THE UTILIZATION OF THE VINEYARDS' PRUNING RESIDUALS FOR BIOENERGY

PIRRO ICKA., ROBERT DAMO.

Department of Agronomy, Faculty of Agriculture, University "Fan S. Noli", Korçë

e-mail: pirroicka@yahoo.com

Abstract

The fire has been an important mean for the civilizations of all times to be used in: heating, cooking, lighting etc., which lead all those civilizations to utilize various sources to reach their aims. Korça region is one of the biggest users of timber for heating purposes in Albania. In the framework of the protecting the forestry and environment, recently in this region are being observed the possibilities to utilize alternative and sustainable sources of the combustibles. A removable source with high utilization potential are the agriculture yields, specially the residuals from the vineyard and orchard pruning, which are the most used and cheapest in energy production. Nowadays at Korça region are being planted about 1095 ha in vineyards and about 309593 pergolas. Almost the entire biomass' residuals after pruning are being removed from the plot and burned or thrown out as useless. The purpose of this paper is to assess the quantity of the residuals from the pruning of vineyards and the possibilities to utilize them for bioenergy. Some properties of this biomass were assessed as: dry matter, volatile matter, fixed carbon and ash.

Key word: Biomass, vineyard, combustibles.

Përmbledhje

Zjarri ka qenë një mjet i rëndësishëm për qytetërimet në të gjitha kohërat: për ngrohje, për gatim, për ndriçim etj., i cila ka bërë që këto qytetërime të përdorim burime të ndryshme për të. Rajoni i Korçës është një nga përdoruesit më të mëdhenj të lëndës drusore për ngrohjen në Shqipëri. Në kuadër të mbrojtjes së pyjeve dhe mjedisit, vitet e fundit në këtë rajon po shikohet mundësia e përdorimit të burimeve alternative dhe të qëndrueshme të lëndës djegëse. Një burim i rinovueshëm dhe me potencial të lartë përdorimi janë mbetjet nga prodhimet bujqësore, sidomos mbetjet e krasitjes së drufrutorëve dhe vreshtave, të cilat janë nga burimet më të përhapura dhe më të lira të biomasës të mundshme për t'u përdorur për bioenergji. Sot në qarkun e Korçës janë të mbjella rreth 1095 ha me vreshta dhe rreth 309593 rrënjë pjergulla. Pothuajse e gjithë biomasa e mbetur nga krasitja pasi largohet nga parcela digjet ose hidhet si mbetje pa vlerë. Qëllimi i këtij prezantimi është vlerësimi i sasisë së mbetjeve të krasitjes së vreshtave dhe i mundësisë së përpunimit të tyre për bioenergji. Për këtë u vlerësuan disa veti të tilla si: lënda e thatë, lënda volatile, karboni i fiksuar dhe përmbajtja e hirit.

Fjalëkyçe: Biomasë, vresht, lëndë djegëse.

Introduction

Since fire was first harnessed, wood has been the primary fuel for it, and wood fuels are still a major source of energy for people in developing countries (May-Tobin, 2011). Increasing the demand for wood fuel is not always accompanied by easy procuration due to environmental problems as well as the reduction in the quality of wood available. During the past few years the global interest in renewable energy sources, especially energy from biomass, has been growing significantly (Bilandzija *et al.,* 2013). Biomass energy may be the most important renewable energy source to meet the increasing energy demand in response to increasing world population and industrialization in a sustainable manner and without polluting the environment (Ekinci, 2011).

In Albania, forest dendromass constitutes to be the main part of wood that is used for heating purposes, causing in many cases deforestations. For that, in the year 2016 in Albania was approved the law No. 5/2016 "About the declamation of the forests moratorium in the Republic of Albania", with purpose to prevents the cutting timber for any activity, except the fuel, during a 10 years' period. But this situation has fostered the ideas to produce and provide renewable and alternative fuel sources.

