

# Cleaner Production of Biomass and Biofuels

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**Abstract.** Ukrainian agriculture is an industry which produces a huge quantity of biomass. The main part of the biomass potential is made up by straw. By moderate estimations only 20% of the total amount of straw can be used for energy production. All plant growing and biomass processing technologies can be based on cleaner production methodology. Only a few ecological options in corn growing technology gave real profit, which was ca 220 UAH per hectare. The main steps for rearing *Trichogramma* insects are technical services in laboratory conditions and soft implementation of them on agricultural plants by special aircraft. The most important result of the research is an overview of the possibilities of Ukraine to cover up to 12% of the total primary biomass energy demand for cleaner biofuel production.

**Key words:** Biomass, biofuels, technology, cleaner production

## INTRODUCTION

Agricultural and environmental machinery are both going to change in a number of modern ways. One of them is the service development of technology for the production & use of biomass for energy production. The market analysis of agricultural products testifies the necessity of transformation of agricultural product in the form of raw material into power setting and production of high-grade fertilizers [1, 2]. But sometimes new bioenergy technologies in rural areas stimulate the heaping up of agricultural wastes. Last years we had such experience in cleaner bioenergy production as a result of growing plants and processing biofuels.

## OBJECTS AND METHODS

The objects of research are agricultural technologies of biomass and biofuels production. Implementation of cleaner production (CP) program by UNIDO method provides conditions for increase in income by means of rational use of natural resources [3]. Our practice based on UNIDO Cleaner Production Project in Ukraine covered product development in agriculture and introduced ecologically more sustainable means of production relating to the use of energy, chemicals and other inputs. The main criteria for motivating and stimulating agricultural workers are the following: timely and effective harvesting; minimum losses; minimum wastes and pollution; higher yield of agricultural and other production. All the options are tested by technological, ecological and economical indicators. Implementation of

the abovementioned options into winter rape and corn cultivation technologies turned out to be economically efficient.

## RESULTS AND DISCUSSION

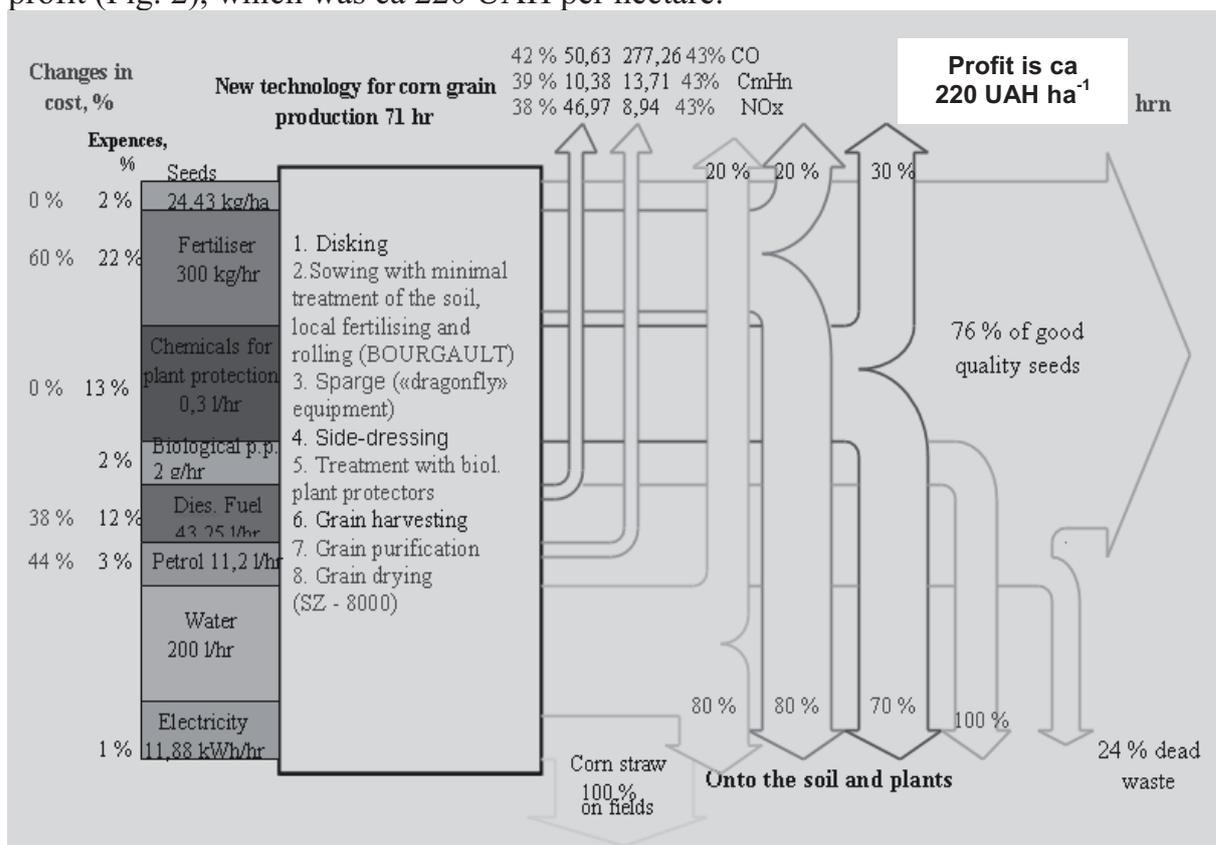
We used UNIDO methodology [3] in developing CP technologies in the field of bioenergy, the algorithms of which are very flexible and can sometimes give a positive result. Our University realized the CP project in an agricultural research station near Kiev in years 2007-2009. A thorough analysis of rape and corn production technologies points at a necessity to implement new energy and material saving processes in crop cultivation.

