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RESERVES OF SOIL PRODUCTIVE HUMIDITY ARE THE KEY TO HIGH YIELD OF SUNFLOWER

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Abstract. *Currently, there is a warming climate. An increase in air temperature leads to an increase in the physical evaporation of water from the soil and the transpiration of plants. As a result, the study of the question of whether the reserves of natural soil moisture supply will be able to reveal the potential of sunflower in conditions of extreme farming is very relevant. In addition to the natural moisture supply of the soil, the yield of sunflower is also influenced by such factors as precipitation, hybrids (varieties), mineral nutrition, irrigation, etc. The paper analyses the data of average annual air temperatures and spring moisture reserves for the period 2006 – 2024 and found that on average for the analysed 15 years, the climatic conditions of our region can provide a sunflower yield of no more than 2 t/ha. Spring soil moisture reserves showed a weak correlation with sunflower yield (r = 0.145), which means that this factor has only a minor influence on yield formation. The correlation strengthens (r = 0.298) if not only spring moisture reserves but also precipitation for April-May are taken into account. However, even in this case, the influence of moisture availability remains average. The average level of correlation (r = 0.505) is reached when April-July precipitation is added to spring moisture reserves. This confirms that moisture supplied during critical phases of sunflower development (June-July) plays a more important role in yield formation than spring moisture reserves alone. Knowing the spring reserves of productive moisture in the soil and the amount of precipitation for the months of April to July, it is possible to predict the yield of sunflower.*

Keywords: *Moisture reserves, Precipitation, Sunflower, Correlation coefficient, Yield.*

INTRODUCTION

Sunflower is cultivated on five continents of the globe. According to Hu, J. and Seiler, G. in 2010, its area in 60 countries of the world exceeded 23 million hectares. This is one of the few field crops with such a unique set of uses. Initially, it was a forage (fodder) crop, later - an oilseed and food (confectionery), a flower (ornamental) for horticulture and the flower industry [10]. In Moldova, Ukraine and southern Russia, sunflower is a strategic crop. Its sown area in the world is constantly increasing and in 2019, according to the Kleffmann Group, it already amounted to 26 million hectares. The main sunflower areas (69%) are concentrated in 5 leading countries - in Russia 8.0 million hectares, in Ukraine 6.2 million hectares, in Argentina, Romania and China 4.8 million hectares [11]. According to 2019 data, Serbia is the leader in yield (3.0 t/ha), followed by China (2.6 t/ha), slightly ahead of Turkey (2.4 t/ha). Ukraine and Moldova are in fourth place in terms of yield - 2.3 t/ha, but in the south of Ukraine (Mykolaiv region), the average yield of irrigated sunflower reached 4 t/ha or more [11]. Moldova is well supplied with heat and has fertile soils, the moisture regime of which is formed mainly due to precipitation. Their amount covers the needs of plants by no more than 50%. For the southern regions, irrigation is an important technological technique with which high yields can be obtained. In Moldova, sunflower is the main oilseed crop, grown on an area of more than 300 thousand hectares [9]. Its yield fluctuates greatly from year to year and on average does not exceed 1.5 - 1.9 t/ha, in Ukraine within 1.7 - 1.9 t/ha, and in Russia it varies within 1.2 - 1.5 t/ha [2, 12, 4]. With irrigation, sunflower productivity is significantly higher - in the Rostov

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region, in the south of Ukraine, the North Caucasus it is 2.5 - 3.6 t/ha of seeds [1, 6], and in Moldova - 3.6 - 4.5 t/ha [3, 4, 7]. Moldova is an arid region. Having low forest cover (8.3%) and a fairly high level of soil degradation (more than 35%), the republic becomes more vulnerable to climate change. The climate in the region is moderately continental with short and warm winters with little snow, a long growing season, hot summers and little precipitation, mainly falling in the form of short-term showers. From the point of view of agricultural production, these are favorable conditions. To obtain high yields, the amount of precipitation in the region should be within 730-800 mm per year, and to ensure the minimum need for moisture, 350-400 mm is enough. In the republic, every 2-3 years is dry. The consequences of these droughts have a negative impact on the agricultural sector, farmers suffer losses [8]. Due to low spring moisture reserves in the soil, farming is risky. During the period of active vegetation of agricultural crops (April - September), on average over the past 75 years, about 299 mm of precipitation falls in our region, which would seem to be enough for plant development [4]. However, this is far from the case. Even in a wet year in terms of precipitation, the optimal water consumption of some agricultural crops significantly exceeds this value. The value of the deficit of optimal water consumption fluctuates from 430-1920 in a wet year to 2050-5450 m3 /ha in a dry year [5]. Thus, the role of meteorological conditions in our region is very high [7].

MATERIALS AND METHODS

To conduct the research, we used averaged data for the period from 2006 to 2024 on sunflower yield, spring moisture reserves from a meter-deep soil layer, and precipitation [13, 14, 15, 16]. Soil moisture reserves were determined using the thermostat-weight method [17]. MS Office XP (Word, Excel) programs were used for calculations and analysis.