Biomass is the third largest primary energy source in the world following coal and petroleum. It is still the main source of energy for more than half of the world's population and provides about 1,25 billion toe of primary energy, or about 14% of the world's annual consumption of energy (Purohit *et al.,* 2006; Zeng *et al.,* 2010). The primary sources of biomass are agricultural and forest residues, energy crops, and organic waste. These sources have been relatively widely used in the EU for long time already, and the future growth in biomass production should be connected to a more intensive use of energy crops (van Dam *et al.,* 2007). Biomass contains less sulphur and ashes than coal, thus generates low emissions of SO_x and particles. Although, in some cases, biomass fuels have high nitrogen content, this may give rise to rather high NO_x emissions (Bilandzija *et al.,* 2013).

Biomass fuels can be made from a large variety of feed stocks, and can be obtained through cultivation, or through natural means, only using readily available and renewable resources (Icka *et al.,* 2017). Agricultural residues are the most potential considering their quantitative availability (Khardiwar *et al.,* 2013). Currently, the biomass produced in fruit plantations is not used widely to produce bio-energy. This is because of unsolved technical problems in harvesting, or a lack of information on the quantity and quality of the residues (Dyjakon *et al.,* 2016). Knowing the amount of residual biomass available in orchards allows for the planning of logistics operations at a local community level, and achieving a cheaper and functional supply chain (Dyjakon *et al.,* 2016).

The main problem of the biomass energy enhancement is in fact related to supply's difficulties: the agricultural sector is able to provide different types of biomass, rising from the herbaceous energy crops to woody, from dedicated to residual productions (Grella *et al.,* 2013). In Albania the residues from pruning of fruit trees and vineyards are generally considered as waste and have left off from the vineyard and are often burned (figure 1).

Traditionally, all biomass fuels are used more or less in the same geographical region in which they are produced (Parikka, 2006), for this reason this paper objective is to estimate the amount of pruning residues in vineyard for use as biofuel in areas where they are produced as well as assessment of some physical and chemical parameters.

Figure 1. Vineyard pruning residue thrown on the field street

Materials and methods

The assessment of biomass production from pruning residue of vineyards was calculated for the Korça district, a region uses a big quantity biomass flue, mainly for heating. This district lies in southeast of Albania and is well-known for its agricultural products. Although it is not a typical region for vineyard cultivation, there are some microclimate that favor its cultivation. About 1095 ha of vineyards and about 309593 pergolas plant, close to the home garden, are cultivated in this region (DBUK). Since the shape and size of canopy of pergolas is very diverse, this biomass, even though considerable, will not be calculated in our study. Assessment of pruning biomass was carries out in 2017 in Stropck's vineyards, where is one of the largest vineyard in the region (40º51'29.519''N 20º41'3.431''E). Planting distance are 0,9 x 2 m, providing 5550 plants/ha. For evaluation of the mass of pruned branches, were collected all branches from a surface by 100 m^2 and weighed immediately. We were selected four plots in random order. For evaluation of physical and chemical properties of pruning biomass, samples were taken and analyzed in the agrochemistry laboratory at Faculty of Agriculture in Korça. The biomass in laboratory were analyzed for: Moisture content (ISO 18134-2:2015), Volatile matter (EN 15148:2009); Ash content (14775:2009), Fixed carbon according Khardiwar *et al.*, 2013, and CEN standards.

Results and discussions

Agricultural residue is a potential source of biomass for energy production due to its availability and almost constant production every year. Vineyard pruning residues usually is seen as a waste and farmer concern is how to eliminate this waste, but now we can see it as a biomass source. The quantity of the biomass directly in field is 16 – 21 kg/100m^2 with average 19,2 kg/100 m^2 or 1920 kg/ha. This is a value compatible with other studies (1850 – 5360 kg/ha, Manzone *et al*, 2016), but the lower value is due to the type of cultivation. According this value, the Korça region has a potential of about 2100 t of fresh pruned or around 1210 odt (oven dry ton).

