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ASSESSMENT OF THE EFFECT OF IRRIGATION METHODS ON THE GROWTH AND DEVELOPMENT OF RYE CROPS

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Abstract
This article presents information on the impact of irrigation in the care of rye crops using traditional and modern resource-saving irrigation technologies on the vegetation period, as well as on plant height during the growth and development of rye. Scientific research was conducted in 2023-2025 in the conditions of light gray soils of the Karshi district. The rye varieties Shalola, Vakhshskaya-116 and Ns Savo were used as the objects of the experiment.

Keywords: Plant, rye, irrigation, norm, vegetation period, light gray soils, development, variety.

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Introduction

Irrigation has become an important issue in the agricultural sector. In regions of the world where water scarcity and drought occur frequently, the introduction of mechanisms and techniques into farming practices for the effective use of water management mechanisms is one of the most important issues. Therefore, the use of precision irrigation and the implementation of resource-saving technologies in practice are very important. Precision irrigation is the implementation of various irrigation techniques that allow farmers to manage their resources efficiently in order to obtain optimal yields. The introduction of resource-saving technologies enables farmers to reduce costs, reduce water consumption, and obtain better yields.

Sprinkler irrigation is a method in which water is sprayed into the air using special sprinklers and falls onto the crop field in the form of rain. This method irrigates similarly to natural rainfall. In a sprinkler irrigation system, water is saved (20–40% less water is used compared to the conventional flow method). It works even when the land is uneven, and soil erosion is reduced. Fertilizer can be applied together with water (fertigation), and it requires less labor.

Literature Review

Winter rye is a cross-pollinated plant. The optimal temperature for germination is 6–12°C. In autumn, it develops into a bush and is resistant to winter conditions and frost. From seed germination to ripening, it requires a temperature of 1800°C. This grain crop is more demanding in terms of moisture than wheat, and its transpiration coefficient is 340–420. Rye demonstrates its greatest water requirement in autumn during soil cultivation and in summer during the fertilization and heading stages [3].

Due to its strong root system and absorptive capacity, winter rye is able to provide itself with nutrients and moisture even in sandy sod-podzolic soils. However, it also responds well to fertilizers and improvements in soil fertility [1].

It is well known that one of the main conditions for the growth and development of plants is moisture, especially in areas characterized by its deficiency. In this case,

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the fertile moisture reserves (PMR) accumulated in the soil by the beginning of the growing season are of primary importance in the formation of rye yield [5].
The influence of various agricultural crops on the absorption and distribution of moisture and heat in the soil layer, as well as the reverse process of the influence of water and heat resources on plant development [4].

Research Methods

Scientific research was conducted in 2023–2025 under the conditions of light-colored sierozem soils in the Karshi district. The Shalola, Vakhshskaya-116, and Ns Savo varieties of rye were used as the experimental objects. The soil of the experimental field consisted of light-colored sierozem soils, was slightly saline, with groundwater located at a depth of 2–2.5 meters and low mineralization (2.5–3 g/l). The experimental design was conducted using a randomized block method in 2 blocks, 36 variants, and 3 replications; the variants were arranged systematically. The total number of plots was 108, the area of each plot was 30 m², and the seeding rate was 4.5 million/ha. In the cultivation of rye, traditional furrow irrigation, as well as sprinkler irrigation methods based on modern resource-saving irrigation technologies, were used. Blocks: Block 1 – furrow irrigation (standard), Block 2 – sprinkler irrigation. In the experiment, irrigation was carried out according to soil moisture levels of 65-70-60%; 70-75-65%; 75-80-70%; and 80-85-75% relative to FC (field capacity).
The collection of soil and plant samples, determination of soil moisture, and accounting for water use and rye yield, as well as their preparation and analysis, were carried out according to generally accepted methods [4].

Analysis of the Research

In the course of studying the effect of irrigation of the rye plant on its growth and development over three years, according to the results obtained, the number of days to heading was 185–191 days across the studied varieties when the irrigation regime of 65-70-60% of soil moisture relative to field capacity (FC) was applied under agro-background conditions where the rye plant was irrigated traditionally

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(by furrows) as well as by sprinkler irrigation methods based on modern resource-saving irrigation technologies. When the irrigation regime of 70-75-65% of soil moisture relative to field capacity (FC) was applied, the number of days to heading across the studied varieties was 189–195 days under agro-background conditions where traditional technology was used; when modern resource-saving irrigation technologies (sprinkler irrigation) were used, it was 190–196 days. When the irrigation regime of 75-80-70% of soil moisture relative to field capacity (FC) was applied, the number of days to heading across the studied varieties was 190–196 days under agro-background conditions where traditional technology was used; when modern resource-saving irrigation technologies (sprinkler irrigation) were used, it was 190–196 and 191–197 days. When the irrigation regime of 80-85-75% of soil moisture relative to field capacity (FC) was applied, it was determined that the number of days to heading across the studied varieties was 191–197 days under both agro-background conditions where traditional technology was used and when modern resource-saving irrigation technologies (sprinkler irrigation) were used.

