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THE FEATURES OF WATER CONSUMPTION OF SUGAR SORGHUM IN EASTERN FOREST STEPPE IN UKRAINE

It was shown the results of research for using soil moisture at different interphase periods of sorghum plants. It was proved the dependence of the coefficient of water consumption of sugar sorghum from row spacing and plant density.

***Keywords**: moisture, sugar sorghum, water consumption, yields.*

The introduction. Under the modern conditions of agricultural production in Ukraine the crucial importance is the perspective of resource capabilities of sorghum crops growing, their production, possibilities of consumption and using. From annual crops sugar sorghum is one of the most high-energy and cost-effective crops. However, the issue of the moisture providing level of sorghum plants, especially during the germination period and during the critical phases of plants development with water, has been insufficiently studied [1].

One of the most important environmental characteristics of the soil is moisture resistant withering. It is known that this index depends on the amount of soil colloids and clay minerals. The moisture withering also depends on the absorptive capacity of the root system of plants. The last parameter defines the lower level of accessible moisture for plants in the soil. For modern hybrids and varieties of sorghum sugar is no data about the coefficient of withering and its influence on reserves of productive moisture and its balance in the soil in the scientific literature. The **goal** of our researches was the establishment the features of water consumption for sugar sorghum plants in different interphase periods of its development [2-4].

The materials and methods of research. The research was carried out during the 2010-2012 on Veselopodilsky experimental breeding station, Semenov district, Poltava region by the scheme:

Factor A - row of width	70 cm (control)
	45 cm
Factor B - density of plant standing	120 thousand/ha (control)
	160 thousand/ha
	200 thousand/ha

The total area of sowing plot is 50 m^2, accounting plot – 25 m^2. The repeated of experiments – 4-time. It was studied the maximum hygroscopicity of soil (MGS), moisture resistant withering, density and soil moisture [5-6].

The results of research. The water content of soil of sorghum plant depends on the stocks of productive moisture in the meter of soil layer. Largely on these stocks is affecting the lower limit of productive moisture, determined by the moisture resistant withering. Therefore, it were selected the soil samples on the horizons of typical chernozem soil and were determined the MGS and withering coefficient for different crops (table 1). The maximum hygroscopicity of the soil belongs to the main water constants, that characterizing the soil moisture. It is known that this index depends on the granulometric composition of the soil, and the presence of humus in the soil.

Table 1

The basic indicators of soil moisture and coefficient of withering of various crops (2010-2012)

The layer of soil, cm	The maximum hygroscopicity of the soil, %	The coefficient of withering		
		millet	corn	sorghum
0-25	8,61	1,47	1,64	1,17
40-60	8,33	1,51	1,59	1,20
60-80	8,21	1,49	1,58	1,18
80-100	7,29	1,43	1,56	1,14
0-100	8,11	1,47	1,57	1,17

The obtained data testify in table 1 about decrease of the maximum hygroscopicity of the soil in the lower layers, which is closely related to the amount of organic matter. On average by profile, this index is 8.11 and represented by the form of hygroscopic moisture completely which is unavailable for plants. The experimental researches have established moisture resistant withering for various crops and the estimated the coefficient of withering indicates that is for millet it was on average 1.47 for corn - 1.59, and for sorghum - 1.17. It shows that the root system of sorghum plants capable by the higher osmotic pressure absorbs the filmy form of moisture in the soil.

The conducted observations of sorghum plant growth and development has been found that in the first phase of development (in phase 5-7 leaves) the root system develops rapidly and reaches a depth of 110 cm. The overground part of plants is developing very slowly and had a height up to 38 cm in this period. This makes it possible to more efficiently use of moisture from the deeper layers of the soil. With the specified biological properties of sorghum plants, even in extremely dry periods for three to four weeks in the end of the summer vegetation continues until the first autumn frost. These results of researches confirm that sorghum is fairly high drought-resistant crops. The reason is that during the soil and air drought sorghum stops growing and goes into antibiotic condition from which emanate under the appropriate conditions [7-8].

