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FEATURES OF FORMATION OF MISCANTHUS PLANTING MATERIAL IN CONDITIONS OF DRIP IRRIGATION

Abstract. To establish the biological characteristics of growth and development of plants and the formation of planting material of miscanthus under conditions of drip irrigation. **Methods.** Field, laboratory, visual, measuring, weight, mathematical-statistical. **Results.** Represented the effectiveness of cultivation of planting material of miscanthus under conditions of drip irrigation without the application of Maxi Marin absorbent and when it is added to the period of planting of the rhizome. High survival of miscanthus plants in transplanting them from growing to open ground is established. In the conditions of drip irrigation it was 4.9% (without absorbent) and 3.3% (for making absorbent) more than without irrigation was. Drip irrigation significantly influenced the plant height and the formation of stems, while the introduction of absorbent was observed only a tendency of increase of these indicators. Introducing absorbent in rainfed conditions has resulted in a substantial increase in the content of free water in the leaves of miscanthus. Drip irrigation has contributed to intensive growth of not only land mass, and the mass of roots that provided a significant increase in the yield of planting material - the rhizome. The average for years of research weight uterine rhizome in drip irrigation was greater in control (without absorbent) by 62.8%, or 917,9 g than the absorbent application, respectively, the 61.8% or 912,7 g compared to irrigated conditions. **Conclusions.** The use of an absorbent as in rainfed conditions without irrigation, and in drip irrigation did not provide the increase of biometric parameters of the plants, weight of roots and, consequently, the output of planting material - the rhizome. The increase of these indicators was significantly affected only drip irrigation. In drip irrigation without any absorbent and when it is added from one of the ovaries rhizomes obtained mass was 15-20 g in 1.5 and weighing 25-30 g in 1.4 times more compared to the cultivation of ovaries without irrigation.

Key words: plant height, number of stems, free water, bound water, mass of rhizomes, rhizome.

Introduction. The signing by Ukraine of the Association Agreement with the European Union requires a review of the strategic priorities for the development of the main sectors of the national economy, especially those that base their activities on the use of natural resources and influence the formation of the assimilation potential of the territories [1].

Ukraine is energy dependent and only partially supplies itself with its own energy resources, so it has to import about 65% of fossil energy resources [2,3]. Traditional fuel due to combustion increases the carbon dioxide content of the atmosphere. Bioenergy crops are a more environmentally friendly source of energy. The use of biofuels will contribute to the epidemiological situation; meeting the requirements of the Kyoto Protocol to the United Nations Framework Convention on Climate Change [4].

A significant alternative to traditional fuels today is biofuels, which are produced from plant bio-energy raw materials grown on low-productive and degraded lands, removed from crop rotation and not used for crop production [5]. Ukraine has all the opportunities to grow bioenergy crops for biofuels: favorable soil and climate conditions for growing plants, low-productive land, a variety of adapted plant species usable in biofuels, varieties of bioenergy crops, science-based technologies and their cultivation.

The leading place among bioenergy crops used for the production of solid fuels is miscanthus. It is a very strong and hardy plant and after a single planting, its creeping rhizome will give new shoots annually [6].

Since miscanthus is a water-loving culture, providing it with moisture is very important for enhancing the photosynthetic activity of plants and, accordingly, improving its productivity. The formation of moisture in the soil is possible due to rainfall, the application of irrigation or absorbents, which contribute to the planting of seedlings in the soil. In conditions of insufficient and unstable moisture, irrigation is one of the main factors for the intensification of agriculture, where guaranteed yields can be obtained only if it is applied.

One way to increase the yield of planting material is to grow miscanthus under drip irrigation. Irrigation drip is not only a means of saving water, but also a mechanism for significantly increasing crop yields [7,8]. This method allows to save up to 450% of water in comparison with irrigation on furrows, in comparison with micro-sprinkling - almost 3 times. provides the normalized supply of water directly to the area of the root system of plants, improve the physic-chemical processes in the soil, as well as to create optimal conditions for the growth and development of the seed plants [9]. Drip irrigation for growing crops has allowed to increase their productivity by 30-50% with savings of irrigation water 3-5 times, mineral fertilizers by 20-40%, energy resources by 50-70%, etc. [10,11]. This irrigation reduces the evaporation of water from the soil surface, since part of the area remains dry [12];

Research on the effectiveness of drip irrigation has been carried out on many crops: corn [13], soybean [14], chicory [15], milk thistle [16], rice [17] and others. There is no information on the effectiveness of drip irrigation for the cultivation of miscanthus planting material.