Taking into account the impact of chemical pest control on farm production and using integral methods of plant control gain more and more ground [4, 5]. Introduction of biological methods of plant protection together with the chemical ones for grain crops will enable to reduce the market production cost by ca 30%. Ecological and biotechnological possibilities of biomass production for energetic purposes are a new way in the development of technologies in rural areas. The modern technology for growing and processing energy plants is based on multistep quality management. The production of special equipment at industrial enterprises seems to be the most promising strategy for the development of the same modern biotechnologies. One of the positive results in our practice was the use of biological methods for plant protection (Fig. 1).



**Fig. 1.** The use of Trichogramma insects for corn protection during plant growth.

Only a few ecological options in the technology for growing corn gave real profit (Fig. 2), which was ca 220 UAH per hectare.



**Fig. 2.** Material flows after implementation of CP options in corn production and processing.

On the way of developing non-food crops and producing energy sources, agricultural and environmental engineering can create a new technique for the production of biofuels from energy crops, building materials, genetically modified organisms and plant cloning. Agricultural and environmental engineering have to transform agricultural production into analogues of energy or industrial engineering. The main part of biomass potential is made up by straw. According to moderate estimations only 20% of the total amount of straw can be used for energy production. Straw is burnt as briquettes, pellets, pressed rolls or bales [4]. Today we develop technologies for processing and using all kinds of solid biofuels. According to our conception some types of biomass will be used in our country. These are straw from cereal crops, stems from maize, sunflower, manure, wood wastes, and so on. There is a huge potential of straw for energy tests amounting from 7 to 12 million tons per year. The results of power use of biofuels from biomass have created a new generation of heating devices which have an output-input ratio in a scope from 85 to 90%.

There is strong interest in liquid biofuel production in the field of agriculture. The potential area to be used for growing oil plants is approximately 6 million hectares. Ca 3 million of them may be squares for rape cultivation. Our University in cooperation with VUZT (Prague) has launched a demonstration project for

manufacturing methyl ether from rape and for the production of other oil seeds amounting to 1,000 tons per year (Fig. 3).



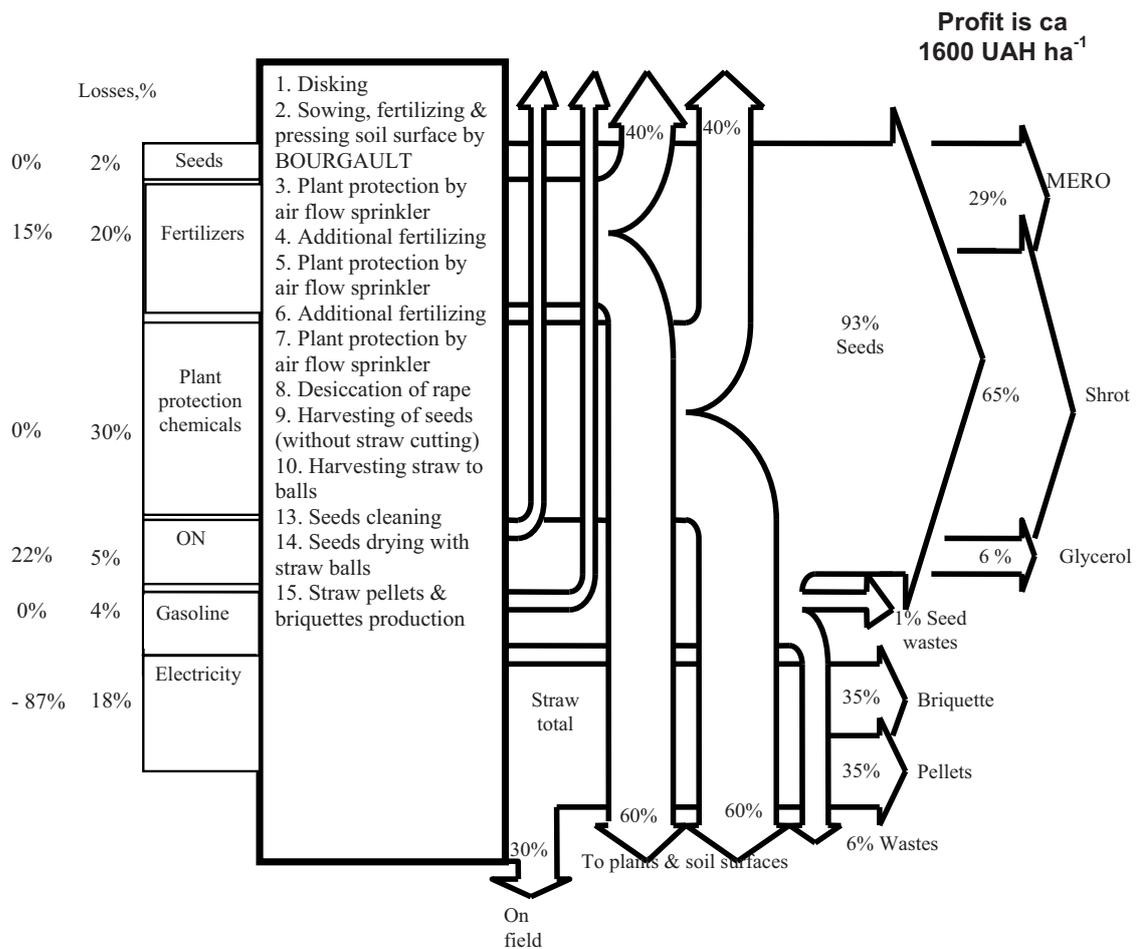
**Fig. 3.** A pilot plant for methyl ether production from oil seeds.

