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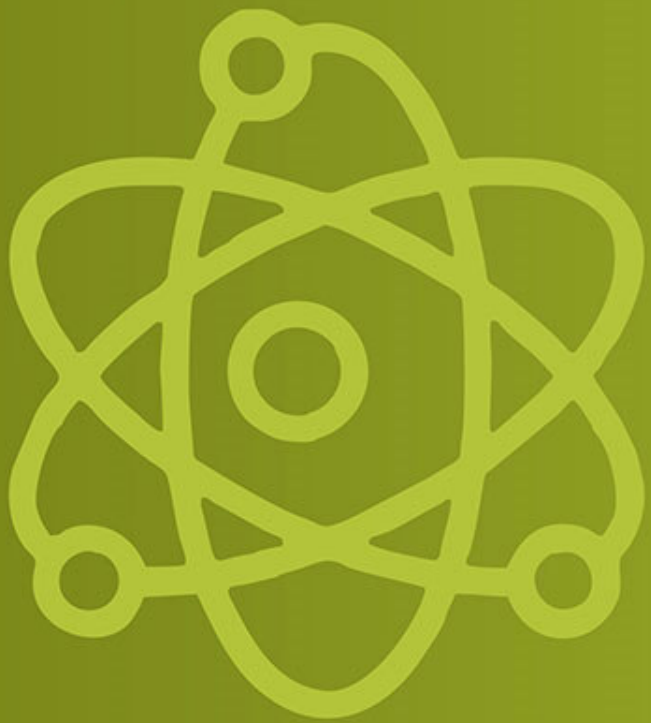

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WATER CONSUMPTION OF SOYBEAN VARIETIES WITH DRIP IRRIGATION IN THE ARID STEPPE OF UKRAINE

Abstract. The study of the influence of the cenosis density of soybean varieties of different ripeness groups on the indicators of water consumption and grain yield has been carried out. The relationship between the indicators of water consumption and the yield of soybean grain under drip irrigation in the arid steppe of Ukraine has been investigated.

Keywords: soybeans, sowing density, drip irrigation, yield, total water consumption.

1. Introduction

Drip irrigation is a method of supplying water with the simultaneous introduction of herbicides, pesticides and growth-regulating agents into the root system of plants, which makes it possible to reduce their consumption. At the same time, there is a decrease in material costs for technical measures, weed control. Drip irrigation involves the use of a drip dispenser that irrigates the roots drop by drop. Wells and open reservoirs can be used as a source of drip irrigation.

The first drip dispenser was created in Israel in 1959 by Simcha Blass at Kibbutz Hatzerim. The drip irrigation system became quite successful and later appeared in Australia, North and South America in the late 1960 s. In the early 1960 s, the first drip tape appeared in the USA thanks to Richard Chapin (the first system was applied during 1964). Further modernization of drip systems was reduced to reducing the financial costs of installing the system, and to reducing the problems associated with clogging of dispensers and supply pipes [1].

For effective crop yields, it is important to observe the correct irrigation regime. The water regime of the soil has a great influence on the productivity indicators of various crops. Thus, the lack or excessive moisture of the soil negatively affects the state of the water-physical properties of the soil. At the same time, the position of irrigated lands deteriorates when taking into account ecological and reclamation factors [2; 3].

When conducting a study for the entire growing season, it is impossible to allow a decrease in moisture in the active soil layer to wilting moisture, that is, in order to obtain high and stable plant productivity, it is necessary to maintain a predetermined lower soil moisture threshold before irrigation [4].

Analyzing the results of the research of various authors, it can be noted that the experiments on the effectiveness of the use of drip irrigation in the cultivation of soybeans are very limited. At the same time, a number of authors believe that in the production of soybeans for seeds, it is necessary to differentiate the soil moisture regime during the growing season of

plants. This is due to the fact that plants, depending on the phase of development, receive the required different amount of moisture. As a result, water is saved per unit of production, and the productivity of plants increases [5–7].

At present, many scientists who have dealt with the irrigation regime of various agricultural crops believe that the lower limit of soil moisture should not decrease below 65–75% of the lowest moisture capacity (HB). With such a decrease, capillary rupture occurs. In addition, it should be taken into account that the lower limit of soil moisture depends on external conditions and biological characteristics of plants [8].

With drip irrigation, the peculiarity of soil moistening to the optimum value also depends on the growth, development and growing conditions of soybeans for grain.

At different stages of development, soybean with drip irrigation uses the greatest amount of moisture for transpiration from the surface of plants and soil evaporation. Thus, the total water consumption is an indicator of the water demand of soybeans [9].

