies

MONITORING TREE REACTION TO THE ENVIRONMENT: SAP FLOW & TREE VITALITY

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Improvement of estimation methods of tree reaction to environmental stress always have been in focus of arboriculture and forestry. Since tree growth is considered to be significantly limited by water availability, tree reaction to environment can be quantified by observations of tree water relations both as instantaneous response and as long term adaptation to changes in environmental conditions. The aim of our study was to investigate the effect of summer transplantation on water use of pedunculate oak (*Quercus robur* L.). Our intention was to test the handiness of usability of sap flow monitoring technique in commercial arboriculture. Digging (combined with watering of uncovered and pruned roots) of 15–20 years old solitaire grown oak located in a floodplain of a lake was started in midday. In afternoon, the tree was lifted by a crane and placed into a wooden box filled with organic soil. Continuous measurements of xylem sap flow by Heat Field Deformation (HFD) method were applied. Multiple linear regression models were fit separately to the data before and after the transplanting in order to assess the influence of vapour pressure deficit (VPD) and solar radiation on the sap flow rate in different depths of sapwood. A day after transplantation, sky overcasted causing decrease of air temperature and VPD. At the moment of removing of a tree out from initial location, sap flow dropped significantly until the watering was started in late afternoon. During following night, sap flow rate increased in whole sapwood exceeding previous nocturnal level. After transplantation, sap flow rate of inner sapwood layers increased higher than before but in outer layers it dropped. However, significantly higher daily cumulated sap flow was observed than in previous days. The regression coefficient for VPD was higher for all depths after the transplanting, which means that changes in sap flow rate became more sensitive to changes

in VPD, indicating reduced capability of water supply. However, the coefficient is positive for the outer layers and negative for the inner layers indicating that sap flow rate reacts inversely to VPD in different sapwood depths of the tree. After the transplanting, all the models were still statistically significant, but the amount of the explained variance dropped rapidly, especially for the outer layers, indicating that the natural relation between VPD and solar radiation to sap flow rate was disturbed and other factors became more important in explaining the variance of sap flow rate.

Keywords: sap flow, tree vitality, water use, transplantation, root pruning, pedunculate oak

MODERN EVALUATION METHODS IN TREE STABILITY ASSESMENT

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This paper presents a modern methodology for assessing the risk in park and street alignment trees of the city of Brasov. The method involves analysing tree stem resistance to wind load, using modern techniques (sonic tomograph and drilling resistance) for the identification of internal defects and studying the tree stem and crown characteristics as well as the distance from objectives to be protected. The purpose of this methodology is to identify trees that have stability problems and the main defects which affect their stability. These trees could be a danger to society in the event of natural phenomena such as strong winds that may cause the breaking of crowns, stems or even uprooting. For an accurate assessment of the risk in these trees, they have been divided into five risk classes depending on the score that they get by adding the points given for each criterion:

- I – Trees with an imminent risk – (80; 130] points;
- II – Trees with a high risk – (60; 80] points;
- III – Trees with a moderate risk – (40; 60] points;
- IV – Trees with a low risk – (20; 40] points;
- V – Trees with a very low risk – [0; 20] points.

The criteria taken into consideration are the following: diminished tree resistance to wind load (the assessment uses percentages based on the stem cross-section tomograph) (0 up to 15 points); presence or absence of one or more tree hollows (0 up to 10 points); tree inclination as opposed to the vertical line (0 up to 15 points); slope (0 up to 10 points); forking in the first half of the tree height (0 up to 20 points); crown asymmetry (0 up to 10 points); crown drying degree (0 up to 10 points); distance from the objective to be protected (buildings, parking lots, alleys,

sidewalks, street cable networks, roads, etc.) (0 up to 15 points); tree height (0 up to 10 points); tree exposed to wind from N, S, E, W direction (0 up to 10 points).

A certain type of action to be taken is recommended depending on the risk class that each tree falls into. For trees in risk class I extraction is recommended, for trees in risk class II crown pruning and tree cabling and bracing are recommended and for trees in risk classes III, IV and V monitoring tree evolution by periodical assessment is recommended.

Keywords: tree stability; sonic tomograph, wood defects, green urban area

WHAT'S NEW IN TREE PROTECTION: VACCINATING TREES AGAINST DISEASES

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A two year field trial was conducted using established pear cv. 'Williams' Bon Chrétien' to assess the efficacy of four commercially available systemic inducing resistance (SIR) agents Rigel (salicylic acid analog) Phusion, (silicon potassium phosphite), Messanger (harpin protein), Bion (Benzo-(1,2,3)-thiadiazole-7-carbothioic acid S-methyl ester (BTH)) applied as a preventative or therapeutic microcapsule trunk injection treatment against the foliar pathogen pear scab (*Venturia pirina*). In addition, a comparative evaluation of a microcapsule trunk injection with the fungicide penconazole used within the UK for pear scab control was conducted. Microinjection with the SIR inducing products or penconazole significantly reduced pear scab severity on leaves and fruit as well as increased leaf colour and yield when applied as a therapeutic and preventative treatment. Greatest effects were however, induced when applied preventatively rather than therapeutically. In this case pear scab severity was reduced by 40–60%. Maximal reductions is scab severity (76–79%) occurred following trunk injection with the synthetic fungicide penconazole. Little difference in the degree of pear scab control was recorded between the SIR agents evaluated. Microcapsule trunk injection with a SIR agent offers potential in the management of pear scab where total control is not required.

