UNIVERSITY OF WEST HUNGARY
Roth Gyula Doctoral School of Forestry and Game Management
Forestry Mechanics Programme

THESES OF DOCTORAL (PHD) DISSERTATION

TREE UTILIZATION WITH HARVESTERS IN DOMESTIC HARDWOOD STANDS

ATTILA LÁSZLÓ HORVÁTH
M.Sc. forestry engineer, teacher

Scientific advisor:
Prof. Dr. Béla Horváth
university professor

Sopron
2015

TABLE OF CONTENTS OUTLINE

1. IMPORTANCE OF THE RESEACH TOPIC

The use of highly sophisticated equipment and software has become an everyday experience in all walks of life by nowadays. This applies to tree utilization also. The planned logging of forest stands and the well-considered marketing of the timber, grown during the long decades is indispensable.

As a result of significant technical development, motor-manual logging was substituted by mechanized harvesting, while automated harvesting is also becoming more and more common. Tree harvesting, being one of the most dangerous professions, has been struggling with the lack of professional manpower recently. All of these facts reason the increasing application of multi-operational logging machines. A highly-mechanized harvesting system together with a well-established IT network could be capable of delivering real-time data on the actual stand of harvesting, which can be highly advantegous respecting logistics and marketing. Moreover, labour with harvesters is safer and more ergonomic.

With the introduction of harvesters a new type of harvesting system (Cut To Length, CTL) was also established. With this new working system harvesters produce the desired assortments right next to the logged trees. The obligatory co-worker of a harvesters is the forwarder. The biggest advantage of this joint system is that no additional equipment or workforce is required. Two workers using two machines are capable of logging the forest stand and forwarding the timber next to a weather-safe road. Since the introduction of combined machines this can further be reduced to one operator and one machine. Purchase price and operational costs of these equipment are rather high, yet compared to traditional logging methods they are capable of 5 to 10 fold higher performance.

Multi-operational logging machines have been developed continuously since the 1960s. They were primarily designed for harvesting softwood stands, but as a result of extensive technical development and increasing economical demands, harvesters are more and more applied in hardwood stands, too. Significant international research has been done on the development of harvester heads which can cope with bent stems and thick branches.

These multi-operational logging machines are already present in Hungary, yet only in a low number. Despite of a negative attitude and judgment, these machines find their role in domestic loggings, as they cannot only work in softwood but also in hardwood stands.

The comprehensive investigation of these machines has become necessary. The diversified forest composition of Hungary represents a challenge to timber producers, as they cannot rely on the results of national research data and scientific literature, only on their intuitions and expectations. In this respect the investigation of the performance of multi-operational logging machines in domestic hardwood stands is indispensable. Basing on scientific data it must be decided if the work carried out by harvesters in domestic hardwood stands in justified well enough iin terms of ecological and economic respects.

2. AIMS OF THE RESEARCH

The author has already been convinced in his student days that the harvesters used in softwood stands could be also utilized in hardwood forests. This idea was primarily to be applied for stands of poplar clones and alder, mainly because these species have a stem geometry and branching system similar to that of spruce. Nevertheless, black locust and beech forests, consisting of fairly straight trunks were also among the targeted stands. The time of the introduction and slow spreading of harvesters in domestic loggings coincided with the beginning of the author's doctoral act.

At the beginning of his research the author has set himself the following aims:

- estimation of the number of harvesters currently in use in Hungary, setting up a database;
- assessment of the volume of timber produced by harvesters working at state-owned forestry companies;
- application possibilities of multi-operational logging machines in domestic forest stands;
- revealing of the factors influencing the throughput of mechanized logging;
- investigation of the role of stem bending, branchiness, and tree forks as cost-affecting and performance-decreasing problems; finding solutions;
- estimation of the operating costs of the machines;
- establishment of multivariate power functions for the preliminary estimation of the cycle time, specific time requirements and performance;
- preparation of norm tables which will be of help to experts for planning the logging with harvesters;
- presentation of the advantages and disadvantages of the mechanized logging working system; comparison with traditional logging practices;
- setting up 3D models for the presentation of the different modes of working with harvesters for education purposes;
- estimation of the future number of harvesters;
- improvement of the domestic judgment and acceptance of multi-operational logging machines and their work.