In general, in certain soil and climatic conditions, when designing the irrigation regime for agricultural crops, the output values are the total water consumption. So, during the growing season of plants, the average daily water consumption, based on temperature indicators, can vary in different ways [10].

A plant, like any living organism, consists mainly of water. This is the foundation of all physiological and biochemical processes in plant cells. Therefore, a decrease in water consumption determines the lack of the presence of saline in plant tissues. As a result, these processes can be completely suspended or slowed down [11].

The rate of water consumption is determined by water consumption for the full growing season – this is a quantitative indicator of water consumption [12].

The indicator of the total water consumption of various agricultural crops – the value is quite variable, it is influenced by agro-ecological and soil cultivation technology. Its main component is transpiration – the extraction of water by plant roots from the soil and its further evaporation [13].

It should be noted that the water consumption of soybeans has been little studied. This is explained by the fact that a guaranteed stable yield of soybean grain for seeds during the entire growing season can be obtained only if the necessary moisture supply to the plants.

2. Materials and methods

The studies were carried out in accordance with the thematic research plan of the Kherson State Agrarian and Economic University on the assignment "Implementation of the technology for the cultivation of basic agricultural crops." Field experiments were carried out at the Sivashskoye agricultural firm of the Novotroitsk district of the Kherson region, located in the agroecological zone of the arid steppe (GTKV–IX = 0.46–0.60) within the range of the Kakhovka irrigation system. The object of the research was the soybean varieties of the Institute of Irrigated Agriculture of the NAAS of various ripeness groups: early ripening – Monarch, Diona; mid-early – Aratta, Sofia; mid-season – Danae, Svyatogor. In the experiment, various seeding rates were used: 300, 500, 700, 900, 1100 thousand plants per 1 ha.

Soil moisture was determined by the thermostat-weight method in four repetitions of the experiment. Soil samples were taken layer by layer every 10 cm to a depth of 0–50 cm after 5 days when determining the timing of irrigation and 0–100 cm to calculate the total water consumption of corn.

The total water consumption of soybeans for individual interphase periods and for the entire growing season was determined by the water balance method according to the formula:

$$E = M + O + \left(W_h - W_k\right),$$

where

E – total water consumption for the billing period, m^3/ha;

M – irrigation rate, m^3/ha;

O – precipitation for the period, m^3/ha;

W_h – moisture reserve in 0–100 cm soil layer during sowing, m³/ha;

W_k – moisture reserve in 0–100 cm soil layer during harvesting, m³/ha.

The accounting of precipitation was carried out according to the data of the agrometeorological station "Askania Nova", with the correction of their amount in accordance with the indicator of the field rain gauge, which was installed directly on the experimental sites.

The water consumption coefficient was determined by the formula:

$$K_E = \frac{E}{B}, \text{ where}$$

Where, K_E is the coefficient of water consumption during the growing season, m³/t;

E – total water consumption, m³/ha;

B – grain yield, t/ha.

The calculated value of the irrigation rate m, mm, can be determined by the formula of A. N. Kostyakov [14]:

$$m = 100 \times v \times h \times (\beta_{нв} - \beta_{ф}), \text{ where:}$$

m – irrigation rate, m³/ha;

v – is the bulk density of the soil, t/m³;

h – is the depth of the moistened soil layer, m;

$\beta_{нв}$ – soil moisture, respectively HB,% of the mass of dry soil;

$\beta_{ф}$ – actual soil moisture before irrigation,% of dry soil mass.

The results of the yield accounting were processed by methods of variance, correlation and statistical analysis using a personal computer and the MS Office "Excel" and "Agrostat" software and information complex [15; 16].

The goal is to scientifically substantiate the elements of soybean cultivation technology to optimize the total water consumption and increase productivity in the Southern Steppe of Ukraine using drip irrigation.

3. Results and discussion

Our observations during 2018–2020. showed that the total water consumption of soybean crops varied depending on all the factors studied in the experiment (Table 1).

