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INFLUENCE OF BASIC SOIL CULTIVATION METHODS AND GROWTH STIMULANTS ON MOISTURE AVAILABILITY OF OILSEED CROPS

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Summary

Aim of research. *Determine moisture availability for oilseed crops, depending on the method of basic soil cultivation and use of growth stimulants.*

Methods of research. *Studies on the effect of basic soil cultivation in combination with the use of growth stimulants on moisture availability and yields of sunflower and flax were conducted in 2011-2013 on the fields of the Institute of Oilseed Crops of NAAS. Research subjects were Kamenyar sunflower hybrid and Vodogray flax variety. Methods of basic soil cultivation: regular plowing (PLN-3-35 at a depth of 22-25 cm), low-till plowing (KLD-3,0 to a depth of 22-25 cm, PKN-3.6 to a depth of 16-18 cm, KSHN-5,6 «Resident» to a depth of 14-16 cm), surface plowing (BDT-7 at a depth of 10-12 cm). Growth stimulants: Agrobak Plus and Rostkoncentrat.*

Results. *Influence of the basic soil cultivation methods in combination with use of growth stimulants on the moisture availability of sunflower and flax under the Steppe of Ukraine conditions was established. Reserves of productive moisture for the time of sowing, depending on the method of basic soil cultivation, were: in the meter layer (0-100 cm) 125.1-133.0 mm or 90.0-95.7% of the average perennial indicators; in a one-and-a-half meter layer (0-150 cm) 168.8-173.8 mm or 78.9-81.2%. Smaller accumulation of moisture in a one-and-a-half meter layer of soil is due to the fact that during the Autumn/Winter/early Spring period, the amount of precipitation was insufficient for penetrating deeper layers. The lowest ratio of water consumption was recorded for sunflower - 1046 m^3/t for low-till plowing with PKN-3,6, and for flax – 1606 m^3/t for regular plowing. The least effective way moisture was used by sunflower and flax was with surface plowing. Ratio of water consumption in that case increased by 191 and 369 m^3/t, respectively.*

Conclusions. *The most effective way moisture was used by sunflower in basic soil cultivation with PLN-4-35 (regular plowing) and PKN-3.6 (low-till plowing), by flax with PLN-4,35 (regular plowing). Use of growth stimulants contributed to a more rational use of productive moisture.*

Keywords: *sunflower, flax, yield, moisture reserves, water consumption ratio.*

Problem statement. For Ukraine, agriculture is one of economy sectors that are subject to significant impacts of climate change and risks from the increased extreme climatic events that have become more intense. At the same time, it should be noted that the agricultural sector of Ukraine is one of the leading sectors of the economy, which guarantees food security both for our country and by realizing world export opportunities [1].

It is important to note that measures to reduce risks from extreme climate events should be coordinated with long-term adaptation strategies. Reduction of risks in the

short and medium term is primarily related to the existing socio-economic development plans, so then adaptation strategies provide for long-term planning of activities aimed at preventing or overcoming the effects of climate change through the use of favorable opportunities.

Adaptation of plants consists of actions aimed at responding to current and future influences and sensitivity to climate change in the context of current and expected socio-economic development. This means not only protection against the negative effects of climate change, but also increased resilience and the use of any possible benefits.

Analysis of recent research and publications. Studies of the stability of crop yields in modern climatic conditions and in the future are a primary task. Given the natural deficit of moisture, the most important factor for obtaining stable yields is its effective use [2].

Measures to accumulate moisture in the soil are the basis for obtaining high yields. From industrial practice and scientific research it is known that sunflower consumes a considerable amount of moisture during the growing season, and therefore the moisture availability for it, is an important factor on which its productivity depends [3].

Study of basic soil cultivation methods and use of physiologically active solutions in the cultivation of new varieties and hybrids of oilseed crops is of great practical importance, since it makes it possible to reduce fluctuations in their yield depending on the level of moisture availability, especially in the south of Ukraine, by optimizing the combined effect of agrotechnical techniques. [4, 5, 6, 7].

Purpose of our study was to determine the moisture availability for oilseed crops depending on the method of basic soil cultivation and the use of growth stimulants.

Materials and methods. Study on the effect of basic soil cultivation methods in combination with the use of growth stimulants on moisture availability and yields of sunflower and flax was conducted in 2011-2013 on the field plots of the Institute of Oilseed Crops of NAAS. Research subjects were Kamenyar sunflower hybrid and Vodogray flax variety.