Keywords: pathogen control, urban landscapes, plant health care, integrated disease management, fungicides

1. INTRODUCTION

During a growing season ornamental and fruiting pear (*Pyrus* spp) trees are highly susceptible to attack by the foliar pathogen pear scab, (*Venturia pirina*) (Sabri et al. 1997). As UK suppliers, vendors and growers of pears adopt a zero tolerance policy towards scab-scab infection reduces the quality and marketable yield of the fruit. Consequently, the economics of fruit production require frequent foliar applications of synthetic fungicides throughout the growing season. Increasing pathogen insensitivity to synthetic fungicides coupled with public demands to reduce pesticide use, stimulated by greater awareness of environmental and health issues has placed greater emphasis on alternative pathogen control strategies (Percival et al., 2009).

Constitutive and inducible based defence responses help protect trees against pathogen attack. Inducible resistance mechanisms such as systemic induced resistance (SIR) can be acquired biologically by challenging a plant with a weaker strain of a specific pathogen or exposing a plant to natural and/or synthetic compounds. Products that induce resistance may be useful in the management of pear scab where it is difficult to control these pathogens with protectant fungicides on rapidly expanding leaves and fruit. SIR products such as Messenger (harpin protein) Bion (BTH), Phusion (silicon potassium phosphite) and Rigel (salicyclic acid analog) are registered for commercial use within the horticultural industry although their availability differs between countries. Several studies indicate these SIR compounds useful in the management of several fungal pathogens with the level of pathogen suppression, on occasion, comparable with synthetic fungicides (Percival and Banks 2014). Consequently, induced resistance could potentially substitute for or supplement control by conventional synthetic fungicides.

Trunk injection for the application of plant protective compounds allows precise and confined delivery to trees that is considered an environmentally safer alternative for pesticide application, which utilizes a tree's vascular system to translocate and distribute active substances into the canopy (Aćimović et al., 2015). Tree injection developed primarily because conventional spray systems used for chemical application can result in soil contamination and aerial drift to non-targets. Trunk injection technology has increased due to the development and availability of injectable compound formulations and new injection devices (VanWoerkom

et al., 2014). The influence of SIR agents applied via trunk injection has little been studied (Aćimović et al., 2015)

Objectives of this study were to investigate the efficacy of four commercially available SIR compounds on controlling pear (*Venturia pirina*) scab under field conditions when applied as a preventative or therapeutic microcapsule trunk injection treatments.

2. MATERIALS AND METHODS

2.1. Field Site

Trials were carried out over two seasons commencing in 2014. The pear trial site consisted of a 1.5 ha block of *Pyrus communis* 'Williams' Bon Chrétien' interspersed with individual trees of *Pyrus communis* Beth and Concorde as pollinators. Planting distances were based on a 2 by 2 m spacing. The trees were planted in 1979 and trained under the central-leader system to an average height of 2 m ± 0.2 m with mean butt diameters of 33 cm ± 5cm. The trial site was located at the Bartlett Tree Research Laboratory, Shinfield Experimental Site, University of Reading, Berkshire. Historically the trees suffered heavily from pear scab infection on a annual basis. Consequently prior to the trial commencing in 2014 trees were inspected in September 2013 and only those trees visually rated with 50–80% of leaves affected, representing severe foliar discolouration and subsequent pear scab infection were used in the trials.

2.2 Microcapsule treatment

Empty microcapsules (Tree Tech Microinjection Systems, Morriston, Florida, USA) were filled with either one of four SIR products (Messanger (active substance (a.s.) Harpin protein), Phusion (a.s. silicon potassium phosphite), Rigel (a.s. salicylic acid analog), Bion (a.s. BTH)). A synthetic fungicide (Topas (a.s. penconazole)) was used for comparative purposes and a water only injection acted as a control. Capsules were calibrated so that each tree received 0.5g a.s. per 25 mm of girth with the exception of harpin protein that based on discussions with manufacturers received 0.07g a.s. per 25 mm of girth. Once the relevant volume of product had

been applied distilled water was added so bring the final volume of each microcapsule to 50 ml. One microcapsule was applied every 50 mm of diameter by drilling a 3 mm hole at the base of the tree into the root flare to a depth of 5 mm. Microcapules were then inserted into each pre-drilled hole and pressurized to 10 p.s.i by hand by pressing on the microcapsule pressurization lid in accordance with the application instructions contained in the Tree Tech microcapsule instruction manual (http://treetech.net/). Empty capsules were then discarded once the product solution had been injected. Treatments were injected at bud break *ca.* 21 March 2014 (preventative i.e. before the visible appearance of pear scab) or July 15 2014 when 5–20% of leaves were affected with pear scab i.e. some yellowing but little or no defoliation (therapeutic).

2.3 Pear scab severity

Scab severity of leaves and fruit was assessed visually commencing on September 26 2014 and September 23 2015. Leaf scab severity of each tree was rated using a visual indexing technique and ratings on the scale: 0 = No scab observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 6–20% of leaves affected with some yellowing but little or no defoliation; 3 = 21–50% of leaves affected, significant defoliation and/or leaf yellowing; 4 = 51–80% of leaves affected, severe foliar discolouration; 5 = 81–100% of leaves affected with 90–100% defoliation. Scab severity on fruit was calculated on the scale: 0 = no visible lesions; 1 = <10% fruit surface infected; 2 = 10–25% fruit surface infected; 3 = 25–50% fruit surface infected; 4 = >50% fruit surface infected. The individual ratings for each tree in each treatment were used as a measure of scab severity for statistical analysis. Leaf and fruit scab severity ratings used in this study was based on UK and Ireland market standards for fungicide evaluation of scab control (Swait and Butt, 1990).

2.4 Yield

Yield per tree was determined by weighing all fruit on each tree at harvest and dividing by the number of trees per treatment.

