

ENERGETICALLY UTILIZABLE PLANTS

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ABSTRACT

This paper deals with energetically utilizable plants. The introduction describes general information about this issue, the main reasons for the cultivation of energy plants and usable positives. It also deals with specific plants for energy use, their description and management, and at the end of this work are the negatives in the cultivation and use of energetically utilizable plants.

1. INTRODUCTION

An important source of renewable energy available energy is biomass, in which solar energy is stored. The term biomass is usually denotes a substance of biological origin, such as plant biomass is cultivated in the soil or in water, animal biomass, organic by-products or organic waste.

Theoretically, to obtain the energy use of all forms of biomass as a fundamental structural element of living matter is carbon and its chemical bonds containing energy. The basic sources of biomass are considered plants that are able to create carbohydrates and then proteins by using solar energy captured by the chlorophyll. In terms of energy use in the Czech Republic it means mostly wood, straw and other agricultural residues and livestock faeces or energy-usable recyclable municipal waste or gaseous products resulting from the operation of wastewater treatment plants. Energy use of biomass is generally considered as desirable and from the point of view of minimizing environmental burdens as fitting.

Interest in the use of biomass as a renewable energy source is increasing mainly in order to reduce the greenhouse gas emissions and bio-waste production. Biomass is one of the renewable energy sources, which is one of its advantages. Another advantage is that it is possible to use surplus land for growing energy crops, or effective landscape maintenance.

Forms of biomass for energy purposes are: biomass for combustion, sugary and starchy crops for ethanol production, oil for the production of fuels and lubricants and biomass for biogas production.

2. ENERGETICALLY UTILIZABLE PLANTS

2.1. Types of plants

Currently are starting to grow plants for the production of phytomass - the so-called energy plantations annual or perennial herbaceous or woody plants. It is around one hundred plant species growing worldwide. Selection of energy plants is determined by many factors such as soil type, methods of use, resources for growing, harvesting, transportation, etc. It is also necessary to compare revenues with the cost of cultivation and production of energy.

The ideal energy crop (ideotyp) should have the following criteria: rapid growth, biomass above ground and furthermore the content of chemical elements, especially nitrogen. Another criterion is that the plants should be among the perennial plants and should well survive the winter. It should be early spring budding and late autumn dying plants with the return of nutrients to the surviving parts of the plant. The crop is expected to grow relatively rapidly even at low temperatures. Plants should be highly resistant to disease and should easily compete weeds. The ideal is low water consumption plants and drought resistance.

Energy crops are plants grown for obtaining hydrocarbons, suitable for the production of energy. Growing energy crops and industrial plants is technologically simpler in comparison with tree species used for the same purpose. In the growing process it is possible to use a similar workflow and technical equipment as for agricultural crops. Plants suitable for cultivation for energy and industrial use in our country can be divided into annual, perennial and hardy.

Annual crops are:

Cereals - uses the technique suitable for other conventional crops. Expansion of cereal production is therefore one of the best options for targeted cultivation for energy and industrial purposes.

Triticale - a hybrid of rye and wheat produces good yields even in less favorable conditions. There is intensive crop, tolerates soil pH is unfavorable, requires less protection against diseases and pests.

Cereals (triticale and winter wheat) - as an energy source is suitable straw after harvest. The grain is used for industrial processing, for feeding purposes or burning, straw is used for feeding, plowing or combustion.

Len setý (*Linum usitatissimum*) is an annual crop suited to areas with higher altitude. Its variants are len přadný and len olejný. One can assume more significant increase of interest for products flax both fiber and seed oil.

Len přadný - the main product is the stem, for industrial use it is molded into cylindrical bales. Flax seed is also industrially processed.

Len olejný - seed that is the major product, is used in oleochemistry such as "drying" oil.



Lnička setá (*Camelina sativa*) in Europe previously grown on large areas, it is easy crop with a short growing season and low agricultural technology. It is suitable for almost all habitats.



Konopí seté (*Cannabis sativa*) is a thermophilic plant consuming the water. It requires fertile soil; the achieved yields are reduced in poorer soils in colder regions. Hemp grows quickly at first, soon creates a lot of leaves and thus suppresses weeds. Characteristic for hemp is very strong fiber. The plants grow to a height of 3.5 m or more. Currently there is not in the Czech Republic capacity for processing hemp straw into fiber.

Laskavec (*Amaranthus sp.*) - a plant known in Central and South America began to grow in recent times in our country. This crop, known mainly in Central and South America began to grow in recent times (from about 1993) also in our country. *Amaranthus* is a robust, highly vigorous plant. This crop is attractive in terms of phytoenergetics for direct combustion. It's thermophilic plant, but economically manages the moisture. *Amaranthus* is well adapted to high temperatures and lack of water. They are therefore ideal for warmer corn and sugar beet production areas in the medium soils, neutral and slightly alkaline. Inappropriate land is overgrown thermophilic species of weeds. *Amaranthus* generates large quantities of materials, therefore, requires a good supply of nutrients, in particular phosphorus.



Sléz přeslenitý (*Malva verticillata*) - was bred as voluminous forage crop. Feeding mallow is high, widely branching stout plant that meets their high stature also as energy crop. It is an annual crop. Sowing mallow is carried out in the period April to May. Growing mallow for energy purposes does not require any special technology or special machinery. Its cultivation can therefore be fully recommended for this purpose to most areas in the whole country, because mallow does not have any special requirements on the climate, it is growing well even at higher altitudes.