RESULTS AND DISCUSSIONS

Recently, climate change towards an increase in air temperatures has been observed throughout the world, including in our region. Regular meteorological observations have been conducted at the Tiraspol agrometeorological station since 1946. During this period, average annual air temperatures have varied greatly, but the trend of their change is positive, indicating a warming of the climate by approximately 2°C (Fig. 1).

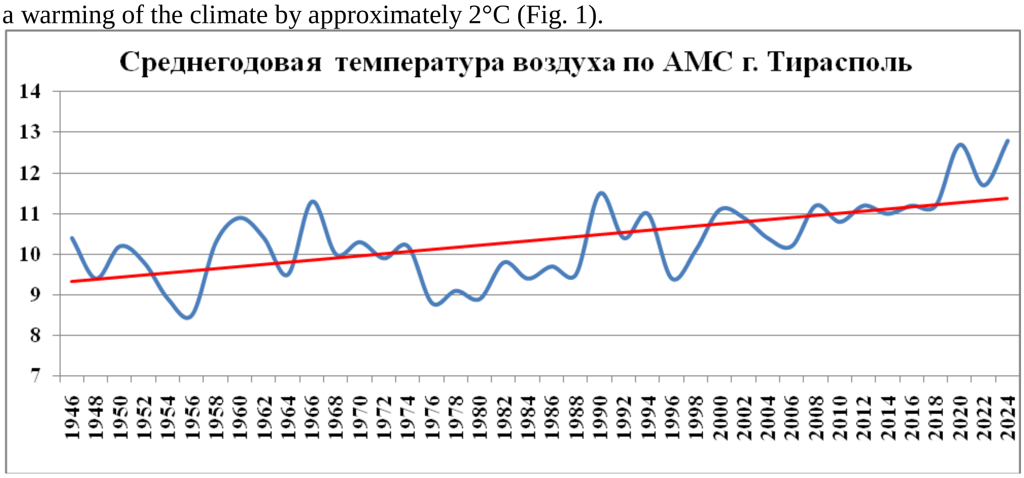

Figure 1. Trend of change in average annual air temperatures, C°

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Rising air temperatures contribute to increased physical evaporation from the soil surface and plant transpiration, so in these conditions, the question of whether natural moisture supply allows sunflower to reveal its potential is of particular interest. From 2006 to 2018, spring reserves of productive moisture were within 130–166 mm, then sharp declines began, reaching a minimum (42 mm) in 2020 (Fig. 2). Agricultural producers believe that crop yields in most cases depend on spring reserves of productive moisture in the soil, but this was not confirmed in our studies (Fig. 2). Most likely, natural reserves of moisture supply in the soil have a greater impact on the effectiveness of fertilizer application in the early stages, thereby providing a good start for plant development.

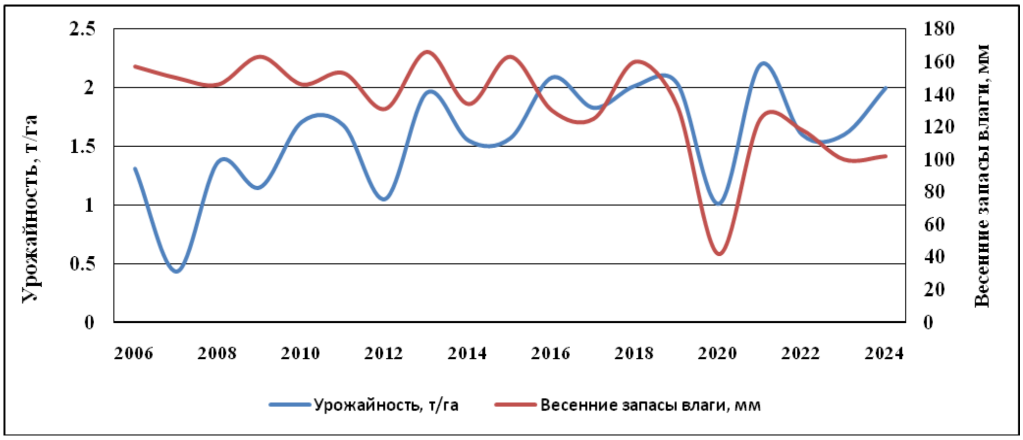

Figure 2. Correlation between spring productive moisture reserves and sunflower yield (Pearson coefficient r = 0.145)

By adding the amount of precipitation for April and May to the spring reserves of productive moisture, increasing the range of their fluctuations to 131-289 mm, it was established that their correlation with the yield increased to 0.298, while remaining weak (Fig. 3). This indicates that even such a reserve of productive moisture is insufficient.

Figure 3. Correlation between the sum of spring productive moisture and April-May precipitation with sunflower yield (Pearson coefficient r = 0.298)

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The average correlation level was achieved only when the spring moisture reserves were supplemented with the precipitation for the months of April-July (Fig. 4). Thus, it was proven that the flowering phase (June-July) is decisive for the formation of the harvest. The obtained dependence with a probability of r = 0.505 shows that the yield of 2.2 t/ha can be obtained in the case when the sum of the spring moisture reserves and the April-July precipitation is higher than 497 mm.