Methods of basic soil cultivation were: regular plowing (PLN-3-35 at a depth of 22-25 cm), low-till plowing (KLD-3.0 to a depth of 22-25 cm, PKN-3.6 to a depth of 16-18 cm, KSHN-5, 6 «Resident» to a depth of 14 -16 cm), surface plowing (BDT-7 at a depth of 10-12 cm).

Sunflower seeds were planted at depth of 6-7 cm with a row spacing of 70 cm and a sowing rate of 50,000 per ha. Subtance application strategies: 1 – control group (treatment with water (250 l/ha)), 2 – Agrobak plus soil treatment (2 l/ha) + seed treatment with Agrobak plus (400 ml/t); 3 – Agrobak plus soil treatment (2 l/ha) + 2 vegetative treatments (2-4 and 6-8 pairs of leaves) with Agrobak plus (2 l/ha) and Rostkoncentrat (0.75 l/ha); 4 – Agrobak plus soil treatment (2 l/ha) + seed treatment with Agrobak plus (400 ml/t) + 2 vegetative treatments (2-4 and 6-8 pairs of leaves) with Agrobak plus (2 l/ha) and Rostkoncentrat (0.75 l/ha).

Experiment plotting and research was carried out in accordance with generally accepted methods in agriculture and plant breeding [8].

Results and discussion. According to long-term data, reserves of productive moisture in Spring on average in 0-100 cm soil layer are 139 mm, and in the 0-150 cm layer – 214 mm. According to the average perennial data, during flax vegetative period (April – mid-July), 125 mm of moisture enters the soil, and 158 mm of moisture during the growing season of sunflower (May-August). Thus, according to average perennial data, the volumes of productive moisture that can be used by crops during their vegetation period are: for flax, 264 mm or 2640 cubic meters per ha, for sunflower 372 mm or 3720 cubic meters per ha (Fig. 1).

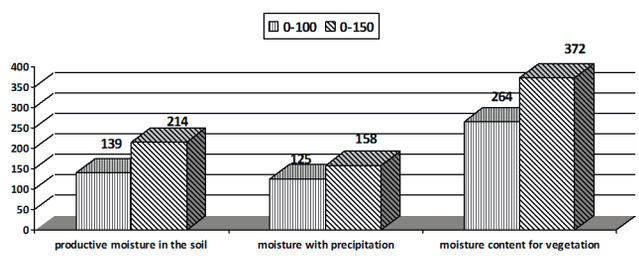

Figure 1 – Average long-term indicators of water availability, mm

In arid climate it is farmers task to effectively use this moisture.

On average over three years of research (2011-2013), the reserves of productive moisture when sowing, depending on the method of basic soil cultivation, were: in a meter layer (0-100 cm) 125.1-133.0 mm or 90.0-95.7 % of the average perennial indicators; in a one and a half meter layer (0-150 cm), 168.8-173.8 mm or 78.9-81.2 % (Fig. 2). A smaller accumulation of moisture in a one-and-a-half meter layer of soil is due to the fact that during the Autumn/Winter/early Spring period, the amount of precipitation was insufficient for penetrating deeper layers.

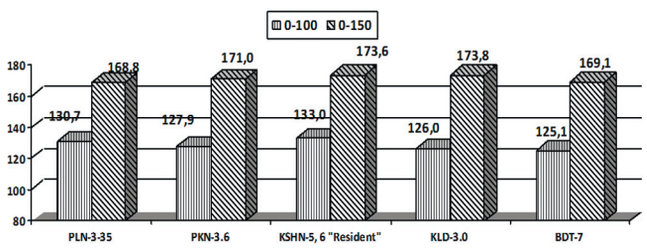

Figure 2 – Reserves of productive moisture in Spring, depending on the method of basic soil cultivation (2011-2013), mm

At the same time, there was an insufficient amount of precipitation, which fell during the whole vegetative period. For example, the amount of precipitation moisture was: for flax – 84.8 mm (67.8 % of the average perennial amount), for sunflower 134.5 mm (85.1 % of the average perennial amount).

Taking into account the moisture reserves in the soil before sowing and the amount of moisture received from the precipitation to form the yield, flax during vegetation could use 203.3-214.7 mm or 2303-2147 m^3/ha of water from the meter soil layer, which is 77.0-81.3 % of the average perennial indicators. And for the formation of the sunflower harvest during the vegetative period, the plants could use 248.4-279.4 mm or 2484-2794 m^3/ha water from a 1.5 meter layer of soil, which is 66.8-75.1% of the average perennial indicators (Fig. 3).