Table 1. – Total water consumption of plants of soybean varieties and components of its balance under drip irrigation (average for 2018–2020)

Plant density, thousand plants/ha	Total water consumption, m³/ha	Components of the balance of water consumption					
		used moisture reserve active layer soil		rains		irrigation rate	
		m³/ha	%	m³/ha	%	m³/ha	%
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
early ripening varieties							
300	4977	548	11.0	1579	31.7	2850	57.3
500	4996	567	11.3	1579	31.6	2850	57.0
700	5004	575	11.5	1579	31.6	2850	57.0
900	5018	589	11.7	1579	31.5	2850	56.8
1100	5039	610	12.1	1579	31.3	2850	56.6
group average	**4963**	**578**	**11.5**	**1579**	**31.5**	**2850**	**56.9**
medium early varieties							
300	5874	645	11.0	1579	26.9	3650	62.1
500	5884	655	11.1	1579	26.8	3650	62.0
700	5891	662	11.2	1579	26.8	3650	62.0
900	5896	667	11.3	1579	26.8	3650	61.9
1100	5899	670	11.4	1579	26.8	3650	61.9

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
group average	**5889**	**660**	**11.2**	**1579**	26.8	3650	62.0
mid-season varieties							
300	6595	680	10.3	1665	25.2	4250	64.4
500	6600	685	10.4	1665	25.2	4250	64.4
700	6610	695	10.5	1665	25.2	4250	64.3
900	6625	710	10.7	1665	25.1	4250	64.2
1100	6630	715	10.8	1665	25.1	4250	64.1
group average	**6612**	**697**	**10.3**	**1665**	**25.2**	**4250**	**64.4**

On average, over three years of research, it was found that during the growing season from sowing to full ripening of soybeans, the total water consumption in the study areas with drip irrigation increases with an increase in the growing season of varieties.

Based on the experimental options, the total water consumption for early ripening varieties is on average 4963 m^3/ha, for medium early varieties – 5889 m^3/ha. The maximum amount of moisture was consumed by soybean plants in the options for sowing mid-season soybean varieties on average – 6612 m^3/ha.

Based on the data obtained, it can be observed that the longer the growing season, the higher the share of the irrigation rate in the structure of total water consumption. So, during the growing season of early ripening varieties, the share of the irrigation rate in the structure of total water consumption was 56.9%, mid-early – 62.0%, mid-ripening – 64.4%. Increasing on average over the years of research from 2850 m^3/ha to 4250 m^3/ha.

The share of participation of the value of soil moisture reserves in the structure of total water consumption in comparison with the irrigation rate has the opposite tendency. Consequently, the share in providing plants with water mainly depends on the adopted irrigation regime. Analyzing the data obtained, it can be noted that the maximum use of productive reserves of soil moisture, with a soil moisture content of 80% HB, depending on the research options, varies on average from 548 m^3/ha (in early ripening varieties with a sowing density of 300 thousand plants/ha) to 715 m^3/ha (for mid-season varieties with a seeding density of 1100 thousand plants/ha). In general, in the structure of total water consumption, the share of soil moisture reserves, depending on the year of study and on the variants of the experiment, varies from 10.3 to 12.1%.

Under irrigation conditions, the total water consumption of soybeans during the growing season is due to vegetative irrigation, productive moisture reserves in the soil, and effective precipitation.

The effectiveness of the irrigation regime of any crop is established by such indicators as the coefficient of water consumption, as well as the size and quality of the crop.

According to the ratio of indicators of total water consumption and yield of soybean varieties, the coefficients of water consumption of crops of soybean varieties of different ripeness groups at different cenosis density were calculated (table 2).

According to factor A (variety), the highest water consumption coefficient, on average over the years of research, was observed in the early ripening variety Diona – 2039.8 m^3/t with sparse sowing. The minimum value of the water consumption coefficient was shown by the mid-early variety Aratta, which used irrigation, soil and rain water most efficiently – 1197.4 m^3 of water per one ton of grain with a plant density of 700 thousand plants ha.

The coefficient of water consumption of early maturing soybean varieties is significantly higher than for medium early varieties – 1638.2 m^3/t, which is 373.8 m^3/t or 29.5% more than the coefficient of water consumption of medium early varieties.

Table 2. – Water consumption coefficient and average evapotranspiration of soybeans under drip irrigation (average for 2018–2020)

