HSR London International Conference on Multidisciplinary Academic Research
(HSR-ICMAR) 2026
https://houghtonstreetreview.com/index.php/conference

UDC 633.34:631.674.5

APPLICATION OF SPRINKLER IRRIGATION TECHNOLOGY IN SOYBEAN IRRIGATION

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https://doi.org/10.5281/zenodo.21551259

Abstract: The article presents analytical data on the influence of the innovative sprinkler irrigation method, applied when growing soybean crops in the meadow-sierozem soil conditions of the Tashkent region, on soil bulk density, porosity, soil water permeability, the timing of soybean irrigation, irrigation norms, and soybean yield.

Keywords: soybean, innovative sprinkler irrigation, soil bulk density, soil water permeability, field moisture capacity, irrigation norms, soybean grain yield.

Introduction

According to studies by the World Resources Institute and the British organization “Economist Intelligence Unit”, in 2040, among the 33 countries expected to reach the greatest water deficit are the countries of Central Asia, in particular Uzbekistan. This requires the rational use of water and the widespread application of modern water-saving technologies. In particular, water-saving technologies are being introduced in the USA on an area of 13.8 million ha, in India on 7.7 million ha, in Brazil on 4.5 million ha, and in Spain on 4.5 million ha. Of these, irrigated lands sown with cotton make up 45% of the total area, of which drip irrigation technology is applied on 12.47% of the area. Obtaining a high and high-quality yield through the application of modern technologies in the irrigation of soybean crops is considered relevant.

One of the most expensive crops in the world is soybean, whose oil-bearing grains are widely used not only for the production of oil and nutritious feed in animal husbandry, but also as a source of protein and biofuel in the human diet. In recent years, the area used for growing soybean has increased by 26.4% (on average by 2.4 percent per year) and amounts to 130.4 million hectares. At the same time, the leading soybean-producing countries (Brazil, USA, Argentina) account for 70.5% of the total sown area. The main producers of soybean grain are Western countries, which in recent years provide more than 82 percent of the world’s gross yield, including Brazil 35.8 percent, the USA 34.3 percent, and Argentina 12.3 percent. In these countries, high results are achieved through the application of various water- and energy-saving agrotechnologies and the correct determination of the norms and timing of sowing, fertilization, and irrigation of soybean. Therefore, based on the existing soil and climatic conditions, the development and introduction into production of modern agrotechnologies for soybean cultivation is one of the pressing issues.

Degree of Study of the Problem

In recent years, scientists have conducted experiments — Kh. Atabaev, N. Khalilov, D. Yormatova, B. Kholikov, R. Siddikov, K. Mirzadzhonov — on the study of cultivation technologies of soybean varieties as main and repeated crops in our republic and abroad, methods of fertilization and irrigation, and their role in crop rotation and soil fertility; N. Urazmatov, U. Nematov, U. Norkulov, S. Isaev, F. Namozov, J. Eshonkulov; and abroad O. Sattorova, as well as B. Vinogradov, P. Vavilov, A. Babikhlar, Andreas Butz, and Hugo Toro Correa carried out scientific work. However, during years of

water deficit in the conditions of light sierozem soils of the Kashkadarya region, the cultivation of soybean varieties as a repeated crop, as well as the methods and regimes of their irrigation, have been insufficiently studied and no recommendations have been given [1, 2, 3, 4].

Research Methods

In 2022–2024, on 0.67 hectares of the territory of the Educational-Scientific Experimental Center of the National Research University "TIIAME", scientific research was conducted on the sprinkler irrigation of soybean varieties "Nafis" and "Uzbek-6". Experimental investigations — laboratory and field experiments, phenological observations, and biometric measurements — were carried out on the basis of the methodologies "Methodology of State Variety Testing of Agricultural Crops", "Methodology of Conducting Field Experiments", and "Methods of Agrophysical Research". Mathematical and statistical processing of the data obtained in the field experiments, using Microsoft Excel, was carried out on the basis of the methodological manual of B. Dospekhov [5, 6, 7].

Research Results

The main part of atmospheric precipitation falls in the form of snow in mountainous areas and in the form of rain in hilly and plain areas. Most of the precipitation falls in winter and spring, and a small part in autumn. The amount of precipitation in the region also varies. Over the year, 261–316 mm of atmospheric precipitation falls on the plains, up to 366–435 mm in the foothills, and up to 700–895 mm in mountainous areas. In the summer months there is almost no rain. In general, analyzing the climatic conditions of the Tashkent region, it can be concluded that this region is suitable for growing any type of agricultural crop, which makes it possible to obtain abundant and high-quality yields.

According to the results of laboratory analyses conducted to determine the mechanical composition of the soil of the experimental plot, it was established that the irrigated low-productivity meadow-sierozem arable layer consists of medium-loamy soil, while the lower layers consist of light loams located in loess deposits, prone to waterlogging, of low-productivity sierozems.