During the study, the effect of irrigation methods and regimes on the growing period of rye varieties was studied. Under the control agro-background conditions, when the furrow irrigation method was applied, the growing period across the varieties was 229–244 days when irrigation regimes of 65-70-60% and 70-75-65% of soil moisture relative to field capacity (FC) were applied; when the irrigation regime of 70-75-65% of soil moisture relative to field capacity (FC) was applied, it was 236–244 days; and when the irrigation regime of 75-80-70% of soil moisture relative to field capacity (FC) was applied, it was 237–245 days. Under the agro-background conditions where drip and sprinkler irrigation methods were applied based on modern resource-saving irrigation technologies, the growing period across the studied varieties was 229–237 days when the irrigation regime of 65-70-60% of soil moisture relative to field capacity (FC) was applied; when the irrigation regime of 70-75-65% of soil moisture relative to field capacity (FC) was applied, the growing period across the studied varieties was 237–245 days; when the irrigation regime of 75-80-70% of soil moisture relative to field capacity (FC) was applied, the growing period across the studied varieties was 237–246 days; and

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when the irrigation regime of 80-85-75% of soil moisture relative to field capacity (FC) was applied, the growing period across the studied varieties was 237–245 days.

Table 1. Effect of Irrigation Methods on the Growth and Development of Rye (2023)

No.	Irrigation method	Irrigation regime	Variety name	Days to heading	Growing period (days)	Plant height (cm)
1	Furrow irrigation (standard)	65-70-60% of field capacity (Background)	Shalola	191	237	121,6
2			Vaxshskaya-116	188	233	111,5
3			Ns Savo	185	229	125,8
4		70-75-65% of field capacity	Shalola	195	244	135,3
5			Vaxshskaya-116	192	240	126,2
6			Ns Savo	189	236	141,7
7		75-80-70% of field capacity	Shalola	196	245	144,3
8			Vaxshskaya-116	193	241	135,5
9			Ns Savo	190	237	151,4
10		80-85-75% of field capacity	Shalola	197	246	151,3
11			Vaxshskaya-116	194	242	142,1
12			Ns Savo	191	237	159,2
13	Sprinkler irrigation	65-70-60% of field capacity (Background)	Shalola	191	237	123,3
14			Vaxshskaya-116	188	233	115,2
15			Ns Savo	185	229	129,1
16		70-75-65% of field capacity	Shalola	196	245	138,2
17			Vaxshskaya-116	193	241	130,4
18			Ns Savo	190	237	143,9
19		75-80-70% of field capacity	Shalola	197	246	146,6
20			Vaxshskaya-116	194	242	138,0
21			Ns Savo	191	237	155,0
22		80-85-75% of field capacity	Shalola	197	245	153,6
23			Vaxshskaya-116	194	242	145,7
24			Ns Savo	191	237	163,3

During the growing period, the plant can grow and develop normally and produce a high yield only if it is provided with all the necessary mineral nutrients. In our scientific studies, when the effect of different irrigation methods and regimes on

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plant height was studied during the cultivation of rye, it was determined that this indicator was (Shalola 110-151, Vakhshskaya-116 101-142, Ns Savo 111-165) cm across the varieties. When we analyzed this indicator according to the irrigation methods used in the experiment, it was determined that the lowest value (105-114 cm) was observed under the agro-background conditions where the traditional irrigation method was used. Under the agro-background conditions where sprinkler irrigation technology was used as a modern resource-saving method, plant height differed from the standard agro-background; that is, unlike traditional irrigation technology, it was determined that the sprinkler irrigation method had a positive effect on rye plant height (4-8 cm). It was also recorded that under the agro-background conditions where the sprinkler irrigation method was used, plant height was higher (13-16 cm) compared with the standard furrow irrigation method.

When analyzing the irrigation requirements and responsiveness of the varieties studied in the experiment, the local Shalola variety showed the lowest plant height (101–105 cm) regardless of the irrigation method and regime, the foreign Vakhshskaya-116 variety showed an average value (114–129 cm), while another foreign variety, Ns Savo, showed the most positive result (136–142 cm) among the varieties when the irrigation technique was applied.

Conclusion

It was determined that the overall growth and development of rye during the growing period (days to heading, growing period) and plant height depend on the irrigation technology used; that is, the results of the conducted research showed that they are directly dependent on the irrigation methods and regimes.

As a modern irrigation method, sprinkler irrigation was found to be a water-saving and water-efficient method compared with furrow (standard) irrigation, and it was determined that the growing period of rye was 233–246 days depending on the pre-irrigation soil moisture level.

Based on the results of scientific research conducted over three years, we concluded that the use of modern water-saving irrigation methods ensures the

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normal overall development of rye plants, has a positive effect on plant height, and, most importantly, ensures efficient use of water.

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