

MISCANTUS PRODUCTIVITY IN VARIOUS FERTILIZATION RATES

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Among the many herbaceous plants cereals take significant place in terms of their worldwide distribution, importance and diverse use. Representatives of the miscanthus genus are among the most productive cereals that have received wide recognition in the last decade. First of all, this is a natural hybrid – a miscanthus giant. Plants of this genus are well known as fodder, ornamental, technical, cellulose, phytomeliorative etc. In the recent period, the focus of both the scientific community and producers has been drawn to the use of miscanthus as an energy plant as a source for the production of various types of biofuels [1, p. 50].

The problem of the use of alternative sources of energy from renewable raw materials is becoming more urgent for today's society in the connection with the energy crisis and the deteriorating environmental condition [2, p. 152].

Until the beginning of the fifth century, miscanthus was only used in China as an anti-erosion plant. Most likely he came to Europe in the XVI century, but it was used only as a finishing plant. In 1935, Danish scientist Ansel Olsen brought to Europe a Japanese clone, which became the basis for the selection of plants used until now. Due to the great harvest, Karl Foster named this plant *Miscanthus sinensis* «Giganteus». From a scientific point of view, this plant was studied for the first time in 1983 at the Plant Breeding Station in Denmark. Since then, intensive research has been carried out on this culture in many European countries, namely Germany, the United Kingdom, Italy, France, Spain, Poland [3, p. 86].

The widespread introduction of miscanthus into the crop culture will contribute not only to the production of renewable energy from biomass, but also to the improvement of the ecological status of Ukraine's agricultural landscapes [4, p. 6].

When growing phyto-energy crops, an important element of technology is the use of fertilizers to increase the yield of vegetative mass. Therefore, it is necessary to investigate the growth, development and productivity of miscanthus plants, depending on the nutritional background. One of the important conditions for

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obtaining high miscanthus yields at rational costs for its cultivation is to determine optimal fertilizer rates. According to Professor V. Zinchenko, with a yield of 20 tonnes of dry miscanthus weight per 1 ha, about 60 kg of N, 16 kg of P₂O₅, 80 kg of K₂O are harvested at low fertilizer levels. Application of nitrogen fertilizers up to 90 kg / ha has a very positive effect on the production of biomass. Common nutrient requirements are as follows: nitrogen (N) 2-5, phosphorus (P) 0.3-1.1 kg / t of dry weight [5, p. 131].

A promising area of researches is further study as for establishing the economic feasibility and payback of different doses of fertilizers, as well as exploring new technology elements for growing miscanthus.

The purpose of the research was to study the productivity of miscanthus at different doses of fertilizers as a promising energy crop for biofuels production in the northeastern part of the Forest-Steppe of Ukraine.

The researches were carried out on the basis of the educational and scientific production center of Sumy National Agrarian University according to the conventional methods [6] during 2018-2019. Soils of the experimental field of chernozem are typical powerful heavy-loamy medium humus, characterized by the following indicators: humus content in the arable layer (according to I.V. Tiurny) – 4.0%, the reaction of soil solution is close to neutral (pH 6.5), the content of easily hydrolyzed nitrogen (according to I.V. Tiurny) 9.0 mg, mobile phosphorus and metabolic potassium (according to F. Chyrikov) respectively 14 mg and 6.7 mg per 100 soil.

Agrotechnics in the experiment corresponded to the recommended at the time of their conduct for the area of the northeastern part of the Forest-Steppe of Ukraine, except for the agro-measure which was provided by the scheme of the experiment for the study, namely the dose of mineral fertilizers. Among nitrogen fertilizers we used ammonium nitrate.

The field experiments were laid out in a randomized manner in triplicate. The accounting area of the elementary plot was 50 m². Miscanthus Osinnii Zoretsvit was used as the study material.