3. APPLIED METHODS

The author has thoroughly studied the applying national and international scientific literature. Only a limited number of literature resources are currently available in Hungarian language on the state-of-the-art harvesters, as they have not been yet used in our country.
Although, some literature can be found on earlier versions of harvesters operating in the 80's in Hungarian softwood and poplar clone stands, primarily with experimenting purposes. These resources served for the author primarily as a basis for the overview of the evolution of logging machines.

By personal communication, telephone calls and questionnaire surveys the author has assessed the number and main characteristics of the harvesters which are in the possession of Hungarian companies.

The assessment of the volume of timber produced by harvesters working at state-owned forestry companies was carried out by the use of table questionnaires. The grouping of data was done broken down by year, wood species, and tree utilization mode.

The author carried out field investigations in order to estimate the labor of the harvesters in various forest stands logged with different tree utilization modes. Data collection was done by the use of a stop-watch, field records, pen and a tape-measure. The types of the operations, wood species, volume of the processed timber in one cycle (number of the produced assortments) and the distances of the changeovers were noted in the records. Each logged tree received so-called „difficulty points" according to stem bending, branchiness, and presence of tree forks.

The author carried out data evaluation using his own written program in Microsoft Excel environment. Duration of actions, difficulty points, volumes of logged assortments were calculated. From the duration of different actions work day structures were established. Using the duration times of the different actions, and the produced volumes the author has determined shift performance, performance per hour and expected performance of the machines.

Basing on field data the author has set up multivariate power functions by means of regression analysis which could serve as a basis for norm tables (time norm, performance- and specific cost tables), as well as for the analysis of the independent variables of time equations.

In order to operate the machines economically, the appropriate knowledge of costs is indispensable, especially the operating costs, which were calculated using the operating cost formula introduced by János Gólya. Knowing performance and cost data the author calculated the specific costs of logging.

The 3D models, created for educational purposes, presenting the different systems of tree logging with harvesters, were implemented with using Google's SketchUp 8 software.

4. SUMMARY OF SCIENTIFIC RESULTS

The principal inspiration of the author to set himself to write a Ph.D dissertation was to draw the attention of experts working in silviculture and tree utilization to the application possibility of harvesters in domestic forest stands.

In the course of the research an overview of the history of the development of multi-operational logging machines was given, involving the detailed introduction of the versions, which had been applied for many decades in tree harvesting. The classification of the currently marketed and used harvesters and harvester heads was carried out. Besides, the alternative fields of the application of multi-operational logging machines and forwarders was also outlined.

According to a national survey carried out by the author, a total volume of 342 901 m3 timber was logged between 2006 – 2014 by the use of harvesters. The annual volume of timber, logged with harvesters increases continuously. Besides of softwood stands, hardwood stands were also logged with these equipment. Respecting tree utilization, harvesters are applied in the clearcutting and sanitary cutting of softwood stands, but also in hardwood forests (primarily Turkey oak, beech and other stands) for increment thinning, and improvement cutting. The author set up databases, involving maps as well as tables, which included companies using harvesters and also the specification of their equipment.

The author concluded that multi-operational logging machines are suitable for the economic harvesting of hardwood stands. According to their technical features, the investigated machines belong to the group of the middle-sized harvesters. The average performance of the harvesters working in hardwood stands – 8 harvesters, 17 different forest stands, 6 different tree utilization modes – was 12,0 m3/h, while in the productive hours it was 15,43 m3/h. In the case of softwood stands these values were 14,41 m3/h and 17,93 m3/h respectively. Of course, the use of harvesters is not recommended in forests yielding the most valuable assortments, because the diameter of the stems makes harvester logging impossible. Nevertheless, if that would be possible in any way, it is surely not recommended, because the precision, also required with motor-manual logging can hardly be achieved, thus the splitting of the stump is usually inevitable.

The author calculated the operating costs of the machines. Basing on field data the author set up multivariate power functions by means of regression analysis which could serve as a basis for norm tables. The author also analyzed the effect of independent variables of time equations. Cycle time is mostly affected by the number of assortments in both hardwood and softwood stands. In hardwood stands the tree stem bending influences the cycle time and specific time requirement to a lesser extent than the branchiness of the stems.