Rational use of this moisture by crops, which was expressed in their yield, was influenced both by the methods of basic soil

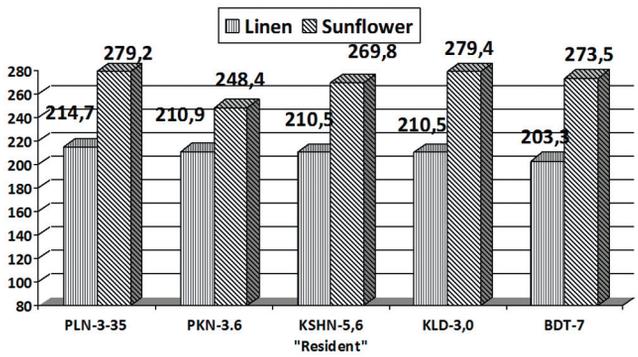

Figure 3 – Consumption of moisture during the vegetative period, depending on the soil cultivation method (2011-2013), mm

cultivation and by the use of physiologically active substances.

Depending on the method of basic soil cultivation, maximum sunflower yield for the Kamenyar hybrid was ensured by regular plowing – an average of 2.61 t/ha; with low-till plowing, the yield decreased to 2.38 t/ha (PKN-3.6), to 2.36 t/ha (KLD-3,0), to 2,23 t/ha (Resident). Smallest yield was obtained by surface plowing – an average of 2.17 t/ha (Table 1). Increase in yield from the use of physiological substances in relation to the control group averaged 0.04-0.15 t/ha. Largest yield – 2.69 t/ha was ensured by cultivation of sunflower with regular plowing in combination with the use of substances according to following scheme: application of Agrobak plus (2 l/ha) to the soil + Agrobak plus seed treatment (400 ml/t) + 2 treatments during vegetative period (2-4 and 6-8 pairs of leaves) with Agrobak plus (2 l/ha) and Rostkoncentrat (0.75 l/ha).

Largest yield in Vodograi flax variety was obtained with regular plowing – an average of 1.34 tons per ha; with low-till plowing yield decreased to 1.14 t/ha (Resident), to 1.11 t/ha (KLD-3.0), to 1.08 t/ha (PKN-3.6). Smallest yield was obtained with surface plowing – an average of 1.03 t/ha (Table 2). Increase in yield from the use of physiological solutions in relation to control averaged 0.07-0.17 t/ha. The largest yield – 1.45 t/ha was ensured by flax cultivation with regular plowing combined with using solutions according to the scheme: application of Agrobak plus (2 l / ha) to the soil + Agrobak plus seed treatment

Table 1 — Influence of the method of basic soil cultivation and physiologically active substances on yield of Kamenyar sunflower hybrid (2011-2013)

Solution use (B)	Basic soil cultivation method (A)					Average for solutions
	Regular plowing (PLN-3-35, 22-25 см)	Low-till plowing (PKN-3,6, 16-18 см)	Low-till plowing (Resident, 14-16 см)	Low-till plowing (KLD-3,0, 22-25 см)	Surface plowing (BDT-7, 10-12 см)	
1	2,54	2,31	2,14	2,26	2,09	2,27
2	2,55	2,36	2,19	2,32	2,14	2,31
3	2,65	2,38	2,26	2,41	2,20	2,38
4	2,69	2,45	2,31	2,43	2,24	2,42
	2,61	2,38	2,23	2,36	2,17	
LSD, t/ha: A – 0,04-0,06; B – 0,04-0,06; AB – 0,08-0,13						

Table 2 — Influence of the method of basic soil cultivation and physiologically active substances on the yield of Vodograi flax variety (2011-2013)

Solution use (B)	Basic soil cultivation method (A)					Average for solutions
	Regular plowing (PLN-3-35, 22-25 см)	Low-till plowing (PKN-3,6, 16-18 см)	Low-till plowing (Resident, 14-16 см)	Low-till plowing (KLD-3,0, 22-25 см)	Surface plowing (BDT-7, 10-12 см)	
1	1,26	0,98	1,03	1,02	0,98	1,05
2	1,32	1,04	1,13	1,08	1,03	1,12
3	1,33	1,14	1,17	1,15	1,04	1,17
4	1,45	1,17	1,22	1,19	1,07	1,22
	1,34	1,08	1,14	1,11	1,03	
LSD05, t/ha: A – 0,03-0,04; B – 0,03-0,04; AB – 0,07-0,08						

(400 ml / t) + one pass in vegetative stage with mixture of Agrobak plus (2 l / ha) and Rostkoncentrat (0.75 l / ha).

The efficiency of using available moisture by agricultural crops is judged by its water consumption ratio. The lower its value, the more effectively moisture was used to form yield.