2.5 Leaf chlorophyll measurements

To keep the physiological age of the leaves comparable throughout the experiment, measurements of chlorophyll content (SPAD) were made only on fully expanded mature leaves. In all cases SPAD measurements were taken from six leaves (two from the top of the crown, two in the centre and two at the base) per tree. A Minolta chlorophyll meter SPAD-502 was used. Chlorophyll was measured at the mid point of the leaf next to the main leaf vein. Calibration was obtained by measurement of absorbance at 663 and 645 nm in a spectrophotometer (PU8800 Pye Unicam) after extraction with 80% v/v aqueous acetone (regr. eq. = 5.58 + 0.053x; r^2 adj = 0.94, P=<0.001) (Lichtenthaler and Wellburn, 1983).

2.6 Statistical Analysis

Mean scab severity values for all treatments were transformed using the Arcsin (sine $^{-1}$) transformation. All data were analyzed using ANOVA and the differences between means were determined using Tukey *w* procedure (*P* = 0.05) using the Genstat for Windows program. Back transformed values are presented here to ease interpretation of these data.

3. RESULTS

For reasons of clarity only data for the 2014 trial is shown. Results of the 2014 trials reflect those obtained for the 2015 trial. Damaging outbreaks of pear scab were recorded on control trees as indicated by high scab severity rating on leaves and fruit of *Pyrus* cv. 'Williams' Bon Chrétien' at the cessation of the 2014 growing season (Tables 1–2). During the study, none of the treated or control trees died as a result of scab attack. None of the SIR agents and fungicide evaluated was phytotoxic to the test trees (data not shown). Microinjection with the SIR inducingagents or the synthetic fungicide penconazole reduced leaf and fruit scab severity and increased estimated leaf chlorophyll content (SPAD) and yield at the cessation of the growing season when applied both as a therapeutic or preventative remedy (Tables 1–2). In all cases greatest reductions (40–60%) in leaf and fruit scab severity were, however, recorded when SIR agents were applied preventatively rather than

therapeutically. Similarly greatest increases (40–60%) in SPAD and yield at the cessation of the growing season recorded when SIR agents were applied preventatively rather than therapeutically. Irrespective of whether applied preventatively or therapeutically there was little difference in efficacy against pear scab recorded between the SIR agents evaluated (Tables 1–2).

In all cases maximal reductions in leaf and fruit scab severity (75–79%) occurred following microcapsule trunk injection with the synthetic fungicide penconazole. Likewise greatest increases in SPAD (62%) and yield (60%) at the cessation of the growing season occurred following microcapsule trunk injection with the synthetic fungicide penconazole (Tables 1–2).

4. DISCUSSION

Previous research indicates that most induced-resistance products evaluated for pathogen control can provide a significant reduction in severity of fungal, bacterial and viral pathogens. However, reductions in pathogen severity tend to be less effective than that achieved with conventional synthetic chemicals, and less consistent (Aćimović et al., 2015; Percival and Banks, 2014). Results of this study reflect previous ones as in the field trials undertaken, the synthetic fungicide penconazole was the most effective in reducing in pear scab severity of leaves and fruit as well as enhancing leaf colur and fruit yield. However, it is important to emphasise development of strains of *V. pirina* resistant to triazole fungicides could limit the effectiveness of this technique with time (Agostini, 2003; Percival and Noviss, 2010; VanWoerkom et al., 2014).

Results of this study also show that salicylic acid, BTH and harpin protein when applied as a preventative treatment at bud break provided a significant degree (40–60%) of protection against pear scab infection of fruit and leaves.

Harpin protein is a naturally occurring bacterial protein present in several plant pathogenic bacteria to include *Erwinia amylovora* responsible for fireblight in pears. Evaluation of the harpin protein as an inducer of plant resistance has been shown to reduce severity of *Botrytis cinerea* on leaves and fruit of several pepper cultivars (Akbudak 2006). Agostini (2003) evaluated the influence of harpin protein on enhanced resistance of potted lemon seedlings against citrus scab (*Elsinoe*

fawcettii), grapefruit against melanose (*Diaporthe citri*) and Dancy tangerine against *Alternaria* brown spot (*Alternaria alternata* pv. *citri*.) In the case of citrus scab, harpin protein provided a significant degree of control in some studies but not others with the efficacy of the product influenced by plant phenology and weather conditions. Research by Percival et al (2009) found harpin protein to provide a useful degree of control against apple and pear scab when applied at least four times across a growing season, with sprays aimed to coincide with distinct phenological stages (bud break, green cluster, 90% petal fall, early fruitlet). Previous research has also demonstrated the salicylic acid analog and harpin protein used in this study successfully inhibited germination of apple scab conidia, subsequent formation of appressoria and reduced leaf scab severity (Percival 2009). In agreement with results of this study salicylic acid and BTH are widely recognised as an inducer of SIR resistance when applied to plants as a foliar spray and/or soil drench (Percival and Banks 2015; Sparla et al., 2004; Enyedi and Raskin 1993) and shown to be effective in reducing disease incidence against several key woody plant pathogens to include powdery mildew, mosaic virus, fire blight (*Erwinia amylovora*), and *Phytophthora spp*.

The use of inorganic phosphite salts as plant protection products has become a common practice within the agricultural and orchard industry where *Phytophthora* diseases are problematic. Likewise, phosphites have been shown to be effective when applied for the suppression of *Pythium*, downy mildew (Jackson et al., 2000; Miller et al., 2006; Wilkinson et al., 2001), fire blight (*Erwinia amylovora*) and potato scab – *Streptomyces scabies* (Lobato et al., 2010). Work has also demonstrated foliar sprays of phosphites can reduce severity of fungal pathogens such as apple (*Venturia inaequalis*) and pear scab (*V. pirina*) under field conditions (Percival et al., 2009).