Using Google's SketchUp 8 software the 3D model of the Valmet 911.3 type harvester was created. The author also created 3D models of the felling areas with differently-aged hardwood and softwood trees, stumps, felling site harvesting losses, skid trails. Models were created for educational purposes.

The author estimated the possible number of harvesters in the future. In his calculations he based on the harvesting data of the OSAP tables (2000-2013) and on the stock of mature forests in the next 10 and 20 years. He concluded that if we intend to realize 30-35% of the domestic loggings by the use of harvesters in the future, then a total number of 140-150 of harvesters would be required.

5. THESES

I. Basing on a survey including the whole country, it has been established that logging with the utilization of harvesters is justifiable in Hungary. Besides of softwood stands, hardwood stands are also harvested with these equipment to an increasing ratio. Harvesters are applied in the clearcutting and sanitary cutting of softwood stands, but also in hardwood forests (primarily Turkey oak, beech and other stands) for increment thinning, and improvement cutting.

II. The established database – involving maps as well as tables, which include companies using harvesters and also the specification of their equipment – is a great help to practical experts in making contacts. The database can be accessed through the following link:
www.google.com/maps/d/edit?mid=zxvskz0Bm6g0.kP-zUFEMjkTo

III. Multi-operational logging machines are suitable for the economical harvesting of hardwood stands. The average performance of the harvesters working in hardwood stands is 12,0 m^3/h, while in the productive hours it is 15,43 m^3/h. In the case of softwood stands these values are 14,41 m^3/h and 17,93 m^3/h respectively, indicating that there is no significant difference between the two types of forest stands.

IV. The average operating cost of a harvester is 14040 Ft/h. The average specific cost of logging using harvesters is 1318 Ft/m^3. Including the costs of forwarding (2000-2500 Ft/m^3 in average) the total costs can be estimated between 3500-4000 Ft/m^3. If we also consider that during the operation of a harvester the work is not only more efficient, but site clearing and the utilization of felling site harvesting losses can also be carried out at the same time, then it can be concluded that the costs of harvesting are about in the same range as those of motor-manual logging, or can be even lower.

V. For the planning of the harvesting process multivariate power time-functions have been set up for hardwood and softwood species and for different types of species, which can be used by practical experts in the field. Using these equations the cycle time, specific time requirements and performance of harvesting can be calculated. Norm tables (including time, performance, costs) have been set up for hardwood and softwood stands, indicating the harvesting time (min/m^3), volume of logged timber in one operating hour (m^3/h) and specific costs of harvesting (Ft/m^3) related to 1 m^3 produced timber, by applying different values for the independent variables.

VI. From the independent variables of the time-functions (stem bending, branchiness, tree forks, number of assortments, stem volume, distance of changeovers) it is the number of assortments which affects the value of the cycle time most significantly in the case of both hardwood and softwood stands. The specific time requirement is mostly influenced by the number

of assortments, stem volume and changeover distance, while performance is mostly affected by stem bending, branchiness and the presence of tree forks.

From among the independent variables it is the number of assortments that affect mostly the percentual change of the cycle time in both hardwood and softwood stands. The percentual change of the specific time requirement is mostly influenced by the number of assortments, stem volume and distance of changeovers. The performance is also determined most significantly by stem volume and the number of assortments.

The presence of bends in the harvested stems influences the cycle time and specific time requirement to a lesser extent (in terms of order and percentual change) than the branchiness of the stems, in hardwood stands. Respecting performance, branchiness influences the most significantly percentual changes, while it is the stem bending, which is the mostly determinant in terms of order.

VII. Using 3D modeling such elements have been modeled with which the 3D demonstration of harvesting working systems can be carried out. These elements can be used for simulator-based theoretical and practical training for the harvester operator and vocational educational, training, research and publication purposes. The following 3D models have been created, demonstrating the harvester aided logging process on flat terrain:

- clearcutting of a softwood stand, using parallel skid trails;
- thinning of a hardwood stand, using parallel skid trails;
- thinning of a hardwood stand, using curved skid trails;
- gradual improvement cutting, preparatory cutting of a hardwood stand using looped skid trail;
- gradual improvement cutting, clear cutting of a hardwood stand using looped skid trail;
- selection cutting of a hardwood stand using looped skid trail;

VIII. The increase in the number of harvesters working in domestic forests can be prognosticated in the future, presupposing the persistence of technical development and the economic growth of the country. Calculations have revealed that if we intend to realize 30-35% of the domestic loggings by the use of harvesters in the future, then a total number of 140-150 of harvesters would be required for the task.