As can be seen in Figure 4, the lowest coefficient of water consumption was recorded for sunflower - 1046 m³/ha along with low-till plowing by PKN-3,6, and for flax - 1606 m³/ha with regular plowing. Moisture was used least effectively by sunflower and flax with surface plowing. Ratio of water consumption increased by 191 and 369 m³/ha, respectively.

Figure 5 and 6 show that the use of growth stimulants contributed to a reduction in the water consumption ratio of sunflower and flax

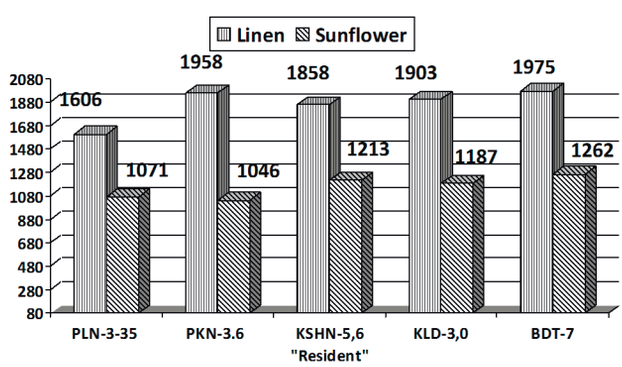

Figure 4 – Ratio of water consumption depending on the method of basic soil cultivation (2011-2013), m³/ha

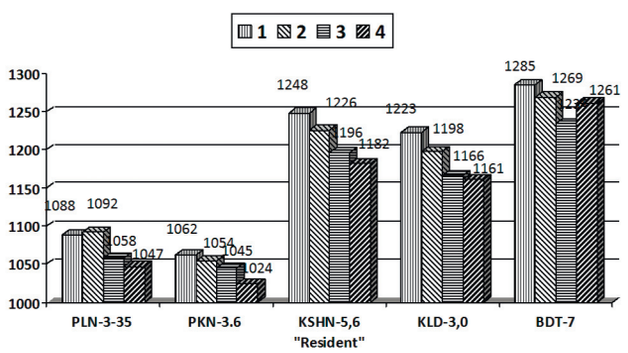

Figure 5 – Water consumption ratio of sunflower under the influence of physiologically active substances (2011-2013), m³/ha

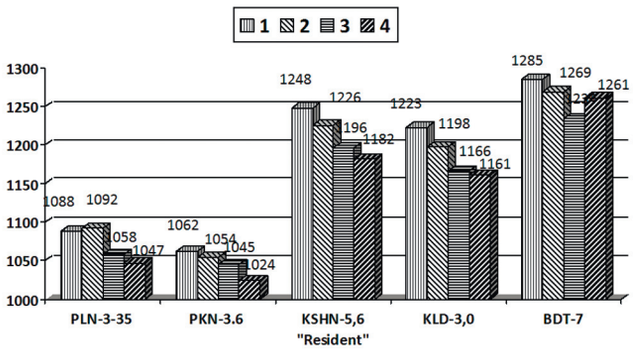

Figure 6 – Water consumption ratio of flax under the influence of physiologically active substances (2011-2013), m^3/ha

with all methods of soil cultivation, which indicates a more economical use of moisture.

Conclusions. As a result of the conducted study, influence of the methods of basic soil cultivation in combination with the use of growth stimulants on the moisture availability of sunflower and flax under the conditions of the Steppe of Ukraine was established. Most effectively moisture was used by sunflower with plowing by PLN-4-35 tool (for regular plowing) and PKN-3.6 (for low-till plowing), and by flax with regular plowing by PLN-4,35. The use of growth stimulants contributed to a more rational use of productive moisture.

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ВПЛИВ СПОСОБІВ ОСНОВНОГО ОБРОБІТКУ ГРУНТУ ТА СТИМУЛЯТОРІВ РОСТУ НА ВОЛОГОЗАБЕЗПЕЧЕННЯ ОЛІЙНИХ КУЛЬТУР

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Анотація

Мета. *Визначити вологозабезпеченість олійних культур залежно від способу основного обробітку ґрунту і застосування стимуляторів росту.*

Методи. *Дослідження з вивчення впливу способів основного обробітку ґрунту в поєднанні із застосуванням стимуляторів росту на вологозабезпеченість і врожайність соняшника і льону олійного проводилися в 2011-2013 роках на полях Інституту олійних культур НААН. Об'єктами досліджень були гібрид соняшника Каменяр і сорт льону олійного Водограй. Способи основного обробітку ґрунту: оранка (ПЛН-3-35 на глибину 22-25 см), безвідвальна (КЛД-3,0 на глибину 22-25 см, ПКН-3,6 на глибину 16-18 см, КШН-5,6 «Резидент» на глибину 14-16 см), поверхневий (БДТ-7 на глибину 10-12 см). Стимулятори росту: Агробак плюс і Ростконцентрат.*