In conclusion, results of this investigation indicate that microcapsule trunk injections of harpin protein, salicylic acid, silicon potassium phosphite or BTH offer potential as a management strategy to suppress pear scab under field conditions where a zero policy of scab infection is not required. Where a zero scab policy is adopted then application with conventional synthetic fungicides would be required (VanWoerkom et al., 2014). Likewise although induced resistance products are not totally effective for scab control, they may be useful in an integrated program with standard fungicides (Percival and Noviss, 2010).

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Table 1: Effect of SIR and fungicide products on leaf and fruit scab severity and yield of pear cv. 'Williams' Bon Chrétien' when applied as a therapeutic treatment.

Treatment	Pear scab severity on leaves[z]	Pear scab severity on fruit[z]	Pear scab SPAD[z]	Pear scab Yield/tree (kg)[z]
Water (control)	3.5a	2.3a	34.1a	5.4a
Harpin protein	2.8b	1.9bc	40.2b	6.0a
Silicon potassium phosphite	2.8b	2.0ab	39.7b	5.9a
BTH	2.6b	1.8bc	41.0b	6.1a
Salicylic acid analog	2.7b	1.8bc	40.8b	6.2a
Penconazole	2.5b	1.6bc	42.1b	5.5a

Significant differences from control by Tukey highly significance test ($P = 0.05$).

[y]Scab severity index: 0 = No scab observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 5–20% of leaves affected with some yellowing but little or no defoliation; 3 = 21–50% of leaves affected, significant defoliation and/or leaf yellowing; 4 = 51–80% of leaves affected, severe foliar discolouration; 5 = 81–100% of foliage affected with 90–100% defoliation.

[z]Mean of ten randomized complete blocks with a single tree per block.

Lower case letters indicate significant differences between means for each evaluation date by Tukey highly significance test ($P = 0.05$).

Table 2: Effect of SIR and fungicide products on leaf and fruit scab severity and yield of pear cv. 'Williams' Bon Chrétien' when applied as a preventative treatment.

Treatment	Pear scab severity on leaves[z]	Pear scab severity on fruit[z]	Pear scab SPAD[z]	Pear scab Yield/tree (kg)[z]
Water (control)	3.3a	2.1a	30.1a	5.0a
Harpin protein	1.4b	0.9b	43.5b	6.9b
Silicon potassium phosphite	1.3b	0.8b	46.7b	7.8bc
BTH	1.4b	0.8b	44.2b	7.5b
Salicylic acid analog	1.0bc	0.8b	45.0b	7.5b
Penconazole	0.7c	0.5c	48.8b	8.0b

Significant differences from control by Tukey highly significance test ($P = 0.05$).

[y]Scab severity index: 0 = No scab observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 5–20% of leaves affected with some yellowing but little or no defoliation; 3 = 21–50% of leaves affected, significant defoliation and/or leaf yellowing; 4 = 51–80% of leaves affected, severe foliar discolouration; 5 = 81–100% of foliage affected with 90–100% defoliation.

[z]Mean of ten randomized complete blocks with a single tree per block.

Lower case letters indicate significant differences between means for each evaluation date by Tukey highly significance test ($P = 0.05$).

UNDERSTANDING TREE BIOMECHANICS AND WIND LOADS

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Wood anatomical properties determine both mechanical properties and thus tree-stability as well as results of all technical diagnostic methods. In this sense, conifer wood has many opposite properties as compared to wood of ring-porous trees. The wood of diffuse porous trees is comparatively more homogenous but identification of incipient decay is more difficult.

Tree-stability and thus safety, however, depends more on geometrical aspects (height, diameter) than on wood material properties. This leads to several conclusions important for tree-safety experts because commonly applied practices show to be inappropriate and further more a waste of time and money. When applying the basic understanding of tree-biomechanical principles, the results is far less pruning than commonly applied.

Keywords: mechanical properties, tree stability, technical diagnostic methods, tree-biomechanical principles

A REVIEW OF AUTOMATED TECHNIQUES IN FOREST PRODUCTIVITY STUDIES

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In the last decade modern technology has become widely spread in all activity domains including forestry. Modern tools and equipment such as G.P.S receivers, sensors, electronic measurement systems and dedicated software make it possible the delivery of real time information that enables a better and more accurate decision making process. Furthermore, the automated techniques used in different scenarios have the potential to make the productivity studies easier than ever. This review is based on a literature research that aimed to quantify the type and applicability extent of different kind of equipment used in the forest productivity studies emphasizing at the same time the importance of such equipment, tools and techniques.

Keywords: modern technology, literature research, productivity studies

FIRST RESULTS OF CHAINSAW ACCIDENTS ANALYSIS IN ANDALUSIA

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In spite of technological advances, forestry tasks continue to be an important source of risks. Many of these occupational risks are linked to hazardous equipment as chainsaw. However, there are not minimum compulsory specifications about the occupational training of the workers affected in Spain and other European countries. In order to define the minimum competencies and skills for chainsaw operators a previous accident analysis is necessary. In this research, we have analyzed all labor accidents occurred to these operators in Andalusia during the period 2009-2013. These Accidents were notified using the Official Workplace Accident Notification Form. A descriptive analysis of all accident variables included in the Official Form were performed using SPSS 22. Results showed that the most common accidents profile linked to the use of chain-saw is a male worker, between 30-49 years old, in a company with more than 25 workers, employed for a specific project or service, with a length of service less than 1 year, caused as consequence of loss of machinery control, with consequences of serious wounds in legs, arms, or fingers. As other previous research from Robb and Cocking (2014), the inexperience is a very important factor in chainsaw accidents. Similarly they pointed arms and legs as the most affected body parts when a chainsaw accident occurs. These results are useful in order to promote new occupational safety standards about the use of chainsaw.