For industrial miscanthus cultivation, as a raw material for biofuels, it is important to provide its producers with sufficient quality planting material. At present, there is no technology for growing miscanthus planting material, which would ensure a high viability of the rhizome and maximize their yield. Therefore, it is relevant to study the peculiarities of formation of miscanthus planting material in the conditions of drip irrigation, which was the task of research.

The purpose of the research is to establish biological features of plant growth and development and the formation of miscanthus planting material in the conditions of drip irrigation.

Materials and methods of research. The research program was intended to determine the peculiarities of the formation of miscanthus planting material in the conditions of drip irrigation and the use of absorbent both without irrigation and with irrigation for the accumulation of moisture near the plants.

Field and laboratory studies of miscanthus giganteus (Miscanthus giganteus JMGreef & Deuter ex Hodkinson & Renvoize) were carried out at the Institute of Bioenergy Crops and Sugar Beets of NAAS and Uman (now - the NASU Tobacco Research Station), located in the central part of the Right-bank Forest Steppe of Ukraine, in the zone of unstable humidity, characterized by temperate continental climate, during 2013-2015.

The scheme of the experiment provides for the complex application of technology elements: factor A - growing conditions: without irrigation and in conditions of drip irrigation; factor B - introduction of MaxiMarin absorbent: control - without absorbent; absorbent granules per well of 1 g. The area of the sowing area - 50 m^2, the accounting area - 25 m^2, the repetition - 4 times.

The soil of the Uman DST chernozem is gravelly loamy with low humus content in the arable layer of 0-30 cm - 3.31%. The thickness of the humus profile is 52–60 cm. The reaction of the soil solution is slightly acidic, pH 6.0–6.1, the hydrolytic acidity is 1.5–2.5 mmol / 1 kg of soil, the degree of saturation of the alkalises is 85–93%. The content of mobile phosphorus compounds is 119 mg / kg and exchange potassium 101 mg / kg soil (according to Chirikov - increased availability). Provision of soil with nitrogen is average (Cornfield) and is 64 mg / kg soil.

Meteorological conditions during the years of research (2013-2015) were difficult, deviations from typical weather conditions were noted. From the three years of the 2013 and 2015 research, there was an insufficient amount of rainfall; accordingly, during the growing season, the moisture deficit was 58.1 and 73.2 mm (figure 1).

During these years, the effectiveness of the use of drip irrigation and absorbent for the accumulation of moisture that was in the soil around the rhizome was better demonstrated. Only in 2014, the amount of precipitation during the growing season was higher than the average of many years by 31.8 mm, which effectively negated the effect of drip irrigation and absorbent.

The limiting factor for obtaining high crop yields in Ukraine is the insufficient and uneven supply of plants with moisture during the growing season. At the present stage of agriculture, a number of effective agro-measures aimed at increasing the production of soil moisture and rational use of soil have been

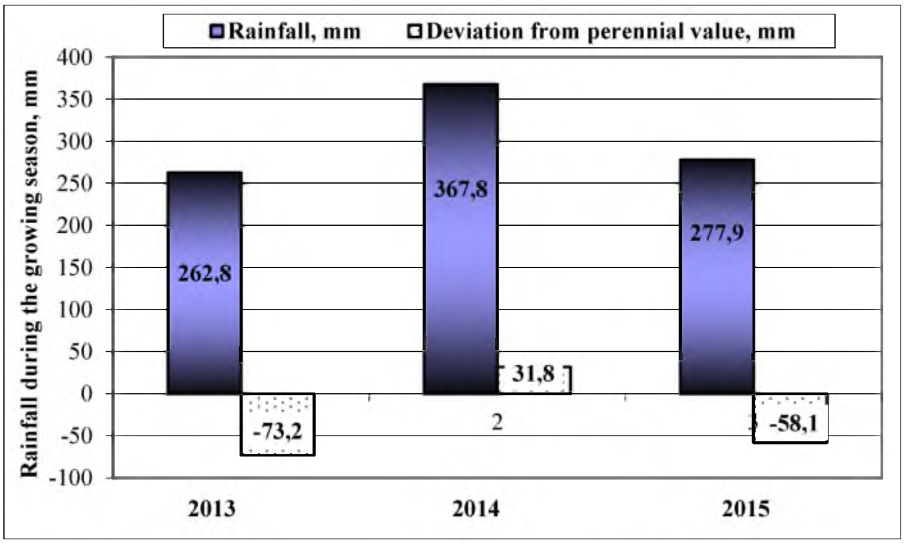

Figure 1 – Supply of moisture during the growing season during the years of research

studied and tested, but the search for new and more effective measures is continuing. One such measure is the use of environmentally friendly polymers in agriculture [18].