6. RECOMMENDATIONS

During the research of the domestic application possibilities of harvesters, several new problems and new fields of investigations have been revealed. Not all of the questions have been resolved yet, as a lack of time and the restrictions of the dissertation, however future research will focus on a detailed analysis of the not-yet-investigated areas with the cooperation of university students.

Further detailed investigation needs to be carried out respecting the precision of assorting. It would be highly advisable to carry out a nationwide survey on the volumes of assortments. Also the investigation of the currently applied conversion factors, comparison with real data and with the results of the software used in harvesters is of significant importance. It would be also necessary to introduce methods and processes for harvesting, which are acceptable for both parties.

In order to achieve a better judgment, acceptance and a wider application of harvesters in Hungary further detailed investigations are needed which could outline the more detailed application possibility of harvesters in different tree utilization tasks. The elaboration of suitable working systems could also be realized respecting economic and ecological factors.

The need for a continuous afforestation and the decrease in the number of skilled workforce throws out the idea of the investigation of the applicability of harvesters in selection cutting. If a well-established skid trail system is present, logging can be accomplished considerately by harvesters and forwarders. If the felling of the trees is carried out carefully and precisely, the damage of other trees can be avoided. When the felled tree is skidded in a lifted of in a half-lifted position the damage of the young trees can be kept to a minimum. The trails made by harvesters can also be used by the forwarders, which can also minimize soil damage, especially if their wheels are designed to ensure the minimum loading of the soil.

In order to obtain a better predictability of the work of the harvesters and to acquire a deeper knowledge on the costs it would be advisable to set up such multivariate power functions which are capable to result reliable norm tables on the species and diameter level. Of course this requires also a more throughout analysis of the operating costs.

Currently the training of the machine operators is not ensured at a sufficient level. It would be necessary to establish a center for the education and training of machine operators. The operators could study the theoretical matter under lecture-room conditions. By the use of tutorial courses and practical tasks running on simulators the operators could learn about the proper operating of the harvesters.

The elaboration of new versions of 3D models, visualizing the working principles of tree harvesting working systems is also a future task. The implementation of new machines, terrains and stands is also needed for achieving complex demonstration.

7. THE AUTHOR'S OWN PUBLICATIONS CONCERNING THE DISSERTATION

7. 1 BOOKS, CHAPTERS IN BOOKS

HORVÁTH A. L. – DR. HORVÁTH B. (2011): A fahasználat újszerű megoldásai, gépei, eszközei (1.1. fejezet). In: Dr. Horváth B. szerk.: „Erdészeti ismeretmegújító szakmai tanfolyam" akkreditált felnőttképzési program tananyaga I., Egyetemi jegyzet NYME - Erdőmérnöki Kar, Sopron, 93 p., pp. 7-14

7. 2 SCIENTIFIC PUBLICATIONS

HORVÁTH A. L. (2009): Magasan gépesített fakitermelési munkarendszerek jelene és jövője Magyarországon. NYME EMK Kari Tudományos Konferencia Kiadvány. Nyugat - magyarországi Egyetem Kiadó, Sopron, 340 p., pp. 45-48

HORVÁTH A. L. (2010): Kötegtermeléses munkarendszer a fahasználatban. IV. Országos Erdészeti Gépesítési Konferencia Kiadvány. NYME EMK EMKI, Sopron, 75 p., pp.55-58

HORVÁTH A. L. (2010): Különleges fakitermelési munkarendszerek. AEE Kutatói Nap 2010 Tudományos eredmények a gyakorlatban. Alföldi Erdőkért Egyesület, Szolnok, 114 p., pp. 74-78

HORVÁTH A. L. (2010): Aprítéktermeléssel kombinált harveszteres fakitermelés akác állományban. AEE Kutatói Nap 2010 Tudományos eredmények a gyakorlatban. Alföldi Erdőkért Egyesület, Szolnok, 114 p., pp. 68-73

HORVÁTH A. L. - HORVÁTH B. (2011): A fahasználat újszerű megoldásai, gépei, eszközei. Őstermelő, gazdálkodók lapja 2011/5. szám, Budapest, HU ISSN: 1418-088X, 128 p., pp. 52-55