Keywords: chainsaw, accident, occupational health and safety, assessment

HAZARD AND DANGER TREE CUTTING
HANGS AND SNAGS 1

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Dwayne Neustaeter, President of Arboriculture Canada Training and Education will introduce techniques for cutting free hung or snagged trees. The importance of planning will be discussed and examined using the 5-15-90 rule as justification behind the methodology. Techniques will emphasize safety and control by employing strategies that utilize distance to improve safety. The significance of risk and proximity is made clear in this hung or snagged tree cutting presentation.

Keywords: tree, cutting, safety, control, hung and snagged

HAZARD AND DANGER TREE CUTTING
HANGS AND SNAGS 2

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Dwayne Neustaeter, President of Arboriculture Canada Training and Education will introduce accelerated teaching techniques while presenting how cut free hung or snagged trees. Learn how simple techniques that make learning fun and therefore more effective, these techniques also improves learners retention. The ´Data doesen't Matta' concept is examined and the significance of context versus content explained.

Key words: accelerated learning, content, context, Data doesn't Matta

TIME CONSUMPTION AND PRODUCTIVITY OF CHAINSAW MANUAL HARVESTING OF RESINOUS SPECIES IN ROMANIA

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Manual harvesting with chainsaw felling and a group based cable skidder is still the most commonly used system in Romanian mountainous areas. This paper presents time consumption and Husqvarna 365 chainsaw productivity in harvesting resinous trees. This information is necessary for planning certain activities (establishing the amount of equipment and the number of work teams) in such a way that they would not exceed the period of time allowed by the law and that they would comply with the working conditions from each felling area. The research was conducted in the Romanian Southern Carpathians, in two mixed spruce (*Picea abies* L. Karst.) and fir (*Abies alba* Mill.) tree stands (S1 and S2). Only one team of workers, made up of a feller and an assistant, was used in the felling operation. This was divided into nine specific stages for which work times were measured. The results indicated a productivity of 10.138 $m^3 \cdot h^{-1}$ in S1 and of 11.374 $m^3 \cdot h^{-1}$ in S2. Work time structure was WP (workplace time) 88.61% and NW (non-workplace time) 11.39% in S1 and WP 83.77% and NW 16.23% in S2. The results obtained showed that the relationship between productivity and *dbh* can be described using power, exponential and linear functions (R^2 = 0.65 to 0.67 in S1 and R^2 = 0.81 to 0.92 in S2). Productivity is also influenced by stump diameter and the distance between trees. Their influence on productivity was emphasized by linear regression equations.

Keywords: harvesting systems; Husqvarna chainsaw; productivity; resinous forest

TREE STABILITY TO TREE SAFETY TECHNICAL DIAGNOSTICS: OVERVIEW, POSSIBILITIES AND LIMITATIONS

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All commonly applied diagnostic methods for technical tree-safety inspections measure specific properties of the wood. Unfortunately, the two most common methods, resistance drilling and sonic tomography, are largely misunderstood and the measured results are often misinterpreted, leading to inappropriate recommendations of what should be done with defected trees.

Before understanding the real principles of these methods and prior to be able to realise the possibilities and limitations, wood anatomy and tree-biomechanics have to be studied in the same depth as the technical properties of the applied methods. In contrary to what most arborists believe, sonic tomography, for example, does not and cannot in principle reveal wood condition. It shows something completely different **t**hat is even more important than wood condition. Similarly, most people do not know about the huge differences between the profiles of the various kinds of resistance drilling devices and many do not know how to compare and to interpret these curves correctly.

Pull-tests are even more complicated and lead to corresponding erroneous results when not fully understood.

Keywords: tree stability, tree safety, drilling devices

ABSTRACTS OF POSTERS

BIOMASS PRODUCTION USING LANDFILL LEACHATE AS A NATURAL FERTILIZER ON ENERGETIC POPLAR IN SRC SYSTEM

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Biomass production, carbon storage and waste management are the main environmental worldwide problems. This paper proposed an integrated method for efficient and low cost management of liquid waste, in this case, landfill leachate, concomitant with its using as a natural fertilizer for energetic poplar in SRC (Short Rotation Culture) system, because it can be an important source of nitrogen and other nutrients, for plant growth. The aim of this study was twofold: on the one hand, to determine the range of values of no-toxic effect concentration (NOEC) and the lowest effective concentration causing toxic effects (LOEC) for leachate, on the other hand to gauge the growth of biomass in two consecutive processes. We took into account the landfill leachate phytotoxicity quantified by appearance of buds, number of leaves, leaf fractal dimensions and evapo-perspiration process on poplar sprouts, exposed at five different concentrations of leachate solution (0%; 6.25%; 12.5%; 25%; 50%; 100%) in 3 replicates, during 6 weeks. After having established the LOEC values between 4.95% and 6.5% or the leachate concentration that doesn't produce any toxic effects on the plant growth we have observed that poplar sprouts grow much better, compared to the ones that have been kept in water at lower concentrations, due to the proper amount nitrogen contained by the leachate. At higher concentrations the leachate turns to be toxic and cannot be used as fertilizer.

Keywords: biomass, poplar, phytotoxicity, landfill leachate, waste

ARBORICULTURE AND URBAN FORESTRY – NEW ACCREDITED STUDY PROGRAMME AT THE FACULTY OF FORESTRY AT THE TECHNICAL UNIVERSITY IN ZVOLEN

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Faculty of Forestry, Technical University in Zvolen, opens new accredited bachelor's degree study programme "Arboriculture and Urban Forestry".The aim of the study branch is to provide the students with knowledge and skills towards the detailed knowledge of trees and plants, as an essential element of ecosystems.