To improve the water supply of miscanthus plants, drip irrigation and granules of MaxiMarin absorbent were used, which at a time when soil moisture was sufficient, absorbed and retained it, turning it into jelly-like granules. Absorbent pellets contain a quantity of liquid that is hundreds of times greater than their own mass: one kilogram of absorbent holds 400 liters of water [19], and during drought give this moisture to the plants, which creates favorable conditions for maximum survival of the planting material, for plant growth and development, and thus significantly affect the yield of planting material (rhizome). The combined use of drip irrigation and absorbent granules will ensure a stable water supply to plants at a lower water consumption for irrigation.

MaxiMarin absorbent - insoluble in water, cross-linked copolymer of polyacrylamide and potassium polyacrylate, which has a nutrient humane component of natural origin. The drugs optimize plant growth by significantly reducing water and fertilizer losses during washing and evaporation, especially in harsh soil conditions with sharp variations in temperature and humidity.

All records and observations were performed on the plants of the first year of vegetation. The field experiments determined: the dynamics of emergence of seedlings (from the first single sprouting to full sprouting) by the method of the Institute of Bioenergy Crops and Sugar Beet NAAS [20], plant survival (the ratio of similar to planted rhizomes) [21], the intensity of plant growth (height of plants, number of stems) by developmental stages [20], free and bound water content in plant ovaries. The mass fraction of free water in the leaves of plants was determined by the refractometric method according to the method of A. F. Marynchyk (1957). The amount of bound water was set as the difference between the amount of total water and conditionally free water. Weight of rhizomes by weighing them. Statistical processing of experimental data was carried out using Fischer method of variance and correlation [22] using StatSoft computer program Statistica 6.0.

Research results. The planting material was propagated through in vitro culture by growing and transplanting into open ground. The survival rate of miscanthus plants for transplants from growing in the open ground for an average of three years was high and was 90.0% in rainfed conditions without the use of absorbent (control), with its use 93,4%, 94.4% in the conditions of drip irrigation, respectively 94.9 % and 96.7%

Autumn-winter moisture reserve in the soil and spring precipitation contributed to the common shoots appear. In all the years of research, the emergence of stairs started after 10-12 days from planting in the soil regardless of growing conditions. Full germination was obtained by 24-27 days from the date of planting in the open ground. There was no significant difference in the intensity of germination in the control and depending on the absorbent application because all the plants were in the same soil and climatic conditions. There were no significant deviations in the passage of the phases of development of

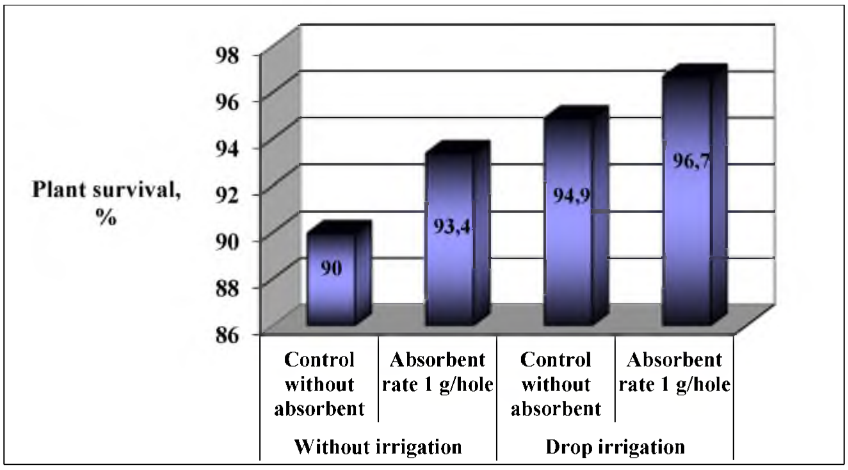

Figure 2 – Miscanthus survival rate (%) for open-field grafting transplantation (Uman RSS, 2013-2015)

miscanthus under conditions of drip irrigation as in the control and use of absorbent compared to bogarne conditions – without the use of irrigation.

But plants under drip irrigation had the best view and all the phenological phases of development took place for 2-3 days longer than in plants where there was no irrigation, which affected the duration of the vegetative period, which was in irrigated condition longer than 6-7 days and was 191 (for making absorbent) and 192 (control – without making absorbent) days. In rainfed conditions, the duration of the vegetation period as in control – without absorbent, and with its use was the same and amounted to 185 days (figure 3).