Domestic practice shows us that it is possible to get 1,200 liters of biodiesel, 2 tons of mill cake and more than 2 tons of solid biofuels in granules or briquettes from one hectare of energy crops.

The CP technologies can be introduced applying the tillage-sowing machine Bourgault, the Dragonfly sprayer, the Biomasser briquette line, the ECO-BIO 100 granulation line, partial replacement of common diesel fuel by biodiesel, the use of new automatic boilers P6-KOBA-25, a grain dryer, a rolling press and biological methods for plant protection. Implementation of the above mentioned options into a technology of winter rape cultivation proved economically very efficient. Energy saving options gave real profit due to new bioenergy technologies [5]. It was ca 200 USD per hectare (Fig. 4).

For example, positive ecological effect was achieved due to the reduction of soil damage, decrease in the use of chemicals and fertilizers, replacement of common diesel by its mixture with biodiesel (emissions of CO<sub>2</sub> were reduced by 50.5 kg) and introduction of granules and briquettes.

As a result of the implementation of CP project, the company actively develops a new ecological policy and is open to dialogue and cooperation in fields of environmental protection with community representatives, authorities and other interested parties in the agricultural complex of Ukraine.



**Fig. 4.** Material flows after implementation of CP options in rape production and processing.

The development of CP bioenergy technologies would reduce Ukraine's dependence on imported energy carriers, enhance its energy security at the expense of organizing energy supply based on local renewable sources, create a lot of new jobs and contribute greatly to the improvement of the ecological situation.

## CONCLUSIONS

Ukraine has high potential of biomass available for energy production. Biomass (excluding the share that is used by other sectors of economy) can cover up to 12% of the total primary energy demand.

Every type of biomass in real conditions has several new effective complex technologies for biofuel production. A few ecological options in the technology of corn growing gave ca 220 UAH profit per hectare. The use of rape for energy purposes based on new technology raised its efficiency to more than 1,600 UAH per hectare.

There is possibility to grow up energetic plants on 10-20% of arable lands in Ukraine. Taking into account the European requirements, in 2010 we have to be ready to produce about 250 thousands tons of biodiesel.

All projects in bioenergy sphere are designed better, when we use the modern strategy for cleaner production, which is promoted by UNIDO.

## REFERENCES

- Dubrovin, V., M. Melnychuk. Trends in development of agricultural and environmental engineering in Ukraine / *Proceedings of the 5th CEE Ag Eng Conference.*– Kiev: NAUU, 2007. – Part 1. – P. 15-27.
- Amon, T., Pötsch, E., Amon, B., Kryvoruchko, V., Bodiroza, V., Zollitsch, W. (2006): Methane production from cereals, sun flower and maize: Optimisation of the methane yield per hectare through time of harvesting, variety and pre-treatment. In: Dechema e.V.: *ACHEMA 2006, 28th International Exhibition-Congress in Chemical Engineering, Environmental Protection and Biotechnology*, 15–19 May 2006, Frankfurt am Main / Germany, 271
- UNIDO Cleaner Production Toolkit. – UNIDO, 2006.
- Біопалива (Технології, машини, обладнання)/ В.О.Дубровін, М.О.Корчемний, І.П.Масло та інші – К.: ЦТІ 'Енергетика і електрифікація', 2004.-256 с.
- Біоенергія в Україні – розвиток сільських територій та можливості для окремих громад. /За редакцією Дубровіна В. О., Анни Гжибек та Любарського В. М.– Kaunas: IAE LUA, 2009.– 120 с.