Graduates are able to assess each function of trees and take decisive action to improve their condition. They can arrange and evaluate the chain of steps from establishing plantations of fast-growing trees, caring for them until their complex processing from the biomass production aspect. Graduate profile is based on the completing the courses aimed at the detailed knowledge of trees and woody plants in general, not only as a core element of forest ecosystems, but as a significant determinant of open landscape and urban communities, as well. In addition to basic preparatory courses the study involves detailed theoretical and practical knowledge and acceptance of the plants from the taxonomic point of view (including the most common cultivars) basic physiological processes, a thorough understanding of disorders, diseases and pests, including diagnostics, stability and mechanical characteristics of trees, knowledge of relevant legislation, and technology used for tree care, operation of a business entity, but also knowledge of the issue of conceptual management of trees in cities. In the urban forestry the attention will be paid to the issue of establishing plantations of fast-growing trees, complex utilization of biomass, biofuels, harvesting and transportation technologies.

Graduates of the "Arboriculture and Urban Forestry" are prepared for performance analysis, evaluation, design, implementation, administration and assessment activities:

- in state, public and local government,

- in state or private bodies dealing with the issue of Arboriculture and biomass in positions where higher education is required,
- in state and nature conservation,
- in lower teaching positions,
- in research into trees and expert assessments.

The accredited programme of study will be carried out in the full-time and part-time forms of a three-year bachelor's degree study programme. After successful completion of study the graduate will be awarded a bachelor's degree (Bc.).

Keywords: arboriculture, urban forestry, new accredited program, profile and job, opportunities for graduates

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GlobalArborist.com helps connect people in the Arboriculture Industry who are looking for work internationally and locally. By creating and sharing job seeker profiles, the particular skills and experience are linked to job advertisements. This type of exposure can open up full-time or part-time employment opportunities, specialist jobs or training roles anywhere in the world. Companies looking for particular skilled Arborists have the benefit of listing required training and qualifications. The job seeker profiles are then linked to the matching jobs and thereby creating a higher rate of appropriate applicants. GlobalArborist.com also provides helpful information on how the industry may vary in different countries such as standards, practices and qualifications. Plus information to help with relocating like traveling with equipment tips and different visa processes.

‘I’v been so lucky to have travelled as much as I have as a climbing Arborist. 8 years ago when I first began my studies in Arboriculture, I wouldn’t have known that working in this industry could give me these types of work and travel opportunities. I created GlobalArborist.com to help others find there own international Arborist experience. The benefits for both individuals wanting to work and travel and companies looking to take on foreign workers are huge.’ - Jack Balsamo creator of GlobalArborist.com

Keywords: arboriculture, jobs, travel, industry information

LET'S CUT ILLEGAL LOGGING IN ROMANIA – FUTURE PERSPECTIVES FORHEALTHIER FORESTS

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What has characterized, both conceptual and behavioural, the last two centuries, was the man trying to dominate nature, exploit and avail himself of all natural resources, regardless of location, extent or their specific. The effect of these human attitudes was the progressive emphasis of the conflict between natural cyclical processes of the ecosphere and linear technologies created and sustained by human civilization. From this point of view, Romania is facing serious problems, especially in what concerns illegal logging. Despite the national legislation and international treaties signed by our country, the results of the latest ratings and reports are not encouraging. Our impression is that Romanian forests could be healthier if we can combine legislation with the real involvement of those who believe in our environment. That is why we made a lege ferenda proposal that could have results in our country. In our proposal we talk about developing the Romanian Forest Police, with clearly defined attributions of those involved in investigating forest crimes and real sanctions for forest crimes. These institutions would be helped by a special public audit service with competences only on forest institutions, both superior and inferior.

Keywords: Human attitude, illegal logging, Romanian legislation, lege ferenda proposal, changes

BIOLOGICAL TOOLS AGAINST WOOD DECAY FUNGI

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The main responsible of the decay occurring in trees are fungi; they could take advantages of the conditions in which many trees live in our cities. Decay in standing trees is a problem concerning human safety, urban ecology and economic losses.
Trees have inner mechanism to contrast fungi, but once the decay process is established, it is irreversible. Trees and fungi start living together.
In this investigation, we conduct a study and a characterization of different wood decay fungi that affected tree in urban areas. The aim is to know the population distribution of the main genus present in our cities and conduct a compared analysis of their population structure.
A possibility to control them could come from biocontrol: using other organism to provide an effective and safer control. Several microorganisms have been used as bio-resource for biotechnological processes.
Among soil – borne microorganism, *Trichoderma* spp. have been widely studied and proposed as biological control agent.
Trichoderma species are currently used in a wide range of commercial applications in combination with other active ingredients, especially used as plant growth promoter in agriculture and horticulture. Their importance in the biocontrol process depends on different aspects as: Trichoderma strain, antagonized fungus, crop plant, environmental conditions (nutrient availability, pH, temperature and iron concentration…).
Trichoderma spp. are free – living fungi that are interactive in root, soil and foliar environments: they based their competitiveness on different aspects: high reproductive capacity, fast-growing on most organic matter, they can survive under unfavourable conditions; moreover, they can act as mycoparasitism agent, parasitizing a great range of other fungi. *Trichoderma* is known to act as plant–growth–promoter and induce resistance in plants.
Trichoderma is not so commonly used in urban environment.

The innovative aspect connected with the use of *Trichoderma* would be a specific application after the characterization of the antagonist potential of different strains.
The genus consists of many species (89, as said in the previous paragraph); because of the biodiversity inside the genus, it very important to conduct a screening of the different *Trichoderma* species, based on genetic tools.
It is fundamental also to consider the environment in which a specific *Trichoderma* strain is isolated. Once obtain a database with the different genetic profile of the fungi, the selection of the specific antagonist would be possible; after identifying a competitive strain, this can be used for the treatment against fungal diseases.
In our cities, this methodology might be used with urban trees: a specific strain could be applied as plant growth promoter in case of young trees; for old and monumental trees, the application of *Trichoderma* could be interesting as biological control agent in order to contrast the processes of wood decay due to pathogen fungi. The consequences would be a reduction of chemicals and a long lasting tree-lined avenue with both environmental and economic benefits.