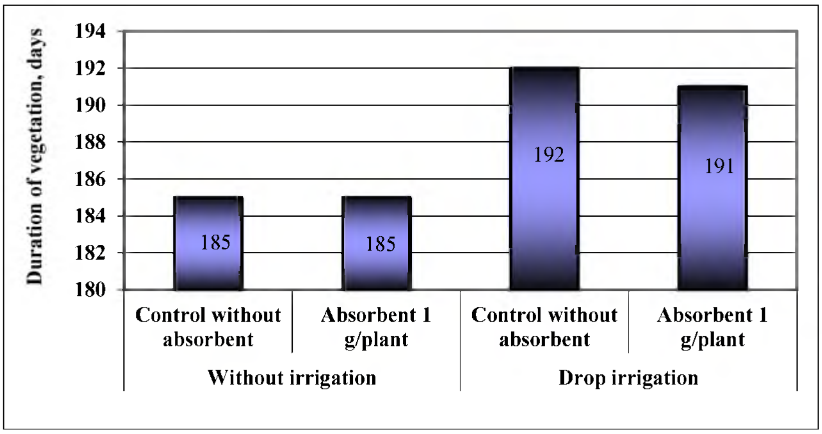

Figure 3 – The duration of the growing season, depending on the growing conditions of miscanthus (average for 2013-2015)

The use of absorbent in rainfall - without irrigation, and in the conditions of drip irrigation did not increase the biometric characteristics of plants. For an average of three years, the height of the plants in the tillering phase (mid-May) in rainy conditions in control - without the introduction of absorbent and when it was introduced was the same and was 88.9 cm in irrigation conditions 92.7 in control and 91.8 cm in application absorbent $HIP_{0,05}$ absorbent = 2.3 cm). No significant difference was found from the height of the plants in the tube exit phase (end of August), depending on the absorbent application in both rainy conditions and drip irrigation.

It was found that growing miscanthus under drip irrigation provided a significant increase in plant height compared to rainy conditions. Thus, on average, of three years into the control phase of the tube exit - without irrigation, the plant height was 180.8 cm, and in the conditions of drip irrigation the plants were 34,2 cm higher, with the introduction of absorbent and drip irrigation the plants were higher by 34,9 cm. A significant increase was obtained from the number of stems both in the tillering phase and in the tube exit phase by drip irrigation (table 1).

Table 1 – Plant biometric indices for miscanthus cultivation under drip irrigation conditions (Uman RSS, 2014-2015)

Variant		The tillering phase		Exit into the tubus	
Growing conditions	Introduced absorbent, g/hole	plant height, cm	number of stems, pcs.	plant height, cm	number of stems, pcs.
Without irrigation	Control without absorbent	88,9	35,5	180,8	47,6
	1,0	88,9	38,3	184,7	51,0
Drop irrigation	Control without absorbent	92,7	47,8	215,0	68,2
	1,0	91,8	48,0	219,6	71,7
$HIP_{0,05\ common}$		3,2	2,4	2,4	2,8
$HIP_{0,05\ irrigation}$		2,3	2,1	2,1	2,2
$HIP_{0,05\ absorbent}$		2,3	2,1	2,1	2,2

The use of absorbent in rainfall conditions significantly influenced the formation of the number of stems. On average, during the years of research, the introduction of absorbent provided an increase in the number of stems in the tillering phase by 2.8 pcs., In the tube exit phase by 3.4 pcs. $HIP_{0,05\ absorbent}$ = 2.1 and 2.2 pcs, respectively). In the conditions of drip irrigation, there was no significant increase in the number of stems depending on the absorbent application in the tillering phase, either on average during the years of research or separately during the years of experiments. In the phase of the tube was observed a significant increase in the number of stems, depending on the use of absorbent.

In plant ovaries, two states of water are noted, one is similar to that of pure water (free water), the other is the result of favorable energy interactions with macromolecular macromolecules, molecules and cellular juice ions (bound water) [23]. In case of excessive humidity, the ratio of free and bound water in the leaves is in favor of free water, and in the absence of moisture, on the contrary, in favor of bound water [24].

Water supply to plants affects the amount of bound and free water in the leaves and their ratio. For excess moisture, the ratio of free and bound water in the leaves in favor of free water, and in the absence of moisture on the contrary - in favor of bound water. It was found that of drip irrigation both in control and in the introduction of absorbent, the free water in the ovaries was significantly greater than without irrigation (table 2).