Variety	Plant density, thousand plants/ha	Grain yield, t/ha	Water consumption coefficient, m^3/t of grain	Average evapotranspiration, m^3/day
Dione	300	2.44	2039.8	46.1
	500	2.60	1921.5	46.3
	700	2.82	1774.5	46.3
	900	2.94	1706.8	46.5
	1100	2.56	1968.4	46.7
Monarch	300	3.47	1434.3	45.2
	500	3.53	1415.3	45.4
	700	3.62	1382.3	45.5
	900	3.85	1303.4	45.6
	1100	3.51	1435.6	45.8
average for the group of early maturing		**3.13**	**1638.2**	**45.9**
Aratta	300	4.49	1308.2	49.4
	500	4.76	1236.1	49.4
	700	4.92	1197.4	49.5
	900	4.85	1215.7	49.5
	1100	4.51	1308.0	49.6
Sofia	300	4.37	1344.2	48.5
	500	4.69	1254.6	48.6
	700	4.85	1214.6	48.7
	2	3	4	5
	900	4.78	1233.5	48.7
	1100	4.43	1331.6	48.8
average for the group of mid-early		**4.66**	**1264.4**	**49.1**
Danae	300	5.39	1223.6	51.1
	500	5.42	1217.7	51.2
	700	5.31	1244.8	51.2
	900	5.25	1261.9	51.4
	1100	4.75	1395.8	51.4
Svyatogor	300	5.38	1225.8	50.3
	500	5.49	1202.2	50.4
	700	5.35	1235.5	50.5
	900	5.27	1257.1	50.6
	1100	4.77	1389.9	50.6
average for the group of mid-season		**5.24**	**1265.4**	**50.9**
LSD_{05}, t/ha		A – 0.12–0.15; B – 0.14–0.16; C – 0.11–0.15		

The indicators of the coefficient of water consumption of soybean varieties indicate an increase in the amount of moisture used for the formation of 1 ton of grain on drip irrigation in case of violation of the optimal density of plant cenosis, which depends on varietal characteristics and ripeness group. Plants of the middle early group of varieties use moisture most efficiently.

In order to effectively plan irrigation with the necessary hydronic module of the irrigation system, it is necessary to take into account the average daily evapotranspiration. Evatranspiration is the total amount of water consumed by a plant, including evaporation from the soil surface and transpiration of water by plants under the influence of air and soil temperature, air humidity, solar radiation, wind, and the phase of plant development.

The maximum average value of the average evapotranspiration, according to factor A – 51.4 m^3/day was determined for the Danae variety, the minimum value for the Monarch variety – 45.2 m^3/day. For factor B (plant density), the maximum value of the average evapotranspiration was observed at a density of 1100 thousand plants/ha, the minimum at a density of 300 thousand plants/ha. On average for ripeness groups, the minimum average evapotranspiration was observed in medium early varieties on average over three years – 45.9 m^3/day.

In the conditions of the arid steppe of Ukraine, for the rational use of natural resources and the production of high-quality soybean grain on irrigated lands within 3–5.5 t/ha, it is important to adjust the elements of the cultivation technology for each variety, taking into account the response to artificial moisture, plant density. To obtain the maximum yield when growing early ripening varieties of Dion, Monarch, it is necessary to form a plant density at the level of 900 thousand plants/ha; mid-early Aratta, Sofia –700 thousand plants/ha; mid-season Danae, Svyatogor – 500 thousand plants/ha. This plant density allows the most economical use of irrigation water for the formation of the maximum grain yield of soybean varieties of different ripeness groups.

Conclusions. It was found that during the growing season from sowing to full ripening of soybeans, the total water consumption in the study areas with drip irrigation increases with an increase in the duration of the growing season of soybean varieties.

The total water consumption for early ripening varieties is on average 4963 m^3/ha, for medium early varieties – 5889 m^3/ha. The maximum amount of moisture was consumed by soybean plants in the options for sowing mid-season soybean varieties on average – 6612 m^3/ha.

Based on the data obtained, it was found that the longer the growing season, the higher the share of the irrigation rate in the structure of total water consumption. So, during the growing season of early ripening varieties, the share of irrigation norms in the structure of total water consumption was 56.9%, medium early – 62.0%, mid-ripening – 64.4%, having increased on average over the years of research from 2850 m^3/ha to 4250 m^3/ha.

The highest water consumption coefficient, on average over the years of research, was observed in the early ripening variety Diona – 2039.8 m^3/t. The minimum value of the water consumption coefficient was shown by the Aratta variety – 1130.7 m^3/t. The minimum values of this indicator for factor B (density) – 1197.4 m^3/t at a seeding density of 700 thousand plants/ha.

The minimum value of the average evapotranspiration for the Monarch variety is 45.2 m^3/day. According to factor B (plant density), the minimum at a density of 300 thousand plants/ha. On average for ripeness groups, the minimum average evapotranspiration was observed in medium early varieties – 45.9 m^3/day. The most efficient use of moisture is the plants of the varieties of the middle early group.

In the conditions of the arid steppe of Ukraine, for the rational use of natural resources and obtaining high yields of soybeans on irrigated lands within

3–5.5 t/ha, it is important to adjust the elements of the cultivation technology for each variety, taking into account the response to artificial moisture and the density of plant cenosis. For the effective use of irrigation water and obtaining the maximum grain yield when growing early ripening varieties of Dion, Monarch, it is necessary to form a plant density at the level of 900 thousand plants/ha; mid-early Aratta, Sofia – 700 thousand plants/ha; mid-season Danae, Svyatogor – 500 thousand plants/ha.