The combustion behaviour of biomass is affects by volatile matter and fixed carbon, together with ash residue and moisture. The moisture content is defined as the quantity of water per unit mass of the wet solid, it plays an important role in the combustion (Khardiwar *et al.*, 2013). The average moisture content of pruning sample is 42,3%; this is a high moisture content, but it is in the fresh catting branches. Biomass fuels are requiring with low moisture content but this can achieve by air drying reaching a moisture content to15%, optimal moisture content for burning. The oven dry mass is 1,1 odt/ha; this value is lower than forest residue, 2 odt/ha (Forest research) but gives around 20,4 GJ/ha·a. (converted to 5,7 MWh/ha·a) or 22300 GJ per year from all vineyards in Korça region.

In general, fuels with high content of volatile matters are flammable and easily burned, combustion happens fast and may be difficult to control, a controlled combustion process is important to achieve a complete combustion (Haugen *et al.*, 2016). Results from analyses in laboratory shows that average volatile matter from vineyard pruning is 44,756%, this value is lower compared to oak, pine and birch 73 – 79% (Haugen *et al.*, 2016), but is equal to charcoal 40 ±5% (FAO 1983). High volatile is easy to ignite but may burn with a smoke flame, while low volatile is difficult to light and burns very cleanly (FAO, 1983)

Table 1. Physical and chemical properties of pruning biomass from vineyard

Fresh mass	Dry mas	Moisture content	Volatile matters	Ash	Fixed carbon*
1,920 t/ha	**1,107 odt/ha**	**42,3%**	**44,756%**	**1,771%**	**9,734 %**

*Fixed carbon of fresh biomass

Ash is the solid residue from combustion process in air, produced from thermochemical or bio-chemical processes (Haugen *et al.*, 2016). It is mineral matter, such as clay, silica and calcium and magnesium oxides, etc., present in the original wood (FAO, 1983). The ash content of biomass influences the expenses related to handling and processing to be included in the overall conversion cost, on the other hand, the chemical composition of the ash is a determinant parameter to consider for the operation of a thermal conversion unit, since it gives rise to problems of slagging, fouling, sintering and corrosion. It is desirable to use lower ash content fuel for gasification (Khardiwar *et al.*, 2013). Ash content in pruning residues from vineyard is 1,771%. Generally, the ash content of wood or woody biomass ranges from 0,5 to 3 % dry weight (Rector *et al.*, 2013). Our value is lower than briquette prepared from soybean and mix biomass respectively 6,58 and 7,34% (Khardiwar *et al.*, 2013), but higher than 0,2% of red oak and 0,6% of beech (Owens and Cooley 2013).

Figure 2. Collection of pruning residues for biofuel

Fixed carbon is the solid fuel left in the furnace after volatile matter is distilled off. It consists mostly of carbon but also contains some hydrogen, oxygen, sulphur and nitrogen not driven off with the gases. Fixed carbon gives a rough estimate of heating value of coal and acts as a main heat generator during burning (Properties of Coal). Calculated value of fixed carbon for pruning residue of vineyard is 9,734 %. To provide ample heat, the fuel must have a high content of fixed carbon and have a high calorific value (Coal). The value of fixed carbon that we estimate is lower than other biomass fuel birch 12,4%; pine 14,7%; willow 18,92% (Grønli), but this is due to evaluation according the fresh mass that contain 43,74 % moisture. If we calculate the fixed carbon for pruning biomass that contain around 20 % of moisture the value will increase up to 30%, higher than other biomass fuel.

The lack of burning fuel has begun to be felt by the population thinking about using the pruning wastes not immediately after pruning, but in the following winter by reducing the moisture content during summer heat (figure 2). This will improve properties of biomass from pruning residues.