Table 2 – The content of free and bound water in plant ovaries depending on the growing conditions of miscanthus (Uman RSS, the average for 2013-2015)

Variant		Water content in plants, %	
Growing conditions	Introduced absorbent, g/hole	free	bound
Without irrigation	Control without absorbent	31,8	35,9
	1,0	32,7	36,0
Drop irrigation	Control without absorbent	33,1	36,3
	1,0	33,2	36,6
$HIP_{0,05\ common}$		0,5	0,6
$HIP_{0,05\ irrigation}$		0,4	0,4
$HIP_{0,05\ absorbent}$		0,4	0,4

The use of absorbent in rainy conditions provided a significant increase in the amount of free water in the leaves compared to the control - without absorbent. In the conditions of drip irrigation there was no significant increase in free water in the leaves compared to the control. The content of bound water in the leaves of plants also varied depending on the water supply. There was a tendency to reduce the content of this water in the control - without absorbent compared to the variants, where the absorbent was applied both without irrigation and for its use. For an average of three years in rainy conditions, the content of bound water was 36.0% for the introduction of the absorbent, and 35.9% for the control without the absorbent. In the conditions of drip irrigation with the introduction of absorbent, the content of bound water was 36.6%, in the control - without absorbent - 36.3%. Similar results were obtained from years of research

The productivity of plants depends on the intensity of photosynthesis, the content of chlorophyll in plants, which is determined primarily by the genotypic features and conditions of its cultivation within the norm of the genotype reaction. It was found that the content of chlorophyll in the leaves was influenced by both the use of absorbent and drip irrigation. Growing miscanthus under drip irrigation provided a significant increase in the amount of chlorophyll compared to non-irrigation conditions. On average, over the three years in the control without irrigation and without absorbent, the chlorophyll content was 2.45%, while in the conditions of drip irrigation it increased by 0.16%. Similar results were obtained in variants with the introduction of absorbent.

Soil-climatic and agrotechnological conditions contributed to the intensive growth of not only the terrestrial mass of plants, but also the mass of rhizomes, which provided an increase in the yield of planting material - rhizomes. It was found that the mass of uterine rhizomes was significantly influenced by drip irrigation. On average, during the years of research, the weight of uterine rhizomes under drip irrigation was 62.8% or 917.9 g higher in control (without absorbent) by 61.8% or 912.7 g, respectively, compared to non-irrigated conditions (figure 4).

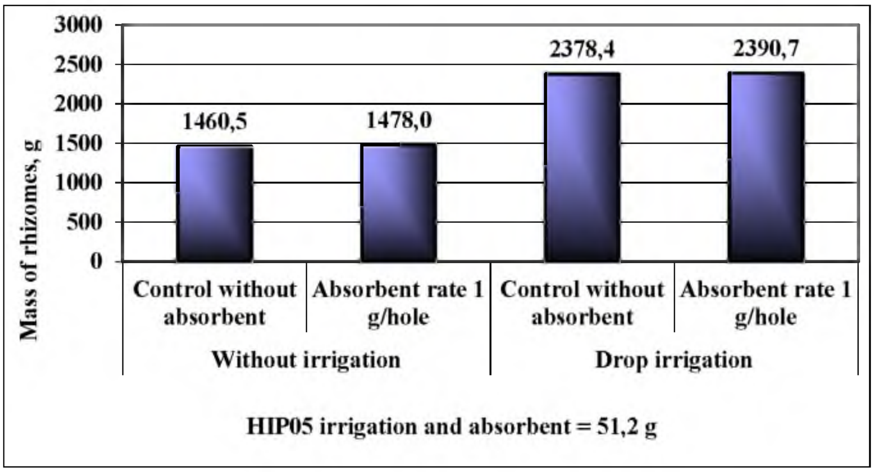

Figure 4 – The mass of rhizomes at the end of the growing season depending on the growing conditions of miscanthus (Uman RSS, average for 2014-2015)

The use of absorbent both without the irrigation, and in drip irrigation did not significantly increase the uterine weight of rhizomes, there was only a tendency to increase it. So, on average, for two years under rainfed conditions of use of the absorbent contributed to the increase in mass of rhizomes 17.5 g, in the conditions of drip irrigation by 12.3 g ($HIP_{0,05\ absorbent}$ = 51 g). Similar results were obtained for the study years.

