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BIOMASS YIELD AT MAIZE UNDER DIFFERENT TECHNOLOGICAL CONDITIONS

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Abstract

The aim of the paper is to present the biomass yields at maize under different technological conditions (two soil tillage, respectively ploughing and harrowing, and two preceding crops, respectively maize and sunflower) in the specific growing conditions from South Romania. In this respect, researches were performed in field experiments located in South Romania (44°29' N latitude and 26°15' E longitude), under rainfed conditions in the year 2014. Six maize hybrids were studied under two soil tillage (ploughing and harrowing) and under two preceding crops (maize and sunflower). The biomass determinations were performed in the early dough-dough plant growth stage, respectively in the growth stage when the maize biomass is of importance to be used as substrate for producing biogas. The results revealed that ploughing and maize as preceding crop have determined the highest fresh and dry biomass yields.

***Key words*:** *biomass, maize, preceding crop, soil tillage, yield*

INTRODUCTION

Biomass presents an increasing importance as source of fuels (solid, liquid and gas) [1]. Among different sources of biomass, the crop biomass both as energy crops or crop residues is one of great importance [4]. Energy crops used for biogas production should provide high dry matter yield and high methane output per area unit, but also they should be easy to cultivate, i.e. to be tolerant to weeds, pests, diseases, drought and frost, and to be able to grow with low nutrient input [2]. Maize (*Zea mays* L.) is one of the plants which fulfil these requirements, this having a high potential of producing biomass.

Maize can be used as source of biomass for producing biogas both as energy crop or crop residues. In fact, maize is considered to be one of the most important sources of biomass for producing biogas. But producing biomass is affected by the environmental, biological and technological factors, all these factors having to be well and correctly managed by the maize grower.

The biomass of maize plant is depending on a sum of growth factors among which the cultivated hybrid, plant population, row spacing and soil conditions have a significant influence on the accumulation of the above-ground biomass and its repartition between plant components [3]. One of the conditions to produce biomass in an efficient way is the use of the most appropriate cultivation techniques [4]. Among the cultivation techniques, the preceding crop within crop rotation and soil tillage are of great importance.

Crop rotation is considered to be a way of increasing the yields without bearing any costs. However, even when crop rotation is practiced, yields can be limited if particular crops are grown frequently [5].

Concerning the soil tillage, many farmers are converting to reduce tillage systems to reduce soil erosion and field-work time requirements, and to remain eligible for government programs [5]. Tillage is one of the highest power-required processes of agricultural production, and in addition, the high cost of energy today forces farmers to find alternative economic tillage [6].

The aim of this paper is to present the biomass yields at maize under different technological conditions (two soil tillage, respectively ploughing and harrowing, and two preceding

crops, respectively maize and sunflower) in the specific growing conditions from South Romania.

MATERIALS AND METHODS

Researches were performed in field experiments located in South Romania, respectively at Moara Domneasca Experimental Farm belonging to the University of Agronomic Sciences and Veterinary Medicine of Bucharest (44°29' N latitude and 26°15' E longitude). The field experiments were performed under rainfed conditions in the year 2014.

For the period April-August 2014, the average temperature was of 18.8°C, while the multiannual average temperature for this period is of 18.5°C. For the same period, the sum of rainfall was of 408.0 mm, while the multiannual average rainfall is of 313.2 mm.

The specific soil from Moara Domneasca area is reddish preluvosoil, with a humus content between 2.2 and 2.8%, a clay loam texture, and a pH between 6.2 and 6.6.

Six maize hybrids were studied, respectively: ES Method (FAO precocity group 380), ES Antalia (FAO precocity group 450), Korimbos (FAO precocity group 530), Janett (FAO precocity group 540), Mikado (FAO precocity group 550), ES Feria (FAO precocity group 550).

Every hybrid was studied under two soil tillage, respectively ploughing and harrowing, and under two preceding crops, respectively maize and sunflower.

Sowing was performed on 30th of April 2014, at row spacing of 50 cm and at plant density of 80,000 plants.ha^{-1}. Fertilization was performed with 106 kg.ha^{-1} of nitrogen and 60 kg.ha^{-1} of phosphorus. The weed control was performed by the help of herbicides, which were completed by one manual hoeing.

Each variant consisted in six lines with a length of 10 m.

In each experimental variant the maize plants from half of square meter (four plants, respectively the plants along one meter of row length at the row spacing of 50 cm) were cut at soil level and were weighed immediately in the field in view to be determined the fresh biomass yield, respectively the yield of above-ground biomass. One average maize plant for each variant was taken into the laboratory and dried in the oven at 80°C for 24 hours in view to be determined the dry biomass yield.

Determinations were performed in three replications in the early dough-dough plant growth stage, respectively in the growth stage when the maize biomass is of importance to be used as substrate for producing biogas. The data are presented and analyzed in the paper as average values for the six studied maize hybrids and are referring to the fresh and dry biomass as above-ground biomass.