Thus, the conducted analysis of the correlation between the sunflower yield and natural moisture reserves allows us to state that the meteorological conditions of our region limit the productivity of sunflower at a level of 2.0-2.2 t/ha, and that the only condition for increasing it is irrigation.

Figure 4. Correlation between the sum of spring moisture reserves and precipitation for the months of April-July with crop yield (Pearson coefficient r = 0.505)

CONCLUSIONS

1. In recent decades, there has been a tendency for average annual air temperatures to increase, which leads to a decrease in productive moisture reserves in the soil.

2. The correlation between yield and spring productive moisture reserves is very weak (r = 0.145), with spring productive moisture reserves and precipitation for April-May - weak (r = 0.298), and with spring productive moisture reserves and precipitation for April-July - average (r = 0.505).

3. Meteorological conditions in our region limit sunflower productivity at a level of 2.0-2.2 t/ha, so the only condition for increasing it is irrigation.

BIBLIOGRAPHY

1.Бессмольная, Е.Н. Режим орошения подсолнечника в засушливой черноземной степи Поволжья. Автореф. дисс. канд. с/х. наук. - Саратов, 2011. 21с

2.Бочковой, А.Д., Перетягин Е.А., Хатнянский В.И., Камардин В.А., Кривошлыков К.М.. Подсолнечник: особенности сортовой политики в зависимости от почвенно-климатических, технологических и социально-экономических условий (обзор). // Научно-технический бюллетень Всероссийского НИИ масличных культур. – 2018. - Вып.2(174). С.120-134

3.Василиогло, Н.И. Гуманюк А.В. Майка Л.Г. Влияние минеральных удобрений на урожайность подсолнечника. Conferinţa naţională cu participare internaţională „Ştiinţa în Nordul Republicii Moldova: realizări, probleme, perspective" (ediţia a treia) - Bălţi, 21-22 iunie 2019, p. 203-207.

http://doi.org/10.59463/RJAS.2025.1.19

4.Василиогло, Н.И., Гуманюк А.В., Майка Л.Г., Матюша Б.А. Влияние удобрений и орошения на урожайность подсолнечника. Solul și îngrâșâmintele în agricultura contemporanâ. Conferința științiifică internațională, consacrată aniversârii a 120 de ani de la nașterea academicianului Ion Dicusar. – Chișinâu, Republika Moldova.- 2017.- P. 84-86.
5.Гамаюн, И.М., Гуманюк А.В., Коровай В.И. и др. Орошение сельскохозяйственных культур при дефиците водных и материально-технических ресурсов (рекомендации). – Тирасполь: Литера, 2005. – 46 с.
6.Лукомец, В.М., Кривошлыков, К.М. Производство подсолнечника в Российской Федерации: состояние и перспективы // Земледелие. – 2009. - №8. – С. 3-5.
7.Мацкова, С., Гуманюк, А., Пазяева, Т. (2023) Запасы продуктивной влажности почвы залог высокой урожайности подсолнечника, Agricultural Sciences, (2), pp. 24–29. Available at: https://doi.org/10.55505/sa.2023.2.03.
8.Пазяева, Т.В., Стоянова, Е.М., Мацкова, С.И., Дорошенко, А.В. (2022) Значение и развитие орошаемого земледелия. В: Вестник Приднестровского Университета. Серия Медико-биологические и химические науки, №2 (71). Тирасполь: Изд-во Приднестр. ун-та, с. 184-190. ISSN 1857-4246. Доступ: http://spsu.ru/images/files/science/Vestnik_2_2022.pdf
9.Ушурелу, Ю. (2017). Итоги сельхозсезона в Молдове, © 2017–2024 Agroexpert. Доступ: https://agroexpert.md/rus/agrarnaya-politika/itogi-selihozsezona-2017-v-moldove
10.Hu, J. and Seiler, G. (2010) Genetics, Genomics and Breeding of Sunflower. https://www.routledge.com/Genetics-Genomics-and-Breeding-of-Sunflower/Hu-Seiler-Kole/p/book/9781138115132
11.Уже разлили масло: рейтинг производителей подсолнечника в 2019 г. https://latifundist.com/rating/uzhe-razlili-maslo-rejting-proizvoditelej-podsolnechnika.
12.Подсолнечник: основные факторы, обеспечивающие успех выращивания Сер 4, 2017 |
13.Технологии | // Источник: https://agro-liga.com/podsolnechnik-osnovnye-faktory-obespechivayushhie-uspeh-vyrashhivaniya/
14.Статистика Приднестровья // Источник: https://mer.gospmr.org/deyatelnost/gosudarstvennaya-sluzhba-statistiki-gosstat/informacziya/ezhegodnik-gosudarstvennoj-sluzhby-statistiki/ezhegodnik-po-respublike.html
15.https://novostipmr.com/ru/news/24-12-26/urozhay-2024-minselhozprirody-rasskazalo-o-proizvodstve-zernovyh-i
16.https://vk.com/wall-213206753_3402
17.https://prbank.idknet.com/data/prbvd246-1.pdf
18.https://asm-agro.ru/articles/produktivnaya-pochvennaya-vlaga-ot-chego-zavisit-i-kak-vliyaet-na-urozhaj/