The mass of rhizomes of miscanthu modifiable by soil-climatic and agro-technological conditions of its cultivation. The variability of the mass of uterine rhizomes over the years of research reproduces the phenotypic nature of this trait, where the cultivation of seedlings without irrigation and without making absorbent (control) in average for two years, 45.2% of uterine roots had a mass from 1451 g to 1475 g, and only 22,6%, from 1476 to 1500 g, rhizomes of more than 1500 g was only 3.2%. The deviation between the extremes variants ranged from 1423 to 1498 grams for the average of 1461. When making absorbent, there were no uterine rhizomes weighing less than 1425 grams, and 50% had a weight of more than 1476 g with variation of the sign from 1445 to 1515,0 grams for the average value of 1478 grams.

In the conditions of drip irrigation all uterine rhizomes weighing more than 2325 g. Without the use of absorbent (control) 46.7% of rhizomes had a mass of 2376 to 2425 g. When making absorbent, there were no uterine rhizomes weighing less than 2350 g , and 86,7% - had weight from 2376 to 2425 g. The deviation between the extremes variants ranged from 2355 to 2425 grams for the average 2391 g. That is, the use of absorbent during the period of rhizome planting and drip irrigation the mass of the uterine rhizomes increased but the deviation between the minimum and the maximum mass decreases which indicates phenotypic changes in this index.

With the increase in the uterine weight of rhizomes increased the yield of rhizome. It is proved that the use of drip irrigation both without the absorbent and when its using in average for years of researches provided the receipt from one of the-ovaries of the rhizome weight of 15-20 g in 1.5 and rhizome weighing 25-30 g in 1.4 times more compared to the cultivation of ovaries without irrigation (table 3).

Table 3 – The exit of the rhizomes at the end of the growing season, depending on the growing conditions of miscanthus (Uman RSS, the average for 2014-2015.)

Variant		Number of rhizomes, pcs.	
Growing conditions	Introduced absorbent, g/hole	weighing 15-20 g	weighing 25-30 g
Without irrigation	Control without absorbent	28,0	28,5
	1,0	28,5	29,6
Drop irrigation	Control without absorbent	42,1	40,1
	1,0	42,4	40,6
$HIP_{0,05\ common}$		1,2	1,3
$HIP_{0,05\ irrigation}$		0,9	1,2
$HIP_{0,05\ absorbent}$		0,9	1,2

The use of absorbent did not provide a reliable increase in the yield of rhizomes in rainfall conditions and drip irrigation, there was only a tendency to increase them. Thus, on average during the years of the study for drip irrigation (control - without absorbent) from one uterine rhizome was obtained rhizomes weighing 15-20 g 42.1 pieces, rhizomes weighing 25-30 g - 40.1 pieces, at the same time as the introduction the absorbent was obtained rhizomes, respectively - 42,4 and 40,6 pieces or more by 0.3 $HIP_{0,05\ absorbent}$ = 0.9 pcs.) and 0.5 pcs. $HIP_{0,05\ absorbent}$ = 1.2 pcs.). In rainy conditions, similar results were obtained. That is, the use of absorbent with a flow rate of 1 g / well did not provide a significant increase in the weight of the rhizome and, accordingly, the yield of planting material.

Conclusions. 1. The survival rate of miscanthus for transplants from growing in the open ground, both in the conditions of drip irrigation, and without its use was higher with the introduction of absorbent, compared with options where the drug was not introduced and was without the use of absorbent (control) 92.5%, with its use - 95.1%.

2. The introduction of absorbent in rainy conditions provided a significant increase in the amount of free water in the leaves compared to the control - without absorbent. In the conditions of drip irrigation there was no significant increase in free water in the leaves compared to the control.

3. The use of absorbent in rainfall conditions - without irrigation, and in the conditions of drip irrigation did not provide an increase in biometric indices of plants, rhizome mass and, accordingly, the yield of planting material – rhizomes. Only drip irrigation was significantly affected by the increase in these indicators.

4. The use of drip irrigation, both without the introduction of absorbent, and for its application has ensured obtaining from one ovariy rhizomes weighing 15-20 g in 1.5 and weighing 25-30 g in 1.4 times more than growing ovaries without irrigation.

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ТАМШЫЛАТЫП СУАРУ ЖАҒДАЙЫНДА МИСКАНТУС ОТЫРҒЫЗУ МАТЕРИАЛЫН ҚАЛЫПТАСТЫРУ ЕРЕКШЕЛІКТЕРІ

В. А. Доронин[1], В. Синченко[1], В. В. Дрига[1], Ю. Кравченко[1], В. В. Полищук[2], В. П. Николайко[3], Т. В. Полищук[3]

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ОСОБЕННОСТИ ФОРМИРОВАНИЯ ПОСАДОЧНОГО МАТЕРИАЛА МИСКАНТУС В УСЛОВИЯХ КАПЕЛЬНОГО ОРОШЕНИЯ

Аннотация. Поставлена цель – установить биологические особенности роста и развития растений и формирования посадочного материала мискантуса в условиях капельного орошения.