RESULTS AND DISCUSSIONS

Fresh and dry biomass yield at maize registered different values according to preceding crop and soil tillage.

The highest fresh biomass yields were registered under ploughing as soil tillage and after maize as preceding crop (Fig. 1). Under these conditions, the average fresh biomass yield was of 59.02 tons.ha^{-1} for the six maize hybrids and the three replications for each hybrid, with a maximum value of 74.13 tons.ha^{-1}.

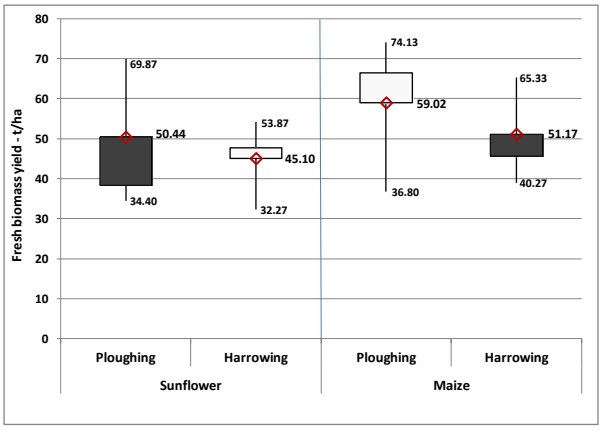

Fig. 1. Fresh biomass yield at maize under different preceding crops and soil tillage (average values and limits of variations for each experimental variant)

Ploughing conditions determined the highest fresh biomass yields compared to harrowing, but also the highest variation of fresh biomass yields (Fig. 1).

Thus, under ploughing conditions the fresh biomass yields varied between 36.8 and 74.13 tons.ha^{-1} for maize as preceding crop and

between 34.4 and 69.87 tons.ha^{-1} for sunflower as preceding crop.
Under harrowing conditions the fresh biomass yields varied between 40.27 and 65.33 tons.ha^{-1} for maize as preceding crop and between 32.27 and 53.87 tons.ha^{-1} for sunflower as preceding crop.
As average values, the highest fresh biomass yields were obtained under ploughing conditions (54.85 tons.ha^{-1}) compared to harrowing conditions (48.22 tons.ha^{-1}).
Also, the highest fresh biomass yields were obtained after maize (54.99 tons.ha^{-1}) as preceding crop compared to sunflower (47.70 tons.ha^{-1}) (Fig. 2).

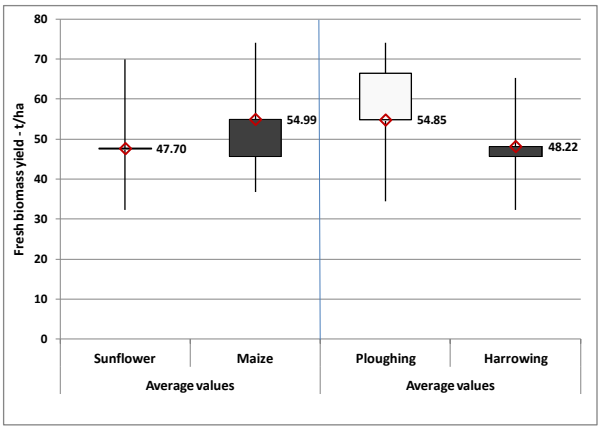

Fig. 2. Fresh biomass yield at maize, as average values for different preceding crops and soil tillage

As in the case of fresh biomass yields, the highest average dry biomass yield was registered under ploughing as soil tillage and maize as preceding crop (Fig. 3).
Thus, under these conditions, the average dry biomass yield was of 20.76 tons.ha^{-1} for the six maize hybrids and the three replications for each hybrid.
But, the maximum value for the dry biomass yield was registered under ploughing as soil tillage and sunflower as preceding crop, respectively 27.64 tons.ha^{-1}.
Also, as in the case of fresh biomass yields, ploughing conditions determined the highest dry biomass yields compared to harrowing, but also the highest variation of dry biomass yields (Fig. 3).
Thus, under ploughing conditions the dry biomass yields varied between 15.40 and 25.92 tons.ha^{-1} for maize as preceding crop and between 12.65 and 27.64 tons.ha^{-1} for sunflower as preceding crop. Under harrowing conditions the dry biomass yields varied between 14.64 and 21.18 tons.ha^{-1} for maize as preceding crop and between 11.17 and 20.56 tons.ha^{-1} for sunflower as preceding crop.