For order to characterize the water consumption of sorghum sowing were analyzed the stocks of productive moisture in the meter soil layer on the main phases of plant growth and development. Typically, for the autumn-winter period in our conditions the meter layer of soil is well moistened and at the time of sowing, in the second decade of May, productive moisture reserves totaled 174.1 - 226.5 mm. During the growing season of sorghum plants the stocks of productive moisture is decreasing during the mass flowering period and reaches a level 64.1 - 110.4 mm.

It was established that during the growing season the loss of water by the plants is uneven. In some periods sorghum spends it less, and in other – more. These expenses depend on the development of aboveground plant mass, the length of the growing season and revenues of the water from atmospheric precipitation (Table 2).

Table 2

The balance of soil moisture of sorghum sowing in the main periods of growth and development (2010-2012)

Indexes	The interphase period, the row of width 70 cm, the density of plant standing, 120 thousand/ha					
	seeding-tillering	tillering - out of the tube	out of the tube - ejection of panicle	ejection of panicle - flowering	flowering -full ripeness	seeding - full ripeness
The revenues of water with precipitation, m^3/ha	514	426	513	138	560	2151
The total water consumption, m^3/ha	298	432	807	1192	759	3488
The average duration of interphase period, days	26	17	24	7	45	119
The average daily water consumption, m^3/ha	10,6	22,6	30,9	132,0	15,6	26,0
The water consumption by period of vegetation,% from total	8,4	12,2	23,8	34,3	21,3	100

According to obtained data (table 2) at different interphase periods of sorghum plant the water from precipitation received at the level of 426 - 560 m^3/ha an average of three years, except during ejection from the flowering panicle (138 m^3/ha). But the overall expense for this period, which lasted an average of nine days, were the largest and were 1195 m^3/ha. In this case the average daily water consumption was 132.0 m^3/ha. For the conditions of the Eastern forest steppes the important period of sorghum plants is between from the going of plants in the tube to the ejection panicle. It continues on average 26 days on average daily water consumption 30.9 m^3/ha, that makes 23.8% of

total expense. Thus, sorghum plants consuming water unevenly: the most of it (55.1%) is used for 35 days between phases out of the tube - flowering.

The analysis of water consumption of sorghum plants during the growing season depending on the elements of technology was showed the following (table 3).

Table 3

The water consumption of sorghum plants depending on the width of row and plant density, average of 2010-2012

Width of row, cm	Plant density, thousand/ha	The total water consumption, m^3/ha	Yield, t/ha		Coefficient of water consumption, m^3/ha
			vegetative mass	dry matter	
45	120	3502	34,6	5,77	852
	160	3478	31,3	5,69	638
	200	3556	35,7	6,13	645
70	120	3518	39,2	6,32	835
	160	3530	37,5	6,19	692
	200	3576	41,2	6,62	701
$LSD_{0,05}$			4,3	1,1	

Depending on the width of the row the total water supply changed from 3478 - 3556 m^3/ha and at the 45 cm width of the row to 3518-3576 m^3/ha to the 70 cm width of the row. The coefficient of water consumption was 638-852 and 692-835 m^3/ha. That is, the total water consumption and its coefficient was greater than the width of the row 70 cm. These features influenced on the yield of sorghum: vegetative mass yield by the width of the row 70 cm was at 4,6-6,2 t/ha dry matter - was 0,49-0,55 t/ha more than on the width of the row 45 cm.

Regard to density of sorghum plant standing, the most optimal, it was during the years of researches - 200 thousand plants per 1 ha, where the yield of green mass was 35,7-41,2 t/ha the dry matter - 6,13-6,62 t/ha, the coefficient of water consumption was 645 - 701 m^3/ha, on the control according 39.2, 6.32 t/ha and 835 m^3/ha.

The conclusions. 1. In the low moisture conditions in Eastern forest-steppe the withering coefficient of sorghum was 1,14-1,2, that significantly less than in millet and corn – respectively 1,43-1,51 and 1,56-1,64.