SZNÉ. MÁTYÁS K. – VÁGVÖLGYI A. – **HORVÁTH A. L.** (2011): Haváriával sújtott területek hasznosítása energetikai célú fatermesztésre. A XVI. Fiatal Műszakiak Tudományos Ülésszaka Nemzetközi Tudományos Konferencia. Erdélyi Múzeum-Egyesület, Kolozsvár, ISSN 2067-6808, 380 p., pp. 295-304

HORVÁTH A. L. (2011): Cseres állományok felújító bontó vágása többműveletes fakitermelő géppel. Tudományos Tanácskozás Konferencia Kiadvány. NYME FMK-EMK, MTA, Sopron, ISBN 978-963-334-007-3, 86 p., pp. 73-77

SZNÉ. MÁTYÁS K. – **HORVÁTH A. L.** (2011): A gyenge fatermőképességű erdőállományok kitermelése, és a képződött faanyag hasznosítási lehetőségei. VI. Euregionális Természettudományi Konferencia Kiadványa. NYME-SEK Tudományos Közleményei XVIII., Természettudományok 13., Szombathely, ISSN 0864-7127, HU ISSN 2061-8336, 222 p., pp. 59-63

HORVÁTH A. L. (2011): Többműveletes fakitermelő gépek alkalmazási lehetőségei viharkárosított állományok egészségügyi termelésében. Környezeti problémák a Kárpát-medencében I., Sopron, http://5mp.eu/fajlok2/karpatmedenceitisz/horvathacikk _www.5mp.eu_.doc.

HORVÁTH A. L. (2011): Harveszteres fakitermelés magyarországi cseres állományban. Tudományos Doktorandusz Konferencia. NYME - EMK, Sopron, ISBN 978-963-334-013-4, 256 p., pp. 223-225

SZNÉ. MÁTYÁS K. – VÁGVÖLGYI A. – **HORVÁTH A. L.** (2011): Energy plantation management – lessons for damaged areas. Land Quality and Land Use Information in the European Union, Keszthely, ISBN 978-92-79-17601-2, ISSN 1018-5593, 399 p., pp 197-206

SZNÉ. MÁTYÁS K. – **HORVÁTH A. L.** – MAJOR T. (2012): Fahasználati munkarendszerek a XXI. században. Erdészettudományi Közlemények 2. évfolyam 1. szám, Erdészeti Tudományos Intézet, Sárvár, ISSN 2062-6711, pp. 135-149,
http://www.erdtudkoz.hu/fileadmin/dokumentumok/emk/erfaved/ErdTudKozl/Szamok/2012/12_Szakalosne_es_mtsai_2012.pdf

HORVÁTH A. L. – SZNÉ. MÁTYÁS K.– HORVÁTH B. (2012): Investigation of the Applicability of Multi-Operational Logging Machines in Hardwood Stands. Acta Silvatica et Lignaria Hungarica Vol. 8, Magyar Tudományos Akadémia Erdészeti Bizottsága, Sopron, ISSN 1786-691X, pp 9-20.

SZNÉ DR. MÁTYÁS K. – DR. MOLNÁR S. – DR. HORVÁTH B. – MAJOR T. – **HORVÁTH A. L.** (2012): The energetic potential of Hungarian forest. Hungarian Agricultural Enginnering 24/2012, Szent István University Faculty of Mechanical Engineering, Gödöllő, HU ISSN 0864-7410, pp 58-62.

HORVÁTH A. L. – HORVÁTH B. – SZNÉ MÁTYÁS K. (2012): Harveszteres fakitermelési technológiák lehetőségei a síkvidéki erdőgazdálkodásban. AEE Kutatói Nap 2012 Tudományos eredmények a gyakorlatban. Alföldi Erdőkért Egyesület, Püspökladány, ISBN 978-963-334-087-5 103 p., pp. 77-81

HORVÁTH A. L. – SZNÉ. DR. MÁTYÁS K. – DR. HORVÁTH B. (2013): Fakitermelés lombos állományokban többműveletes fakitermelő gépek alkalmazásával. Erdészettudományi Közlemények 3. évfolyam 1. szám, Erdészeti Tudományos Intézet, Sárvár, ISSN 2062-6711, pp. 97-110