Результати. *Встановлено вплив способів основного обробітку ґрунту в поєднанні із застосуванням стимуляторів росту на вологозабезпеченість посівів соняшника і льону олійного в умовах Степу України. Запаси продуктивної вологи на час сівби залежно від способу основного обробітку ґрунту склали: в метровому шарі (0-100 см) 125,1-133,0 мм або 90,0-95,7% від середніх багаторічних показників; у півтораметровому шарі (0-150 см) 168,8-173,8 мм або 78,9-81,2%. Менше накопичення вологи в півтораметровому шарі ґрунту пов'язане з тим, що за осінньо-зимово-ранньовесняний період випадало недостатнє для проникнення в глибші шари кількість опадів. Найменший коефіцієнт водоспоживання відзначений у соняшника – 1046 м³/т за безвідвальної обробки ПКН-3,6, а у льону – 1606 м³/т по оранці. Найменш ефективно волога використовувалася посівами соняшника та льону по поверхневому обробітку ґрунту. Коефіцієнт водоспоживання при цьому збільшився на 191 і 369 м³/т відповідно. Висновки. Найбільш ефективно волога використовувалася посівами соняшника за основного обробітку ґрунту знаряддями ПЛН-4-35 (оранка) і ПКН-3,6 (безвідвальна), льону олійного знаряддям ПЛН-4,35 (оранка). Застосування стимуляторів росту сприяло більш раціональному використанню продуктивної вологи.*

Ключові слова: *соняшник, льон олійний, врожайність, запаси продуктивної вологи, коефіцієнт водоспоживання.*

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ВЛИЯНИЕ СПОСОБОВ ОСНОВНОЙ ОБРАБОТКИ ПОЧВЫ И СТИМУЛЯТОРОВ РОСТА НА ВЛАГООБЕСПЕЧЕННОСТЬ МАСЛИЧНЫХ КУЛЬТУР

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Аннотация

Цель. *Определить влагообеспеченность масличных культур в зависимости от способа основной обработки почвы и применения стимуляторов роста.*

Методы. *Исследования по изучению влияния способов основной обработки почвы в сочетании с применением стимуляторов роста на влагообеспеченность и урожайность подсолнечника и льна масличного проводились в 2011-2013 годах на полях Института масличных культур НААН. Объектами исследований были гибрид подсолнечника Каменяр и сорт льна масличного Водограй. Способы основной обработки почвы: вспашка (ПЛН-3-35 на глубину 22-25 см), безотвальные (КЛД-3,0 на глубину 22-25 см, ПКН-3,6 на глубину 16-18 см, КШН-5,6 «Резидент» на глубину 14-16 см), поверхностный (БДТ-7 на глубину 10-12 см). Стимуляторы роста: Агробак плюс и Ростконцентрат.*

Результаты. *Установлено влияние способов основной обработки почвы в сочетании с применением стимуляторов роста на влагообеспеченность посевов подсолнечника и льна масличного в условиях Степи Украины. Запасы продуктивной влаги на время посева в зависимости от способа основной обработки почвы составили: в метровом слое (0-100 см) 125,1-133,0 мм или 90,0-95,7 % от среднемноголетних показателей; в полутораметровом слое (0-150 см) 168,8-173,8 мм или 78,9-81,2 %. Меньшее накопление влаги в полутораметровом слое почвы связано с тем, что за осенне-зимне-ранневесенний период выпадало недостаточное для проникновения в более глубокие слои количество осадков. Наименьший коэффициент водопотребления отмечен у подсолнечника – 1046 м^3/т по безотвальной обработке ПКН-3,6, а у льна – 1606 м^3/т по вспашке. Наименее эффективно влага использовалась посевами подсолнечника и льна по поверхностной обработке почвы. Коэффициент водопотребления при этом увеличился на 191 и 369 м^3/т соответственно. Выводы. Наиболее эффективно влага использовалась посевами подсолнечника по основной обработке почвы орудиями ПЛН-4-35 (вспашка) и ПКН-3,6 (безотвальная), льна масличного орудием ПЛН-4,35 (вспашка). Применение стимуляторов роста способствовало более рациональному использованию продуктивной влаги.*

Ключевые слова: *подсолнечник, лен масличный, урожайность, запасы продуктивной влаги, коэффициент водопотребления.*