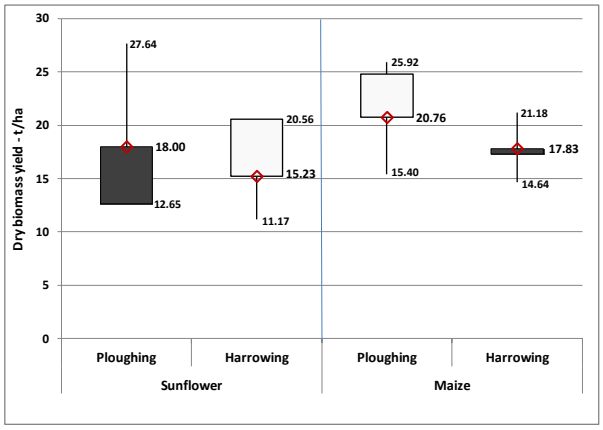

Fig. 3. Dry biomass yield at maize under different preceding crops and soil tillage (average values and limits of variations for each experimental variant)

As in the case of fresh biomass yields, the highest dry biomass yields as average values were obtained under ploughing conditions (19.38 tons.ha^{-1}) compared to harrowing (16.53 tons.ha^{-1}).
Also, the highest dry biomass yields were obtained after maize (19.29 tons.ha^{-1}) as preceding crop compared to sunflower (16.62 tons.ha^{-1}) (Fig. 4).

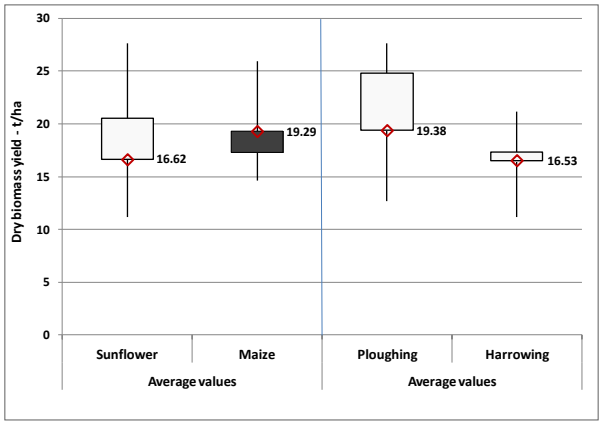

Fig. 4. Dry biomass yield at maize, as average values for different preceding crops and soil tillage

In average for the six maize hybrids and the three replications for each hybrid, under different soil tillage conditions and under different preceding crops, the share of dry

biomass on plant components varied as follows: between 31.3 and 33.7% for stalk, leaf sheaths and tassel; between 17.3 and 17.7% for leaf blades; between 43.0 and 44.5% for ears; between 6.0 and 6.9% for husks (Fig. 5).

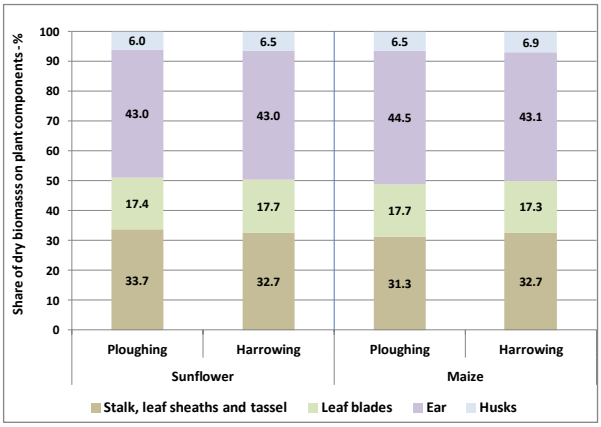

Fig. 5. Share of dry biomass on maize plant components under different preceding crops and soil tillage

As average values, between the two preceding crops (maize and sunflower), maize determined a higher share of dry biomass for ears (43.8%) and husks (6.7%), while sunflower determined a higher share of dry biomass for stalks, leaf sheaths and tassel (33.2%).

Between the two soil tillage (ploughing and harrowing), ploughing determined a higher share of dry biomass for ears (43.7%), while harrowing determined a higher share of dry biomass for stalks, leaf sheaths and tassel (32.7%) and tassel (6.7%).

It is interesting to notice that the share of dry biomass for leaf blades was the same (17.5%) for all the experimental variants (Fig. 4).

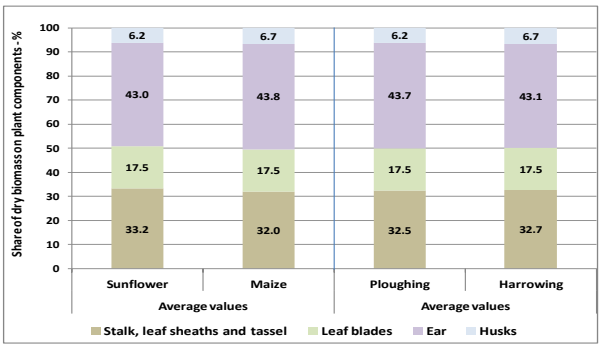

Fig. 6. Share of dry biomass on maize plant components, as average values for different preceding crops and soil tillage

CONCLUSIONS

Ploughing has determined the highest fresh and dry biomass yields compared to harrowing, but also the highest variations of the yields.

Among the two studied preceding crops (maize and sunflower), maize determined the highest fresh and dry biomass yields.

The combination of ploughing and maize as preceding crop has determined the highest fresh and dry biomass yields.

Also, this combination of ploughing and maize as preceding crop as technological conditions has determined the highest share of dry biomass on ears.

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