

THE USE OF EUCALYPTUS OIL FOR WIREWORMS CONTROL IN ENERGETIC WILLOW CROPS

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REZUMAT. În energetica forestieră, o specie de arbore sau arbust lemnos cu creștere rapidă, este utilizată pentru a furniza bio-combustibil pentru încălzire sau producerea de energie. Salcia de împletitură (*Salix viminalis*, L.), datorită creșterii sale rapide și rezistenței la boli, este cea mai comună specie energetică dintre speciile forestiere cu ciclul scurt din Europa. Lucrarea prezintă unele detalii cu privire la controlul viermilor sârmă în culturile de salcie energetică, concluzii cu privire la evoluția și posibilitatea de utilizare a unui sistem de tratare cu ulei de eucalipt, folosind echipamente clasice. Cocluzia principală confirmă faptul că, deși are un efect insecticid puternic, uleiul de eucalipt a blocat dezvoltarea plantelor.

Cuvinte cheie: Agriotes spp, salcie, ulei de eucalipt, biomasă, tehnologie, energii regenerabile.

ABSTRACT. In energy forestry, a fast-growing species of tree or woody shrub is grown specifically to provide bio-fuel for heating or power generation. The basket willow (*Salix viminalis*, L.), due to its rapid growth and resistance to disease, is the most common species in short rotation energy forestry in Europe. The paper shows some details about wireworms control in energetic willow crops, some conclusions about evolution and possibility for the use of technical system with eucalyptus oil, using classic equipment. Main conclusions confirm that, even the insecticide effect is strong the eucalyptus oil blocked the plants development.

Key words: Agriotes spp, willow, eucalyptus oil, biomass, technology, renewable energies.

1. GENERAL CONSIDERATION

In energy forestry, a fast-growing species of tree or woody shrub is grown specifically to provide bio-fuel for heating or power generation. Due to its rapid growth and resistance to disease, the basket willow (*Salix viminalis*, L.) is the most common species in short rotation energy forestry in Europe (Tucu D., 2007).

Increasing energy efficiency and renewable energy sources are high priorities for each country, especially for Romania, which already obtain more than 10% (2010) of its energy supply from renewable sources. The share of renewable energy sources from other countries energy system has increased rapidly during the past decade. From 2020, Romania proposed to use more from 24% of energy consumption from renewable energies. (National Strategy 2011)

Cultivation of willow (*Salix*) as a raw material for bio-fuel production amounted to about 5 000 ha in 2020

Salix clones are common crops in short-rotation crops (SRC) plantations in Europe (Mitchell et al., 1999). In addition to the high potential of SRC products as fuel and fibre, SRC is also seen as a means to provide a livelihood for farmers under conditions of surplus food-crop production (Mitchell et al., 1999).

Planting short-rotation woody crops on former lands leads to the improvement of soil properties. Most notably by increasing the amounts of organic carbon, differentiation of the homogenised upper soil horizons, increasing biomass and biodiversity of soil organisms (Jug et al., 1999; Makeschin, 1994). Soil biota provides a range of ecosystem services through regulating decomposition, nutrient mineralisation, energy flow and transformations within the main nutrient cycles (Wardle et al., 1999). In farming systems, soil biodiversity contributes to the productive capacity of the system, and buffers the soil against environmental change (Giller et al., 1997).

In the same time the ensuring of the energetic security, promoting technological development and innovation and providing opportunities for employment and regional development (especially in rural and isolated areas) is also most important (Directive EU, 2009).

According to the same document it is necessary that increasing demand for biofuels and bioliquids do not have the effect of encouraging the destruction of biodiverse lands. For these reasons will be promote that agricultural cultures which not originate in biodiverse areas or, in the cases of environmental protected areas, the promoters must demonstrate that the production of such raw material does not interfere with those purposes (Directive EU, 2009).

2. MATERIAL AND METHOD

2.1. Site description

The experimental site was located at Ghilad, Timis County, 37 km south-west of Timisoara (fig.1, Tucu et.al, 2011). The site is situated 300 m from the Timis River, at about 75 m above sea level. The site is characterized by a high groundwater level and

shallow root depth. The soil is classified as a chernozem It is used as pasture land and was not plowed and unfertilized regularly. The soil is characterized as a hard and floating area. Annual precipitation in the three years of the study was 493, 623 and 509 mm, respectively.

Reliability notes are also presented in figure 1

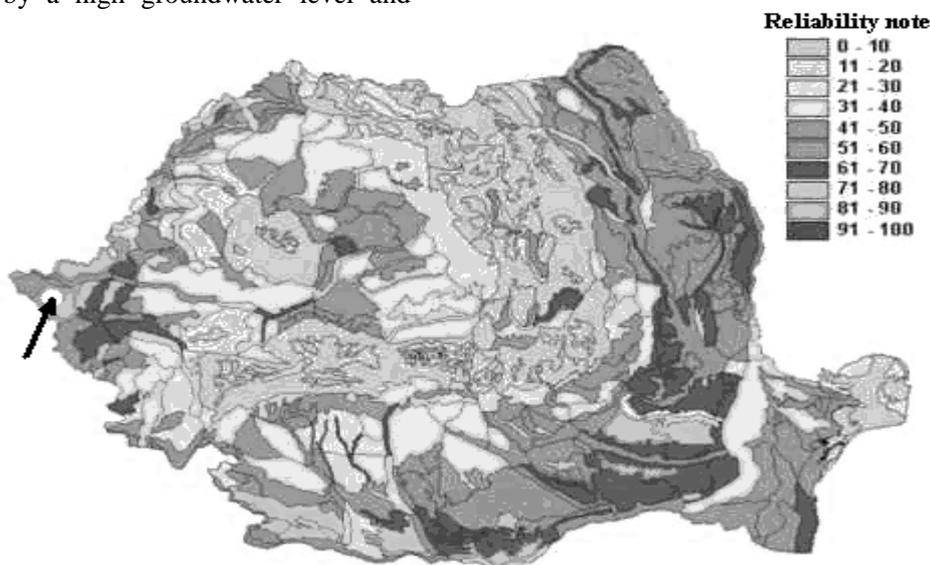


Figure 1. Position of experimental site and reliability note of soil.