HORVÁTH A. L. – SZNÉ. DR. MÁTYÁS K. – DR. HORVÁTH B. (2013): Harveszterek Magyarországon. FATÁJ Online. FAGOSZ. 2013. 11. 26. http://www.fataj.hu/2013/11/262/201311262_HarveszterekMagyarorszagon.php

HORVÁTH A. L. – SZNÉ. DR. MÁTYÁS K. – DR. HORVÁTH B. (2013): Fakitermelés lombos állományokban többműveletes fakitermelő gépek alkalmazásával. Erdő-Mező Online. 2013. 11. 29. http://erdo-mezo.hu/2013/11/29/fakitermeles-lombos-allomanyokban-tobbmuveletes-fakitermelo-gepek-alkalmazasaval/

HORVÁTH A. L. – SZNÉ. DR. MÁTYÁS K. – DR. HORVÁTH B. (2013): Fakitermelő kombájnok Magyarországon. Agroinform. 2013. 11. 26. http://www.agroinform.com/aktualis/Harveszterek-Magyarorszagon/20131126-23522/

HORVÁTH A. L. – SZNÉ. DR. MÁTYÁS K. – DR. HORVÁTH B. (2013): Harveszterek hazánkban. Hírek KOMATSU. 2013. 12.12. http://www.kuhn.hu/hungary/hu-hu/mainmenu/hirek-akciok/hirek/hirek-komatsu.html

DR. HORVÁTH B. – SZNÉ MÁTYÁS K. – MAJOR T. – **HORVÁTH A. L.** (2013): A hazai faenergetikai potenciál elemzése. Faenergetika napjainkban (A fa, mint a

legfontosabb megújuló energiaforrásunk) c. konferencia. In Dr. Molnár S. – Dr. Komán Sz. szerk.: „Dendromassza alapú energiaforrások”. Sopron, ISBN 978-963-359-021-8, 30 p., pp. 7-11

HORVÁTH A. L. – DR. HORVÁTH B. (2013): Forvarderek alkalmazési lehetőségei napjainkban. AEE Kutatói Nap 2013 Tudományos eredmények a gyakorlatban. Alföldi Erdőkért Egyesület, Lakitelek, ISBN 978-963-08-7830-2, 121 p., pp. 99-105

HORVÁTH A. L. (2014): Többműveletes fakitermelő gépek – harveszterek – csoportosítása. In Dr. Bidlo A. – Horváth A. – Dr. Szűcs P. szerk.: IV. Kari Tudományos Konferencia - Konferencia Kiadvány. Nyugat-magyarországi Egyetem, Erdőmérnöki Kar, Sopron, ISBN 978-963-359-033-1, 407 p., pp. 359-366

HORVÁTH A. L. (2014): Többcélú gépek alkalmazási lehetőségei energetikai faültetvényeken. In Dr. Czupy I. szerk.: Lignocellulózok energetikai hasznosításának műszaki vonatkozásai. Nyugat-magyarországi Egyetem Kiadó, Sopron, ISBN 978-963-334-190-2, 40 p., pp. 17-22

HORVÁTH A. L. – DR. HORVÁTH B. (2014): Harveszterek terjedése Magyarországon. AEE Kutatói Nap XXII. Tudományos eredmények a gyakorlatban. Alföldi Erdőkért Egyesület, Lakitelek, ISBN 978-963-12-0848-1, 111 p., pp. 56-63

HORVÁTH B. – **HORVÁTH A. L.** (2014): Erdészeti többcélú kihordó fejlesztése. Erdészeti Lapok CXLIX. évf. 1. szám (2014. január). Országos Erdészeti Egyesület, Budapest, ISSN 1215-0398, pp. 6-8

HORVÁTH A. L (2014): Magyarországi harvester-térkép készül. Erdő-Mező Online. 2014.02.03. http://erdo-mezo.hu/2014/02/03/magyarorszagi-harvester-terkep-keszul/

HORVÁTH A. L. – DR. HORVÁTH B. (2014): Forwarderek alkalmazási lehetőségei napjainkban. Erdő-Mező Online. 2014.02.12. http://erdo-mezo.hu/2014/02/12/forwarderek-alkalmazasi-lehetosegei-napjainkban/