Keywords: fungi biocontrol biotecnology trees arboriculture

BIBIO MARCI L. (*DIPTERA: BIBIONIDAE*): AS A NEW INSECT PEST OF RASPBERRY PLANTATIONS IN WEST BULGARIA

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Bibionids founded in Europe mainly inhabit the forest edges and there where the presence of organic matter is located. They are sporadic and irregular pests. Although under certain stress conditions, a wide range of crops may be attacked. The St. Mark's fly, *Bibio marci* (Linnaeus 1758) was noticed on raspberry plants, *Rubus idaeus* (Linnaeus 1753) in West Bulgaria. The adults were collected from raspberry plants during the growing seasons from April to June of 2015 and 2016.The adult was identified as *Bibio marci* based on the morphological characters and taxonomic key of this species. This study represents the first report of *Bibio marci* as a new insect pest attacking raspberry plantations in Bulgaria.

Keywords: *Rubus idaeus*, *Bibio marci*, pest status

NON-DESTRUCTIVE TECHNIQUES FOR CONTROL OF PERSONAL PROTECTIVE EQUIPMENT AGAINST FALLS FROM A HEIGHT

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This research is aimed at assessing the possibility of using current methods of non-destructive material testing, inspection and revision of personal protection equipment (PPE) for working at heights.

The aim is to propose (based on assessment of used non-destructive methods of material testing) a method that can be used for the control and revision of equipment for personal protection and work at heights.

This research will therefore discuss various methods of non-destructive testing of materials such as capillary defectoscopy etc. Penetration testing is a non-destructive method used in the detection of surface open cracks and discontinuities of various shapes and sizes, and in all non-porous metallic, but also non-metallic materials (e.g. copper, aluminium, ceramics, glass, rubber, plastics, etc.). Furthermore, this research will examine the possibility of using ultrasonic flaw detection for PPE control. The ultrasonic testing method is based on changes in transmittance and reflectance of ultrasonic waves due to the discontinuities of the material. Ultrasound, as well as sound and noise, are mechanical vibrations of particles around the equilibrium position moving within a flexible environment. The frequency range of ultrasonic vibrations is outside the audible range, i.e. more than 20kHz. For the purposes of flaw detection the frequencies which are commonly are found within the range of 100 kHz to 50 MHz, exceptionally up to 200MHz. This research will also assess the suitability of using visual inspection methods, both direct, and through a microscope. Direct visual inspection is one of the oldest commonly practiced diagnostics methods. Its low time-consumption, and especially the low price usually ranks it above defectoscopic methods in terms of availability. It is performed by the naked eye or through a magnifying glass.

Based on the evaluation of different methods, a detailed methodology of PPE inspection will be developed, and upon completion will be available for practice.

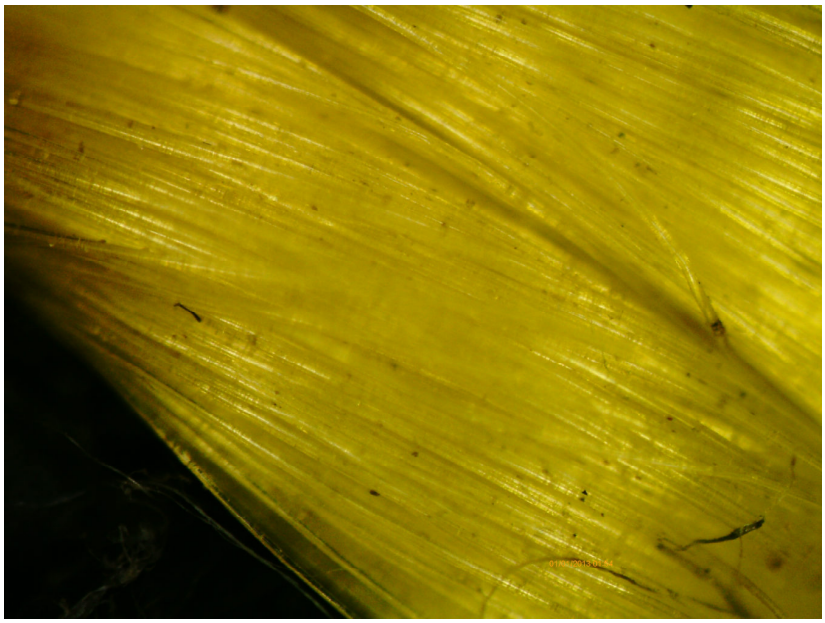

Figure 1: Prusik knot undamaged fibers (magnification 100x)
Source: Pavel Nevrkla