As shown by the results of agrochemical observations of the soil, studied in the general context at the beginning of the vegetation period of soybean variety "Uzbek-6", the soil bulk density in the 0–30 cm layer equals 1.28 g/cm³, in the 0–50 cm layer 1.31 g/cm³, in the 0–70 cm layer 1.34 g/cm³, and in the 0–100 cm layer 1.37 g/cm³. At the same time, the average soil porosity decreased from top to bottom, that is, in the 0–30 cm layer it amounted to 52.5%, in the 0–50 cm layer 51.4%, in the 0–70 cm layer 50.3%, and in the 0–100 cm layer 49.2%.

At the end of the vegetation period on the experimental field, the smallest change in soil volume between the variants was as follows: in the sprinkler irrigation variant, when growing soybean variety "Uzbek-6" as the main crop, the soil bulk density amounted to 1.38 g/cm³ in the 0–30 cm layer, 1.39 g/cm³ in the 0–50 cm layer, 1.40 g/cm³ in the 0–70 cm layer, and 1.42 g/cm³ in the 0–100 cm layer.

At the beginning of the vegetation period of soybean variety "Uzbek-6" as the main crop, the soil water permeability amounted to 730 m³, 73.0 mm, or 0.20 mm/min over 6 hours, and by the end of vegetation a decrease in soil water permeability was observed owing to the irrigations and agrotechnical measures carried out on the experimental field throughout the entire vegetation period. The field moisture capacity of the soil on the experimental field, when cultivating soybean variety "Uzbek-6" as the main crop, amounted to 21.5% in the 0–30 cm layer, 21.5% in the 0–50 cm layer, and 21.6% in the 0–70 cm layer. It was noted that in the 0–100 cm layer it amounts to 22.2%, with each irrigation during vegetation carried out in accordance with the field moisture capacity of the soil.

Table 1

Yield of soybean variety "Uzbek-6" and water consumption per 1 c of yield (average data over 3 years)

Var.	Irrigation methods	Pre-irrigation soil moisture	Wetted calculated layers, cm	Irrigation norm, m³/ha	Yield, c/ha	Water consumption per 1 c of

		relative to FMC, %				**soybean, m³**
1	Furrow irrigation (control)	70-75-75	50-50-70	3193	24.3	131.8
2	Sprinkler irrigation (experiment)	70-75-75	30-40-40	2693	27.1	102.9

During the studies, we carried out the irrigation of soybean variety “Uzbek-6” in compliance with the above conditions. In the course of analyzing the three-year experimental data, it was determined that when growing soybean in compliance with the sprinkler irrigation schedule and applying agrotechnical measures, a high crop yield is achieved. That is, in the 1st variant, when furrow irrigation of soybean variety “Uzbek-6” was carried out at a pre-irrigation soil moisture of 70-75-75% relative to the field moisture capacity (FMC), with an irrigation norm of 3193 m³/ha, the grain yield amounted to 24.3 c/ha at a water consumption rate of 131.8 m³ per 1 c. In the 2nd variant, when irrigation was carried out by the sprinkler method, observations showed an irrigation norm of 2693 m³/ha, a grain yield of 27.1 c/ha, and a water consumption rate of 102.9 m³ per 1 c of yield, that is, a yield increase of 2.8 c/ha, which, as can be seen from the indicators, is lower in water consumption than furrow irrigation (Table 1).

Conclusion

Based on the results of the experimental studies, innovative sprinkler irrigation is recommended at a pre-irrigation soil moisture of 70-75-75% relative to the FMC according to the 2-4-4 scheme, with an irrigation norm of 2693 m³/ha and a single irrigation norm of 200–250 m³/ha, during the growth of soybean variety “Uzbek-6” as the main crop in the conditions of meadow-sierozem soil.

List of Used Literature

1. Isaev S., Qodirov Z., Xamraev K., Atamuratov B., Sanaev X. Scientific basis for soybean planting in the condition of grassy alluvial soil prone to salinization // Journal of Critical Reviews, Vol 7, Issue 4, 2020.
2. Isaev S., Qodirov Z., Saylikhanova M. and Fozilov Sh. Influence of elements of irrigation technology of medium and late varieties of soybean on soybean yield // IOP Conf. Series: Earth and Environmental Science 937 (2021) 022129, doi:10.1088/1755-1315/937/2/022129.
3. Isaev S., Safarova H., Najmiddinov M. and Jumabaev F. Grain yield of repetitive mung bean variety Marjon, after autumn wheat // IOP Conf. Series: Earth and Environmental Science 937 (2021) 022132, doi:10.1088/1755-1315/937/2/022132.
4. Shamsiev A., Isaev S., Goziev G., Khusanov S., Khusanbaeva N. Efficiency of the irrigation norm for winter wheat and soy varieties in the typical land of Uzbekistan // IOP Conference Series: Earth and Environmental Science, 2022, 1068(1), 012025, doi:10.1088/1755-1315/1068/1/012025.
5. Methods of agrochemical, agrophysical and microbiological studies in irrigated lands. Tashkent. USSRCRI, 1963. P. 439.
6. Methods of agrochemical analysis of soil and plants. Tashkent, 1977. P. 249.
7. Methods of conducting field experiments. Tashkent, 2007. P. 148.