ASPECTS REGARDING THE ACACIA CROP IN THE AGROFORESTRY SYSTEM FOR THE PRODUCTION OF DENDROMASS

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Abstract

One of the main uses of dendromass from the oldest times has also been the production of energy, but its high consumption at global level has raised serious issues in the society lately, so that solutions are permanently sought in order to generate resources which would be capable of energy production. The dendromass obtained in agroforestry systems, for the production of wood pellets, in short production cycles, may be a sustainable alternative for the European Union states, in search of such energy production alternatives.

According to EUROSTAT 2016, EU-28 has been the largest worldwide producer of wood pellets, its production reaching a value estimated at 13,1 million tonnes in 2014; the production in EU-28 has increased by 97% overall in the period 2009-2014; EU-28 is also a net importer of wood pellets: the level of the imports from the member states of the EU has increased to 8 million tonnes in 2014, a global increase of 364% compared to the year 2009. The main suppliers of the EU have been The United States of America and Canada; a lot less is supplied by Russia and other countries such as Belarus and Ukraine.

The production and use of renewable sources such as the dendromass obtained in the energy crops, may significantly contribute in the field of energy security of the states which dedicated mandatory targets regarding the renewable energy sources. At global level it joins the other species of plants capable of storing atmospheric carbon in trunk, branches and root and the soil on which it is cultivated is also enriched by the input of atmospheric nitrogen which the plant fixates in the soil via roots, forming nodosities of the Azotobacter type. It is known that in Romania acacia generally prefers the warm regions, with gentle, long autumns, safe from early frosts. The specialized literature as well as the experience of the past years confirmed the fact that acacia is a capable and available species, a species which presents impressive advantages from the standpoint of biomass production in agroforestry systems.

Key words: energy plantations, agroforestry, short rotation forestry, black locust

INTRODUCTION

The weakly productive agricultural lands from the point of view of the yield or the abandoned agricultural lands may be successfully capitalized by the creation of energy plantations for obtaining dendromass, and the correct choice of the species based on the pedoclimatic conditions may bring a considerable contribution to the production plans of the dendromass obtained in the energy plantations. The dendromass growth rate of plants, the harvesting, humidity, contents of ash and the management complexity may represent the main selection criteria for the implementation of such projects at local, regional or European level.

Thus, a level of access to public information is required, which implies transparency that can be seen from two perspectives: the prospect of the economy, transparency leads to increased performance and, at the same time, earnings, as well as from an institutional point of view the level of public administration for attracting funds. Decisional transparency implies that the means by which public administration provides citizens with all the necessary elements of their own activity (Timofte, 2016).

The results obtained in Lugoj, in an interval of 3 years, in which acacia (*Robiniapseudacacia L.)* was cultivated in an agroforestry system, we may say, are considerable and correspond similarly to researches in the specialized literature; (Erik et al.) states that the former agricultural lands, which have been abandoned due to optimization and intensification of agriculture, allows the use of lands for other purposes, by planting some forestry species for the production of alternative energy, and (Rédei, 2011) says that in Hungary acacia is the most appropriate forestry species for wooden biomass production by establishing energy crops in an agroforestry system.

In general, acacia has been very much used for forestations of some degraded lands, on eroded coasts, on crude soils, being a good soil fixer. The ecologic plasticity it displays, made it to be cultivated sometimes even in improper conditions, because acacia still has some ecologic plasticity limits, well delineated and known in the specialized literature as well as from numerous experimentations carried out in the approximately 150 years of cultivation, in our country.

In Romania (Ciuvăţ etal., 2015) mentions that in the south of Oltenia, acacia offers all types of forest ecosystem services in an area characterized by one of the smallest percentages of forestation at national and European level. The forestation and stabilization of the flying sands in the South of Oltenia have had a double advantage: by saving both the agricultural crops and the local villages exposed to desertification and offering wood and wooden products, thus contributing to the durable development of the region by also protecting it from an economic standpoint.

Acacia has proven from the very beginning to be an almost perfect species for this purpose, because it has some properties fully compatible with the necessities of energy production, such as (Halupa, 1992; Rédei, 2000; Hernea et al., 2009):

- a very rigorous growth in the juvenile phase;
- a great capacity of tillering;
- the acacia wood has a great density;
- increased production of dry substance;
- excellent wood combustibility;
- a relatively short duration for the drying of the biomass;

- easy and well known technologies for biomass harvesting and processing.