2. During the vegetation sorghum plants are consuming water unevenly: the most intense 55% of water consumption is going 35 days between phases "out of the tube - flowering".

3. In eastern forest-steppes the total water consumption and its coefficient depends on the width of row and the density of plants standing. These indicators were higher by the sowing with 70 cm width of row and density of plant standing 200 thousand/ha, where the yield of vegetative mass and dry matter were respectively 41.2 and 6.62 t/ha.

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Анотація

Сторожик Л.І.

Особливості водоспоживання сорго цукрового в Східному Лісостепу України

Наведені результати досліджень щодо використання вологи ґрунту у різні міжфазні періоди розвитку рослин сорго. Встановлена залежність коефіцієнта водоспоживання сорго цукрового від ширини міжрядь та густоти рослин.

Ключові слова: *волога, сорго, водоспоживання, урожайність.*

Аннотация

Сторожик Л.И.

Особенности водопотребления сорго сахарного в Восточной Лесостепи Украины

Приведены результаты исследований по использованию почвенной влаги в различные межфазные периоды развития растений сорго. Установлена зависимость коэффициента водопотребления сорго сахарного от ширины междурядий и густоты стояния растений.

Ключевые слова: *влага, сорго, водопотребления, урожайность.*

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ЕНЕРГЕТИЧНА ЕФЕКТИВНІСТЬ ВИРОЩУВАННЯ РІЗНИХ ГІБРИДІВ ЦУКРОВИХ БУРЯКІВ ЗАЛЕЖНО ВІД ПОЗАКОРЕНЕВОГО ПІДЖИВЛЕННЯ МІКРОДОБРИВАМИ

Представлені результати досліджень з вивчення енергетичної ефективності мікродобрив "Реаком-р-бурякове", "Реастім ріст бурякове", "Реастім гумус бурякове" у позакореневе підживлення цукрових буряків. Найбільш енергетично ефективним було внесення мікродобрива "Реастім гумус бурякове" в фазі змикання листків в міжряддях при вирощуванні гібрида Весто: енергоємність врожаю – 267,1 ГДж/га, енерговитрати – 41,7 ГДж/га, Кее – 6,41.

Ключові слова: *мікродобрива, гібриди, енергоємність врожаю, енерговитрати, Кее .*

Вступ. В світовій практиці в останні роки поряд з традиційними методами оцінки ефективності виробництва сільськогосподарських культур через вартісні і трудові витрати все більшої популярності набуває метод енергетичної оцінки агротехнологій. Метод базується на порівнянні енергії акумульованої в урожаї з енергію витраченою на вирощування культур. Застосування цього методу дозволяє знайти шляхи скорочення витрат енергії, акумульованої в засобах виробництва, і сприяє удосконаленню технологічних прийомів вирощування сільськогосподарських культур [1].

Добрива здатні суттєво підвищувати урожайність вирощуваних культур на фоні помірних енерговитрат, що є важливим елементом на шляху підвищення енергетичної ефективності агротехнологій [2-4]

Матеріали і методика досліджень. Дослідження проводили в умовах польового досліду (2008-2010 рр.) на Уладово-Люлинецькій дослідно-селекційній станції (Правобережна частина Лісостепу України). Ґрунтова відміна чорнозем типовий вилугуваний легкосуглинковий. В дослідах вивчався вплив позакореневого внесення мікродобрив «Реаком-р-бурякове», «Реастім ріст бурякове», «Реастім гумус бурякове» на енергетичну ефективність вирощування різних гібридів цукрових буряків.

Площа посівної ділянки – 75 м^2, облікової – 50 м^2, повторність – чотириразова.

Агрохімічна характеристика орного 0-30 см шару ґрунту: вміст гумусу за Тюріним – 4,0-4,2%, рухомого фосфору та калію за Чиріковим – відповідно 150-190 і 70-80 мг/кг ґрунту,