Conclusions

Pruning residues from vineyard are a potential biomass fuel for the farmers that produce them. Biomass from pruning of vineyard can be estimated more than 1,1 odt/ha, that is a considerable biomass which should be used. This biomass has compatible properties with other biomass used in Korça region.

The biomass produced by vineyard pruning residue in Korça region can give more than 22300 GJ energy in the year, all this energy that is lost should be collected and protected.

The biomass from pruning residues of vineyards is not easy to manipulate, but it can be grinded to use as a chip or to prepare pellets or briquettes mixed with other agricultural residues, in this manner we can increase the caloric value of product.

Reference

Bilandzija N., Voca N., Kricka T., Matin A., Jurisic V. (2012): Energy potential of fruit tree pruned biomass in Croatia. Spanish Journal of Agricultural Research 2012 10(2), 292-298

CEN solid biofuels standard, European Committee for Standardization

Coal Chapter 7 https://www.ems.psu.edu/~radovic/Chapter7.pdf

DBUK Drejtoria e Bujqësisë dhe Ushqimit Korçë

Dyjakon A., den Boer J., Bukowski P., Adamczyk F., Frąckowi P. (2016): Akwooden biomass potential from apple orchards in Poland. Drewno, Vol. 59, No. 198

Ekinci K. (2011): Utilization of apple pruning residues as a source of biomass energy: A case study in Isparta province, Energy Exploration & Exploitation, Volume 29, Number 1, 2011. 87–107

FAO (1983): Simple technologies for charcoal making

Forest research https://www.forestresearch.gov.uk/tools-and-resources/biomass-energy-resources/ reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-pa/

Grella M., Manzone M., Gioelli F., Balsari P. (2013): Harvesting of southern Piedmont's orchards pruning residues: evaluations of biomass production and harvesting losses. Journal of Agricultural Engineering; volume XLIV(s2): e108

Grønli M. Solid Fuel Characterisation-methods, equipment and characteristics. Norwegian University of Science and Technology, Department of Energy and Process Engineering, NO-7491 Trondheim, Norway

Haugen H. H., Furuvik N. C. I. Moldestad B. M. E. (2016): Characterization of biomass wood. Proceedings of the 2nd International Conference on Energy Production and Management (EQ 2016)

Icka P., Damo R., Icka E. (2017) Reed biomass, a possibility of cultivation and protection of "wetland" in Korça field in Albania. The Annals of "Valahia" University of Targoviste

Khardiwar M. S., Dubey A. K, Mahalle D. M., Kumar S. (2013) Study on Physical and Chemical Properties of crop Residues briquettes for gasification International Journal of Renewable Energy Technology Research Vol. 2, No. 11, November 2013

Manzone M., Paravidino E., Bonifacino G., Balsari P. (2016) Biomass availability and quality produced by vineyard management during a period of 15 years. Renewable Energy

May-Tobin C. (2011). The Root of the Problem—Drivers of Deforestation What is driving tropical deforestation today? Wood for Fuel. Chapter 8

Owens E., Cooley S. Ash content of Irish woodfuel. Coford Connects 2013 20:49

Parikka M. (2006) Biomass Potential in Europe. ExCo2006, Biomass Potential in Europe, Stockholm

Properties of Coal https://www.researchgate.net/profile/.../Properties+of+coal.pdf

Purohit P, Tripathi AK, Kandpal TC, (2006) Energetics of coal substitution by briquettes of agricultural residues. Energy 31: 1321-1331

Rector L. R., Allen G., Hopke P. K., Chandrasekaran S. R., Lin L. (2013) Elemental Analysis of Wood Fuels Final Report. New York State Energy Research and Development Authority

Van Dam J, Faaij APC, Lewandowski I, Fischer G. (2007) Biomass production potentials in Central and Eastern Europe under different scenarios. Biomass Bioenerg 31: 345-366

Zeng XY, Ma YT, Ma LR, (2010) Utilization of straw in biomass energy in China. Renew Sust Energ Rev 11: 7261-7266