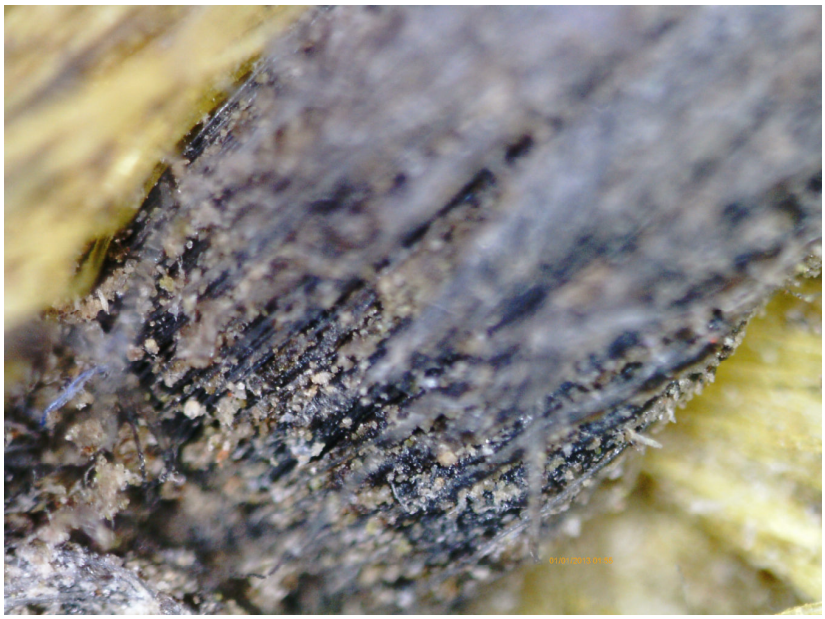

Figure 2: Prusik knot fibers thermally degraded (magnification 100x)
Source: Pavel Nevrkla

Keywords: non-destructive testing, penetration testing, ultrasonic testing

ERASMUS + & ABA INTERNATIONAL 'VET-SAFETY' PROJECT

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The non-profit umbrella body Awarding Body Association International (ABA) was formed by education and vocational training partners in 2012. This followed their successful development of the European Chainsaw Certificate (ECC) and subsequently the European Lifting Equipment Certificate (LOLER) which are now both recognised international awards. Core to the mission of ABA is the promotion and recognition of skilled operator's certification internationally helping to remove potential barriers to employment and mobility whilst at the same time, improving safety standards for these individuals.

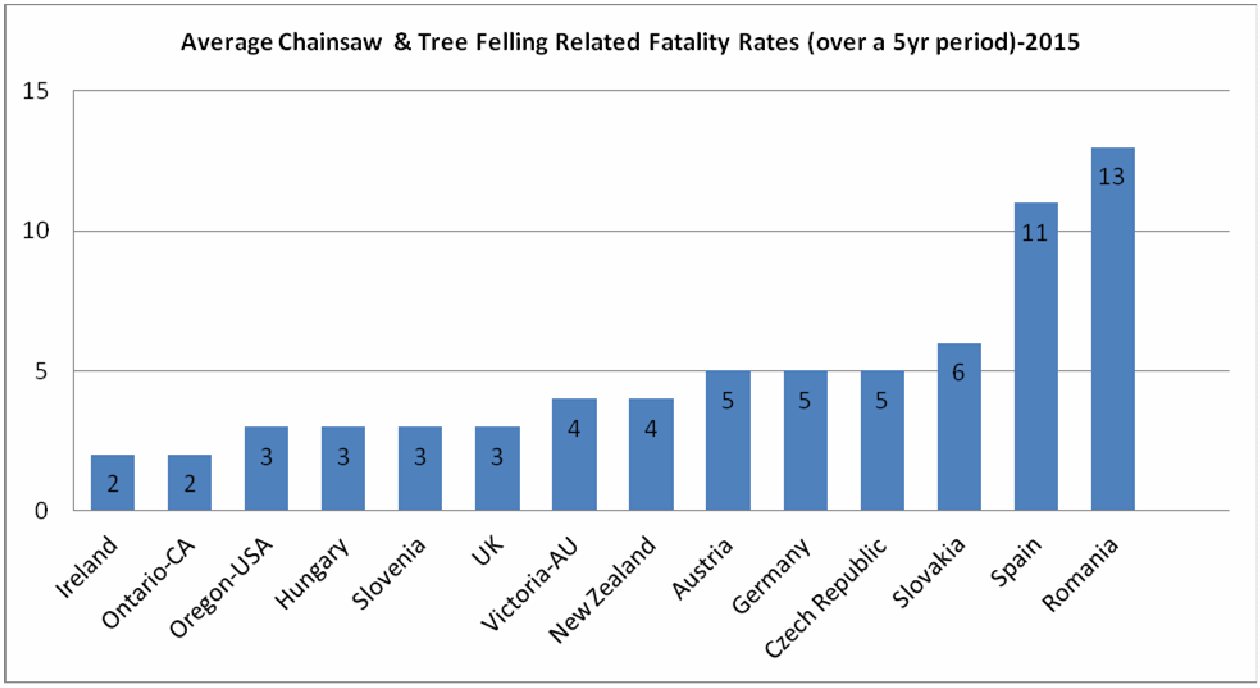

Figure 1: Current 'Vet-Safety' research has highlighted incidence rates to skilled chainsaw operators on an international level based on a review of national statistics
Source: William Robb

A current project ABA is involved in which is co-funded by the Erasmus + programme is Vocational Education and Training Standards in Agriculture, Forestry and Environmental Safety at Heights 'Vet-Safety'. Within these 'Vet-Safety' skill sectors many of the major injuries and fatalities to skilled operators occur due to falls from heights. In order to help reduce accidents in this sector ABA is supporting the project in the development of new international standards for training and certification but not only for candidates but also skills instructors and assessors.

Table 1: Falls from a height - national statistics 2011-2012

Source: William Robb

COUNTRY	FATALITIES	INJURIES
France	47	18,970
United Kingdom	40	7,960

Currently over 100 accredited certifications have been issued by ABA to instructors and assessors representing educational and training centres from over sixteen different countries. All have been independently examined to rigorous international standards under the supervision of experienced specialists. ABA is also developing four new international work at height qualifications for both operators and instructors which are due for completion in September 2017. The project results and its successful impact will be sustained by the organisation into the future, rolled out into more centres, countries internationally and continuously updated.

Erasmus+

This project co-funded by Erasmus + has been carried out with the support of the European Community. The content of this project does not necessarily reflect the position of the European Community or the National Agency, nor does it involve any responsibility on their part.

ATTACHMENTS


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