Методы. Программой исследования предполагалось определить особенности формирования посадочного материала мискантуса в условиях капельного орошения и применения абсорбента как без орошения, так и с поливами для аккумуляции влаги у растений. Основными методами исследования являются: полевой, лабораторный, визуальный, измерительно-весовой, математически-статистический.

Результаты. Освещены эффективность выращивания посадочного материала мискантуса в условиях капельного орошения как без применения абсорбента MaxiMarin, так и при его внесении в период посадки ризом. Установлена высокая приживаемость растений мискантуса при пересадке их для доращивания в открытый грунт, который в условиях капельного орошения был на 4,9% (без абсорбента) и на 3,3% (при внесении абсорбента) больше, чем без поливов. Капельное орошение существенно влияло на высоту растений и формирования стеблей, в то время как после внесения абсорбента наблюдалась лишь тенденция повышения этих показателей. Внесения абсорбента в богарных условиях обеспечило существенное повышение содержания свободной воды в листьях мискантуса. Капельное орошение способствовало интенсивному нарастанию не только наземной массы растений, а и массы корневища, что обеспечило достоверное повышение выхода посадочного материала – ризом. В среднем за годы исследований масса маточных корневищ при капельном орошении была больше в контроле (без применения абсорбента) на 62,8% или на 917,9 г при внесении абсорбента – соответственно на 61,8% или 912,7 г по сравнению с поливными условиями.

Продуктивность растений зависит от интенсивности прохождения фотосинтеза, от содержания в растениях хлорофилла, что обусловлено, прежде всего, генотиповыми особенностями и, в пределах нормы, реакции генотипа – условиями его выращивания. Установлено, что на содержание хлорофилла в листьях влияли как применение абсорбента, так и капельное орошение. Выращивание мискантуса в условиях капельного орошения обеспечило существенное увеличение количества хлорофилла по сравнению с не поливными условиями. В среднем за три года в контроле – без полива и без абсорбента содержание хлорофилла составил 2,45%, в то время как в условиях капельного орошения он увеличился на 0,16%. Аналогичные результаты получены в вариантах с внесением абсорбента.

Ограничивающим фактором получения высоких урожаев сельскохозяйственных культур в Украине является недостаточное и неравномерное обеспечение растений влагой в течение вегетации. На современном этапе земледелия изучен и апробирован целый ряд эффективных агромероприятий, направленных на увеличение запасов продуктивной влаги в почве и рационального ее использования, на поиск новых и эффективных мероприятий. Одним из таких мероприятий является применение в земледелии экологически безопасных полимеров.

Выводы. Применение абсорбента как в богарных условиях – без орошения, так и в условиях капельного орошения не обеспечило увеличение биометрических показателей растений, массы корневища и, соответственно, выхода посадочного материала – ризом. На увеличение этих показателей существенно влияло только капельное орошение. При капельном орошении без внесения абсорбента и при его внесении с одного маточника получено ризом массой 15-20 г в 1,5 раза и массой 25-30 г в 1,4 раза больше по сравнению с выращиванием маточников без орошения.

Ключевые слова: высота растений, количество стеблей, свободная вода, связанная вода, масса корневища, ризом.

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REFERENCES

[1] Hmyria V.P., Polishchuk V.V., Kozachenko I.V., Sovgira S.V. (2019) Investment support for the development of the forestry of ukraine in the context improving the country forest resource potential. Bulletin of National Academy of sciences of the Republic of Kazakhstan, 1 (377): 249–255 (in Eng.).

[2] Royik M.V., Kurylo V.L., Hanzhenko O.M., Humentyk M.Ya. (2012) Perspectives of bioenergy development in Ukraine. Sugar beet. N 2–3. P. 6–8 (in Ukr.).

[3] Blyum Ya.B., Hryhoryuk I.P., Dmytruk K.V. (2014). System of use of bioresources in the latest biotechnologies of alternative fuels production. Kiev: Agrarian Media Group. 360 p. (in Ukr.).

[4] Kaletnyk H.M. (2008) Development of the biofuels market in Ukraine. Kiev. Agrarian Science. 461 p. (in Ukr.).

[5] Vojodymyr A. Doronin, Viktoriya V. Dryha, Lesia M. Karpuk, (2018). Specific aspects of the formation of Miscanthus planting material dtpending on cultivation conditions. EurAsian Journal Biosci. 12 (2). P. 325-331 (in Ukr.).