References:

1. The technology that saved the world from hunger: drip irrigation. Aggeek. 16 августа 2018. URL: https://aggeek.net/ru-blog/tehnologiya-kotoraya-spasla-mir-ot-goloda-kapelnoe-oroshenie
2. Taherzadeh O., Caro D. Drivers of water and land use embodied in international soybean trade Journal of Cleaner Production.– 20 June.– Vol. 223.2019. – P. 83–93. URL: https://doi.org/10.1016/j.jclepro.2019.03.068.
3. Marchenko T., Borovik V., Lavrynenko Y., Klubuk V. Manifestation and variability of the singn "number of beans on productive nodes of paints" in hybrids and varieties of different "groups of maturity. Danish Scientific Jornal (DS). Istedgade 1041650, Copenhagen Denmark,– No. 41.2020. – P. 3–6. URL: http://www.danish-journal.com/wp-content/uploads/2020/11/DSJ_41_2.pdf. ISSN3375–2389
4. Akhmedov A. D., Temerev A. A., Galiullina E. Yu. Reliability of the drip irrigation system. Agronomy Forestry.– No. 3(19). 2010.– P. 1–6.
5. Dubenok N. N., Borodychev V. V., Lytov M. N., Belik O. A. Features of soil irrigation with drip irrigation of crops. Achievements of science and technology of agrarian and industrial complex,– No. 4.2009. – P. 22–25.
6. Matev A., Petrova R. Evapotranspiration of Soybean Grown by Different Irrigation Regime. Plant science.– Sofia. Agricultural academy.– No. 50.2013. – P. 43–51.
7. Rahman T., Liu X., Hussain S., Ahmed S., Chen G., Yang F. Water use efficiency and evapotranspiration in maize-soybean relay strip intercrop systems as affected by planting geometries. PLoS ONE.– No. 12(6). 2017. e0178332. URL: https://doi.org/10.1371/journal.pone.0178332
8. Yang F., Huang S., Gao R. C., Liu W. G., Yong T. W., Wang X. C. Growth of soybean seedlings in relay strip intercropping systems in relation to light quantity and red far-red ratio. Field Crops Res.– No. 155. 2014.– P. 245–253.
9. Cui L., Su B. Y., Yang F., Yang W. Y. Effects of photosynthetically active radiation on photosynthetic characteristics and yield of soybean in different maize-soybean relay strip intercropping systems. Sci. Agric. Sin.– No. 47. 2014.– P. 1489–1501.
10. Yang F., Wang X. C., Liao D. P., Lu F. Z., Gao R. C., Liu W. G. Yield response to different planting geometries in maize-soybean relay strip intercropping systems. Agron. J.– No. 107. 2015.– P. 296–304.
11. Orjuela-Abril S., Rojas-Suárez J.P., Duarte-Forero J. E. Estudio de desempeño y emisiones en motores diesel operando con biodiesel a partir de aceite de soja y emulsiones de agua. Aibi Revista De investigación, administración E ingeniería.– No. 9(1). 2021.– P. 19–29. URL: https://doi.org/10.15649/2346030X.935
12. Wang W. S., Wang C., Pan D. Y., Zhang Y. K., Luo B., Ji J. W. Effects of drought stress on photosynthesis and chlorophyll fluorescence images of soybean (Glycine max) seedlings. Int J Agric & Biol Eng.– No. 11(2). 2018.– P. 196–201.
13. Wang D., Shannon M., Grieve C., Yates S. Soil water and temperature regimes in drip and sprinkler irrigation, and implications to soybean emergence. Agricultural Water Management.– No. 43(1). 2000.– P. 15–28. URL: https://doi.org/10.1016/S0378–3774(99)00057–8

14. Pisarenko V. A., Andreyuk E. I., Dulgerov A. N. Recommendations on the regime of irrigation of agricultural crops taking into account the microbiological state of soils in Ukraine.– Kiev: Naukova Dumka, 1985.– 26 p.
15. Ushkarenko V. O., Nikishenko V. L., Goloborodko S. P., Kokovikhin S. V. Dispersion and correlation analysis of the results of field experiments: a monograph.– Kherson: Aylant, 2009.– 372 p.
16. Ushkarenko V. O., Vozhegova R. A., Goloborodko S. P., Kokovikhin S. V. Methods of field experiment (Irrigated agriculture).– Kherson: Green DS, 2014.– 448 p.

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