Planting short-lived *Robinia* plantations for renewable bioenergy production is currently fashionable (Sádlo et al., 2017).In the last two decades, more and more agricultural land surfaces have started to be cultivated with species producing significant quantities of vegetal biomass, usable in the manufacturing of bio-fuels.

MATERIAL AND METHODS

The researches included in the present paper have been carried out in the period 2015-2017, on the private property of the economic operators, interested in the production of dendromass for the purpose of using it in the production of pellets and finally in the production of electrical and thermal energy.

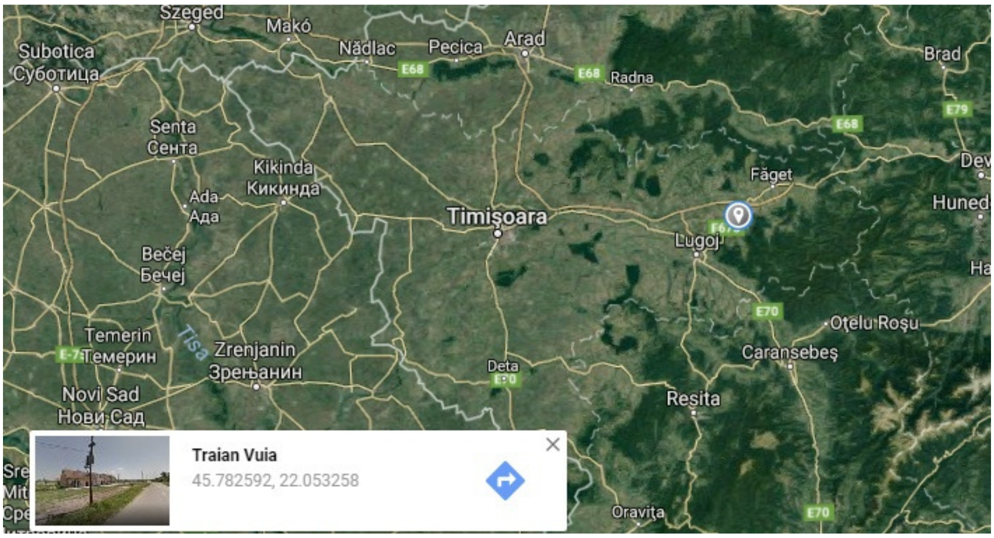

Fig.1. The site for the study (source: google maps)

The establishment of the energy acacia plantations was carried out at the end of 2014, the land was well prepared by works on the whole surface through a scarification at an average depth of 0,6 metres, followed by a soil ploughing at a depth of 0,4 metres, and the breakage of the soil with the disk harrow. The planting process was done in a mechanized manner, by using a plough specialized for this purpose. The productivity at the planting of the acacia seedlings by using a tractor of 110 horse power and the specialized device on two rows was of circa 10 ha/day/12 hours. The seeding material using upon planting was according to the valid Romanian Standard, of first quality.

The number of plants was 7800 pieces/ha upon the establishment of the energy plantation.

In the vegetation period after planting, the interval between the rows of seedlings was maintained over the whole period of vegetation in the form of a black ploughed field, and for the elimination of the weeds which also constituted a competition for the optimum development of the acacia seedlings one used the total herbicidation of the crops.

Fig.2. Overview from the acacia energy plantation in the 2nd year of vegetation

The data collection consisted in:

- the mechanized harvesting of 3 lots of 500 sqm, at the beginning of spring in the period March-April, for each year separately,
- the harvested dendromass was deposited for drying in a natural state,
- in the month of September for each of the three years considered in the study one carried out the weighing of the dendromass which at that moment had 8% humidity.

RESULTS AND DISCUSSION

From the centralization and carrying out of the averages between the obtained values in t/kg, one obtained the following date, represented in Figure 3.