Scheme of experience:

- control (without fertilizers);
- N₃₀ – application in the tillering phase;
- N₆₀ – application in the tillering phase;

The growth and development rates of miscanthus plants during the growing season make it possible to influence well-timed the process of formation of high crop productivity.

Formation of overground mass of miscanthus, height in particular, depends on the morphological features of the variety, hydrothermal and agrotechnological measures, including fertilizer. Thus, in the fertilizer-free version, the height of the main shoot was the lowest during the whole growing

season. In the second decade of July the height of the plants under control was 172.4 cm, while in the fertilized variants it was higher by 14.0-39.2 cm. In August, the height of the main shoot of miscanthus was on average 29-31 cm higher than in July. In August, the height of the main shoot ranged from 201.3 to 241.8 cm, depending on the variants studied. The maximum height of 241.8 cm was observed in the fertilizer variant N_{60} , and the lowest 201.3 cm was observed in the fertilizer-free version.

In the summer, from the end of July, the lower leaves grow old, because the developed leaf potential of the crop prevents sufficient plant light. In the autumn after the first frost, aging accelerates and nutrients accumulate in the rhizomes. The leaves die off, and subsequently the stems dry out during the winter to relatively low moisture content. Accordingly the weight of the plant decreases.

At the end of the growing season (late August to early September) the weight of the plants ranged from 48.5 to 77.0 g, in the version N_{60} . The lowest weight of the plants was observed in the control – 48.5 g, which is more by 20.5 g in variant N_{30} and 28.5 g in variant N_{60} . Thus, the maximum weight was 77.0 g in variant N_{60} .

The weight of the dry plant in the control was 25.1 g, N_{30} – 32.5 g, N_{60} – 37.1 g. The maximum weight of the dry plant was noted in variant N_{60} – 37.1 g, which is more than 4.6 g in variant N_{30} and 12 g in the control.

An important indicator that determines the size of the assimilation surface per unit area is the density of the stem, which, unlike the density of standing plants depends on the features of their development, in particular the ability to form additional shoots in specific conditions.

The sampling density of miscanthus plants with application of different fertilizer doses varied. Thus, the highest density was observed in variant N_{60} and was 42 pieces per m^2 ; slightly lower density was obtained in variant N_{30} – 38 pieces per m^2 and the lowest density was formed at the control of 37.0 pieces per m^2 .

The main indicator of the miscanthus giant in terms of economic value as biomass is yield. The yield of miscanthus plants increased with the introduction of mineral fertilizers (Figure 1).

Analyzing the miscanthus giant yield over the years of research and according to variants, it was noted that the maximum yield by fertilizer doses was obtained on variant N_{60} – 15.58 t/ha, which is more by 20.7% for variant N_{30} (12.35 t/ha) and 40.4% for control (9.29 t/ha).

According to the results of the research, it was found that the best conditions for the growth, development and formation of the crop formed on the variant with the application of mineral fertilizers at a dose of N_{60} . The application of mineral fertilizers at the dose of N_{60} ensured a maximum height of 241.8 cm, the weight of the dry plant was 37.1 g, with a pre-harvesting density of 42.0 pieces per m^2 and yield of 15.58 t/ha.

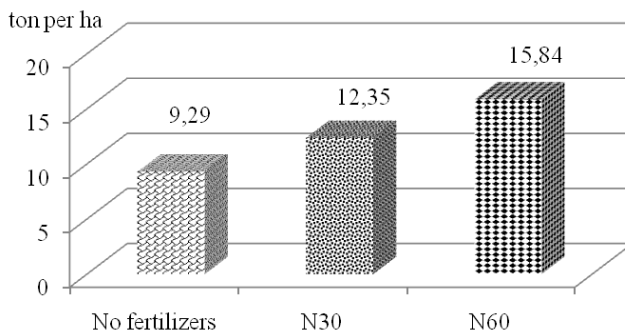


Figure 1. The yield of dry biomass of miscanthus plants depending on the dose of mineral fertilizers (average for 2018-2019), t / ha

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