HORVÁTH A. L. (2014): Többműveletes fakitermelő gépek – harveszterek – csoportosítása. Erdő-Mező Online. 2014.05.14. http://erdo-mezo.hu/2014/05/13/tobbmuveletes-fakitermelo-gepek-harveszterek-csoportositasa/

7. 3 SCIENTIFIC LECTURES

HORVÁTH A. L. (2009): Magasan gépesített fakitermelési munkarendszerek jelene és jövője Magyarországon. NYME EMK Tudományos Konferencia 2009, Sopron

HORVÁTH A. L. – SZNÉ. MÁTYÁS K. (2011): A gyenge fatermőképességű erdőállományok kitermelése, és a képződött faanyag hasznosítási lehetőségei. VI. Euregionális Természettudományi Konferencia, Szombathely

HORVÁTH A. L. – SZNÉ. MÁTYÁS K. – VÁGVÖLGYI A. (2011): Haváriával sújtott területek hasznosítása energetikai célú fatermesztésre. A XVI. Fiatal Műszakiak Tudományos Ülésszaka, Kolozsvár

HORVÁTH A. L. – DR. RUMPF J. (2011): Többműveletes fakitermelő gépek erdészeti alkalmazásának terjedése a magyar erdőgazdálkodásban. XL. FAGOSZ Faipari és Fakereskedelmi Konferencia, Balatonszemes

HORVÁTH A. L. (2011): Harveszteres fakitermelés magyarországi cseres állományban. Doktoranduszok Tudományos Konferenciája az Erdőmérnöki Karon, Sopron

VÁGVÖLGYI A. – SZNÉ. MÁTYÁS K. – **HORVÁTH A. L.** (2011): Energy plantation management – lessons for damaged areas. Land Quality and Land Use Information in the European Union, Keszthely. http://lq2015.georgikon.hu/wp-content/uploads/2014/08/25_Szakalos_Matyas.pdf

HORVÁTH A. L. – SZNÉ. MÁTYÁS K. (2013): Fakitermelési munkarendszerek szélsőséges termőhelyeken. NYME EMK Tudományos Konferencia, Sopron

HORVÁTH A. L. (2014): Fakitermelés lombos állományokban többműveletes fakitermelő gépek alkalmazásával. Öforst Forsttechnik GmbH. - John Deere gépbemutató, Oltárc, http://prezi.com/wvxz-heriqrf/?utm_campaign=share&utm_medium=copy

HORVÁTH A. L. (2014): Többcélú gépek alkalmazási lehetőségei energetikai faültetvényeken. 'Lignocellulózok energetikai hasznosításának műszaki vonatkozásai' című konferencia. Sopron

7. 4 POSTERS

HORVÁTH A. L. (2010): Különleges fakitermelési technológiák a fa energetikai hasznosításának szolgálatában. MTA AMB XXXIV. Kutatási és fejlesztési tanácskozás, Gödöllő

HORVÁTH A. L. (2010): Különleges fakitermelési munkarendszerek. AEE Kutatói Nap 2010 Tudományos eredmények a gyakorlatban, Szolnok

HORVÁTH A. L. (2010): Aprítéktermeléssel kombinált harveszteres fakitermelés akác állományban. AEE Kutatói Nap 2010 Tudományos eredmények a gyakorlatban, Szolnok

HORVÁTH A. L. – HORVÁTH B. – SZNÉ MÁTYÁS K. (2012): Harveszteres fakitermelési technológiák lehetőségei a síkvidéki erdőgazdálkodásban. AEE Kutatói Nap 2012 Tudományos eredmények a gyakorlatban. Püspökladány

HORVÁTH A. L. – DR. HORVÁTH B. – SZNÉ MÁTYÁS K. (2013): Forvarderek alkalmazési lehetőségei napjainkban. AEE Kutatói Nap 2013 Tudományos eredmények a gyakorlatban. Lakitelek

HORVÁTH A. L. (2013): Többműveletes fakitermelő gépek – harveszterek – csoportosítása. NYME EMK Tudományos Konferencia, Sopron

HORVÁTH A. L. – DR. HORVÁTH B. (2014): Harveszterek terjedése Magyarországon. AEE Kutatói Nap XXII. Tudományos eredmények a gyakorlatban. Lakitelek