2.2. Agriotes description

Typical members of the family Elateridae:with an unique characteristic - the ability of the adults to catapult themselves up into the air after having fallen on their backs. The body of the adult is about 7-10 mm (0.27-0.29 inch) long, narrow, flat, and brown to black in color. The larvae are thin and long (up to 30 mm; 1.18 inch), and they have an uncommonly hard yellow to light-brown body.

The genus *Agriotes* contains several species, some of them very difficult to distinguish, which are broadly similar in their biology. *Agriotes* prefer humid climates and are mainly found in Europe and the former USSR. In North America, other members of the Elateridae are known as 'wireworms', but introduced *Agriotes* spp. have been gaining importance for some years. In Europe, *A. lineatus* and *A. obscurus* are the predominant species. They preferred habitats as grasslands such as meadows, pastures etc., but fallow land, and sometimes fields with clover, cereal or alfalfa can also be occupied. The oviposition sites invariably have moist, heavy soil.

The adult beetles do not cause damage, but the larva is the economically important, destructive stage. It normally lives underground, feeding mainly on roots and tubers of numerous different plant species. In potatoes, beets etc. it bores sharp-edged, deep holes of ca. 0,003 m diameter, especially in dry periods, thereby rendering the product unmarketable.

Secondary infection by fungal and bacterial diseases frequently increases the damage further. Germinating seeds attract the larvae by their emission of CO₂, and the hypocotyl is often destroyed before emergence, e.g. in beet.

Most damage occurs on roots; sometimes these are completely bitten off, so that even older plants can easily be pulled out. In their young stages, even woody plants are at risk, e.g. in nursery plantations. Seedlings can also be attacked by gnawing near the soil surface.

In all cases, the vascular bundle becomes interrupted- and thereby the supply of nutrients and water - causing the plant to develop slowly, wither and eventually to die. The larvae often attack several plants each, so the damage (which first becomes visible by yellowing of the central leaves in grasses and cereals) appears in patches.

2.3 Experimental layout

The experiment was carried out over three months, referred to hereafter as month 1, 2 and 3. The rows of cuttings were planted at 0,59 m between planted cuttings along the row and 0,75 m between rows. In each row were planted 315 cuttings. Two blocks of planted areas were created:

- one for test where the planted cuttings were not treated with insecticide (noted T1, T2 and T3);
- second areas with planted cuttings for treating with eucaliptus oil (10 rows).

On each rows were determined the cuttings that started to grow.

Each time the experimental parcel was placed in the attack are of the wireworms.

For cuttings treatment with eucalyptus oil was used a solution of 80-85 % cineol, applied on cuttings before planting.

2.4. Statistical analysis

Statistical analyses were performed by STATEGRAPHS. Tests of significant differences between herbicide treatments within each sampling occasion were performed and the pooled variance was later used in Fisher's tests after a significant *F*-test. The criterion for significance was set at probability level $p < 0.05$.

3. RESULTS

In table 1 are presented the results for test area.

Table 1 Results for test area

Number of rows	Planted cuttings/row	Cuttings that started to grow
1	315	183
2	315	221
3	315	202

In table 2 are presented the results for treated cuttings.

Table 2 Results for cutting treated with eucalyptus oil (80-85 % cineol)

Number of rows	Planted cuttings/row	Cuttings that started to grow
1	315	3
2	315	6
3	315	3
4	315	0
5	315	0
6	315	2
7	315	0
8	315	2
9	315	1
10	315	2

Each month were made pictures of plant evolution, for each 10th cutting on the row.

Picture 1 presents the aspect of test cuttings after 30 days.

Picture 2 presents the aspect of cuttings treated with eucalyptus oil (80-85 % cineol), after 30 days from the planting moment.

4. DISCUSSION

After statistical tests and practical observations and pictures from the field, could be made next observation:

A. For test area:

- A massive wireworms infestation is observed in situation of test cuttings, which are not treated;

- The attack is very powerful, the worms destroying the bark, sprouts and the young shoots.



Picture 1 Aspects of test cuttings



Picture 2

Aspects of cuttings treated with eucalyptus oil

B. For cuttings treated with eucalyptus oil:

- The eucalyptus oil obstructs the growth and development of the energetic willow cuttings in the culture;

- The oil cannot be used to control pests in energetic willow plantations.

5. CONCLUSIONS

As European country Romania needs to consider the aspects of *Agriotes* attack. It prefer humid climates and are mainly found in Europe. Other members of the Elateridae known as 'wireworms', but introduced *Agriotes* spp. have been gaining importance for some years.

The adult beetles do not cause damage, but the larva is the economically important, destructive stage. It normally lives underground, feeding mainly on roots and tubers of numerous different plant species.

It is necessary to develop a national plan in this area. Also, in specific regions as the west of the country, such systems must be integrated at regional cross-border level, according with the similarly agricultural potential.

The use of eucalyptus oil is not recommended, the most effective for controlling the wireworms in an energetic willow crop are insecticides.

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