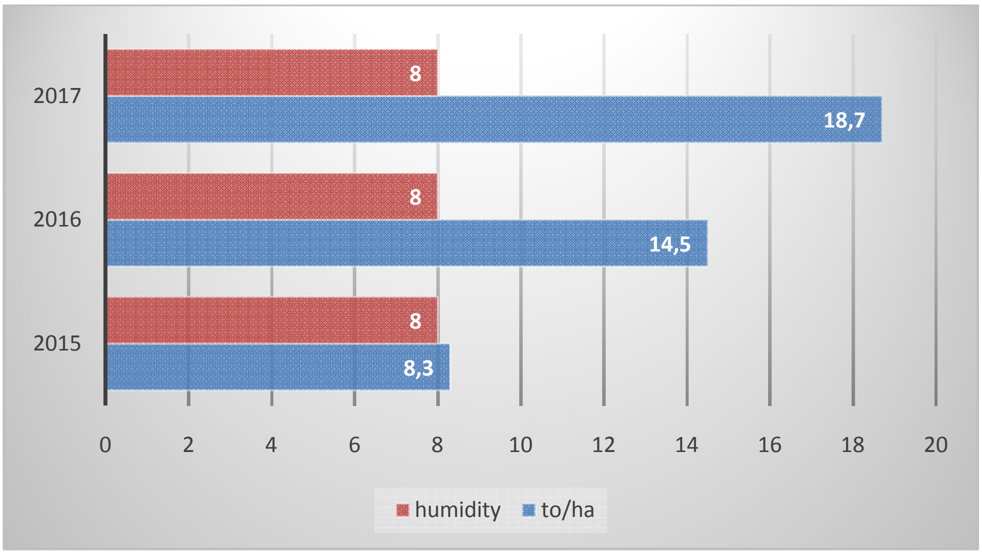

Fig. 3. The quantity of obtained dendromass in to/year/ha, at the humidity of 8%

From the results of these measurements but also from the experience of the three years of cultivation of acacia as energy plantation in order to obtain dendromass based on the number of plants/hectare, as well as by studying the specialized literature, several aspects start to take shape, regarding the most efficient method for establishing and exploiting an acacia plantation for the production of dendromass, so that we may draw the following conclusions:

1. The optimum moment for harvesting the dendromass is in the period February-March.
2. In the first year of harvesting after tillering, as they are thinner, they allow an easier and less expensive harvesting with light machinery which does not cause problems in case of excessive moisture of the plantation soil, the harvesting becomes faster and without risks of losing the optimum cutting moment.
3. The root system increases in volume in each year of vegetation, it is stimulated with each cutting, and an eventual average scarification on top of the harvested acacia row, could have a positive effect on the growth of the offshoots from the new generation, producing a soil oxygenation and easing the activity of the symbiotic bacteria by the extraction of nitrogen from the atmosphere, allowing a natural, cost free fertilization.
4. It is interesting that the acacia bark has a caloric power upon burning greater than that of the acacia wood itself, having the highest caloric power upon burning of the soils used in the energy plantations (Fehér, 2013).

5. For the average production of dendromass we have NOT taken into account:
   - 5.1. The management of the slurry from the zootechnical farms, which may bring a contribution of minimum 20-30% to the dendromass production
   - 5.2. The tillering capacity of acacia together with the formation of the root system, after the age of 5 years after establishment, which is much stronger.

CONCLUSIONS

The results obtained after the three years of experimentations indicate that the annual cutting in an energy acacia plantation for the production of dendromass is very efficient, thus in the third year one obtained an average production of 20,7 tonnes/ha, 14,5 tonnes/ha for the second year and 8,3 tonnes/ha for the first year, dendromass with a humidity of 8%.

We have identified potential beneficiaries of such energy plantations for the production of dendromass established at regional level so:

- ➢ the environment, by storing carbon in the biomass and atmospheric nitrogen in the soil; the reduction of the greenhouse effect;
- ➢ the fauna;
- ➢ the human factor, by the creation of new work places at local level, welfare;
- ➢ the local councils of communes and towns which earn own incomes without the need to request help from the government;
- ➢ the schools, hospitals, town halls or economic operators from the rural environments of small/medium towns, which can consume thermal agent based on wood/wooden biomass;
- ➢ one of the major advantages is *the reduction of the pressure* at local and national level on the forest by the introduction in the local/national circuit of the wooden biomass for consumption for: heating, production of electrical energy, product manufacturing;
- ➢ the owners' associations (farmers, tenant farmers);
- ➢ the stations for the production of energy;
- ➢ the roads and localities (communes and towns) by creating protective forestry curtains.

Pellet manufacturing:

- ➢ Due to the high caloric capacity of the acacia dendromass, only CLASS 1 pellets may be obtained;
- ➢ The production cost for the pellets is circa 60-70 Euro/tonne;

- 1 cubic metre of methane gas = 10 kWh energy, the equivalent of 2 Kg of acacia pellets;
- 1 kWh methane gas costs between 0,1-0,12 Lei;
- 1 tonne of pellets is the equivalent of 500 kWh;
- 500 kWh x 0,12 = 600 Lei; (140 Euro).....60 Euro.
- **Final conclusion:**
- **500 kWhmethane gas acquisition cost 140 Euro**
- **500 kWh from pellets made of energy acacia, cost 60 Euro**

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