Brukev řepka olejka (*Brassica napus*) - rape cultivation in our country very well developed and familiar to farmers. Rape is grown for seeds, which produce high-quality oil. However, recently it is extensively used for the production of biodiesel.

Slunečnice roční (*Helianthus annuus L.*) - Sunflowers are also significant, with us commonly known oilseeds. After harvesting the main product, oilseed, remains of this sturdy plants large amount of overhead material which is not efficiently used and is often the problem with removing of these coarse organic residues. This is essentially a straw, but also on sunflower outfits that remain after seed crushing. These residues after sunflower harvest - at full maturity - can also be used for direct combustion. However, it is necessary that this matter has been sufficiently dried out and adjusted to suitable shapes, such as by cutting the rough chop, which can be considered a certain analogy of wood chips.



Among perennial crops include:

Pupalka bílá (*Oenothera pallida*) - for energy purposes should be used only by-product, i.e. straw. We are recently starting to grow it as an important medicinal plant. Its oil seeds contain a number of outstanding natural substances that readily handles the pharmaceutical industry. This plant is known by us as wild, native to North America. Experience with the use of evening primrose straw has not been sufficient for us yet.

Topinambur hlíznatý (*Helianthus tuberosus L.*) is especially grown for its tubers. In our country they are most often used to feed the deer, or they can be used in the food industry, especially for fructose, glucose and inulin content. Jerusalem artichoke is a perennial plant, which creates numerous irregular tubers, but also a large number of above-ground mass. It grows to a height of 2.5 m. Growing Topinambour for energy purposes appears to be advantageous not only for the relatively high yields of the dry matter, but also because it is a perennial plant, the culture is easily maintained and does not require any special treatment.

Krmný šťovík (*Rumex*) is a type of crops, cultivated in Russia. We have tentatively started to grow a variety called Uteusch. Sorrel is a perennial crop because it can stand on its habitat to 18 years, which is in terms of phytoenergetics undoubtedly very convenient. Sorrel is a robust, high plant that from the second year after the foundation of the culture usually reaches about 2 m high branched stems. Sorrel is resistant to freezing and has no definite site requirements. He's doing well in the lowlands and at higher altitudes. Because it is highly vigorous crop needs to grow and develop enough nutrients in the soil.



Ozdobnice čínská (*Miscanthus sinensis*) is a tall robust grass, reaching up to 4 meters high, which commemorates the reed. It is supposedly a perennial, endures up to 20 years. Data from abroad gives very high yields of this crop and around 20 t / ha aboveground dry matter. For these properties it has been recommended for a number of years (and often still is) in Western Europe for energy use for direct combustion. In these states is basically the only representative of energy plants with herbal character. It comes from Southeast Asia and therefore *Miscanthus* grows well in warmer areas.



For Phytoenergetics can use the energy of grass. These include:

Chrastice rákosovitá (*Phalaris arundinacea*) - naturally widespread across Europe. It is growing well in our country, especially at sites with sufficient soil moisture. It is a tall perennial grass reaches a height of 2 m. It provides high yields and therefore it is also nutrients demanding, but for agricultural engineering it is unassuming. It creates long underground projections, which is i. a. guarantee of its long-term persistence. It is highly adaptable to external influences, since it will not harm the prolonged drought or spring frosts. Even well tolerates short-term flooding or shade. Use of *Phalaris* for phytoenergetic purpose seems to be very promising.

Ovsík vyvýšený (*Arrhenatherum elatius*) - this relatively high perennial grass can also be used for direct combustion. It has a thicker blade, reaching about 80 to 130 cm. It is a domestic grass, and therefore it is growing well in our conditions. *Arrhenatherum* is the grass of spring nature. It is not fitting to harsh conditions.

Among the fast-growing tree species include cottonwood (*Populus L.*). It is a woody plant of rapid growth. Climatic conditions are one of the key factors affecting the vegetation of poplars. Another determining factor is the water regime in the soil. Matching sites are those where the average depth of groundwater is 0.6 - 1 m. Cottonwood harvest is done in the winter months when the trees are leafless, and dry trees reaching 50% of weight.

3. CONCLUSIONS

The main risk associated with the targeted growth of biomass refers to the so-called food security. Given that some energy crops were originally used mainly in the food industry, their use for energy purposes may cause an increase in food prices. Similarly, farmers' transition to growing energy crops from traditional commodities, which are not suitable for energy purposes, has an impact on food shortages and thus increase food prices.

Another disadvantage is occupation of vast areas of introduced plants to the detriment of native flora. The problem lies in the fact that native vegetation is replaced more and more by introduced vegetation, a non-native species. Organisms of consumers, whether it's often rare species of

insects and soil microorganisms, or grand vertebrates, are in most cases dependent on native vegetation, the foreign taste is disgusting to them, or even it is harmful to them. A study of University of Delaware in the USA even demonstrates a significant impact on the birds, who found on introduced tree species smaller food supply.

The best decision is 'everything in moderation'. Otherwise, we will have a few years in Europe, instead of fields and meadows only wood plantations and solar power plants.

REFERENCES

- [1] http://www.mpo-efekt.cz/dokument/99_8089.pdf
- [2] <http://www.vukoz.cz/index.php/sluzby/energeticke-plodiny>
- [3] <http://www.energetickerostliny.cz/>
- [4] <http://www2.zf.jcu.cz/~moudry/databaze/Fytomasa.htm>

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