[6] Humentyk M.Ya. (2011) Similarity of miscanthus depending on variation of planting depth of rhizomes. Scientific papers of the Institute of Bioenergy Crops and Sugar Beets: Coll. Sciences. Kiev. Issue 12. P. 55–61 (in Ukr.).

[7] Romashchenko M.I., Koryunenko V.M., Kalyenikov A.T. (2004). Micro-irrigation of agricultural crops. Melioration and water management. Issue 90. P. 63-86 (in Ukr.).

[8] Pysarenko V.A., Kokovikhin S.V., Pysarenko P.V. (2005) Recommendations on crop irrigation regmes in Kherson region. Kherson: Island. 20 p. (in Ukr.).

[9] Kutovyy V.A. (2007) Irrigation efficiency depending on irrigatin methods on seeds of two-year crops. Vegetables and melons. Issue 53 (in Ukr.).

[10] Koryunenko V.M., Matviyets′ O.H. (2004) Drop irrigation - the basis of agrotechnology of the XXI century. Panorama. 14 (9288), 8 (in Ukr.).

[11] Molyanov V.D., Moiseyev M.Yu. (2003) Drip irrigation on potato fields. Potatoes and vegetables. 1, 24-25. (in Ukr.).

[12] Romashchenko M.I. (2012) Drop irrigation of vegetables and potatoes in the conditions of the Steppe of Ukraine. K.: DIA. 248 p. (in Ukr.).

[13] Lavrynenko Yu.O., Kokovikhin S.V., Pysarenko P.V. (2009). Corn on irrigated lands of southern Ukraine. Kherson: Island. 428 p. (in Ukr.).

[14] Netis V.I. (2017) Soybean cultivation technologies under irrigation conditions. Irrigated agriculture: present, problems, prospects: materials of a regional scientific-practical Internet conference (Dnipro, November 2-3, 2017) [To the 80th anniversary of Professor Kiver V.H.]. Dnipro: SDAUU. P. 71-73 (in Ukr.).

[15] Mykolayko V.P. (2016) Features of growth and development of seed plants of chicory root crops depending on agrotechnological conditions of seed cultivation. Scientific works of Podilsky Agrarian and Technological University: Coll. Sciences. Kamyanets-Podilskyi Ave. Issue 24. Part I. P. 151-158 (in Ukr.).

[16] Domyn A.V., Tkachova Ye.S., Hamayunova V.V. (2015) Advantages and prospects of drip irrigation in the Steppe zone of Ukraine. The latest technologies of agro-industrial production: materials of the All-Ukrainian Scientific and Practical Conference of Students (Kirovograd, April 15-17, 2015). Kirovograd. P. 21-23 (in Ukr.).

[17] Averchev O. Osiniy O. (2016) Agroecological substantiation of rice cultivation on drip irrigation in the south of Ukraine. Breeding, seed production, technologies for growing cereals and other crops, achievements and prospects: International materials. scientific and practical conference. (Kamianets-Podilskyi City, April 26-28, 2016) Ternopil: Step. P. 100-102. (in Ukr.).

[18] Horobets′ A.M., Moroz O.V., Smirnykh V.M., Most′ovna N.A., Shopsha H.M., Repa L.P., Yaroshchuk T.A. (2012) Use of Maximarin Superabsorbent to Improve Sugar Beet Moisture. Sugar beet. N 2. P. 20-22 (in Ukr.).

[19] MaxiMarin - Super-obslrbent. 2013. URL: https://fialka.tomsk.ru/forum/viewtopic.php?t=35416(in Eng.).

[20] Methods of Research in Beet Growing / Ed. M.V. Royika, N.H. Hizbullina. Kyiv: FOP Korzun D. Yu., 2014. 374 p. (in Ukr.).

[21] Kovalchuk V.P., Vasil'yev V.G., Boyko L.V., Zosimov V.D. (2010) Collection of methods for studying soils and plants. Kiev: Trud-GriPol-XXI century. 252 p. (in Ukr.).

[22] Fisher R. A. (2006) Statistical methods for research workers. New Delhi : Cosmo Publications. 354 p. (in Eng)

[23] Mykhaylyk V.A., Davydova O.O. (2019) The state of water during dehydration of parenchymal tissues of sugar beet before and after long-term storage. Bioenergy. N 1 (13). P. 31-34 (in Ukr.).

[24] Ushkarenko V. O. (1994) Irrigated agriculture. Kiev: Harvest. 325 p. (in Ukr.).