AMERICAN JOURNAL OF BIOLOGY AND NATURAL SCIENCES
https://biojournals.us/index.php/AJBNS
ISSN: 2997-7185

Article

Dependence of Potato Growth, Development, and Yield on Irrigation Methods in The Conditions of The Zarafshan Valley

Rizaev Sh.Kh.[1], Mirfozilov N.A.[2], Bobomirzaev P.Kh.[3], Sharifov K.[4]
1. Doctor of Agricultural Sciences, Professor, Samarkand Agroinnovations and Research University, Uzbekistan
2. Doctor of Philosophy (PhD) in Agricultural Sciences, Senior Lecturer, Andijan Institute of Agriculture and Agrotechnologies, Uzbekistan
3. Doctor of Agricultural Sciences, Professor, Samarkand Agroinnovations and Research University, Uzbekistan
4. Doctor of Philosophy (PhD) in Agricultural Sciences, Senior Lecturer, Samarkand Agroinnovations and Research University, Uzbekistan

Citation: Rizaev Sh.Kh., Mirfozilov N.A., Bobomirzaev P.Kh., Sharifov K. Dependence of Potato Growth, Development, and Yield on Irrigation Methods in The Conditions of The Zarafshan Valley. American Journal of Biology and Natural Sciences 2026, 3(3), 192-195.

Received: 25th Jan 2026
Revised: 15th Feb 2026
Accepted: 10th Mar 2026
Published: 31st Mar 2026

Abstract: This article presents data on the dependence of potato growth, development, and yield on irrigation methods under the conditions of meadow-gray soils of the Zarafshan valley.

Keywords: Meadow-Gray Soils, Potato, Growth, Development, Yield, Irrigation Methods, Zarafshan and Romano Varieties, Furrow Irrigation, Sprinkler Irrigation, Tuber Yield

Introduction

Today, significant attention is being paid to increasing high yields through the creation of new varieties, the introduction of modern technologies, methods of variety and seed control, phytosanitary monitoring, and the complex application of agricultural measures for seed potato production by the International Potato Center (CIP, Peru), the World Vegetable Center (AVRDC, Taiwan), and the German Potato Industry Association (UNIKA, Germany) [1]. The global average yield of potatoes is 15 t/ha, while it is 10-11 t/ha in Russia, 40-45 t/ha in the Netherlands and Germany, and 30-35 t/ha in the USA, England, and France [2]. In Uzbekistan, the average potato yield is 17 t/ha. In recent years, special attention has been paid to increasing yield and production volume by introducing new technologies, conducting extensive work on seed production, regionalizing new foreign varieties, applying resource-saving technologies in their cultivation, and utilizing in vitro and hydroponic methods [3].

Furthermore, the currently observed changes in global climate conditions, droughts, and water scarcity naturally create challenges in achieving high potato yields. In this regard, ensuring the

necessary moisture in the arable layer during potato cultivation requires the introduction of water-saving irrigation methods in agricultural technology[4]. By implementing these technologies, it is possible to achieve higher and better-quality yields while simultaneously saving irrigation water. Sprinkler irrigation is considered an effective method for potato cultivation, and conducting scientific research on its effectiveness under the conditions of the Zarafshan valley is one of the crucial issues[5].

Materials and Methods

Taking the above into account, the impact of furrow (traditional) and sprinkler irrigation methods on the growth, development, and tuber yield of potato varieties was studied under the conditions of the Samarkand region in the Zarafshan valley. Field experiments were conducted in the meadow-gray soils of the educational-experimental farm of the Samarkand Institute of Agro-innovations and Research[6].

The research objects included meadow-gray soils, "Zarafshan" and "Romano" potato varieties, furrow and sprinkler irrigation methods, and various irrigation regimes. Field experiments, including planting, crop management, harvesting, yield calculation, phenological observations, measurements, and analyses, were carried out according to generally accepted methodologies [7]. Water consumption in furrow irrigation-specifically the amount of water entering the field, infiltrating the soil, and leaving as runoff-was measured using "Cippoletti" and "Thomson" weirs. In the sprinkler irrigation method, water consumption was determined using a specialized water meter on the control panel. The experiments were conducted in four replications. The plot dimensions were as follows: furrow length (L) = 100 m; furrow spacing (w) = 0.7 m; area of one furrow 100x0,7=70 m^2; area of one replication 70x4=280 m^2.[8] The total area for four replications was 280x4 =1120 m^2, and for all furrow-irrigated variants, it amounted to 1120x4=4480 m^2. For two varieties, the total area was 4480x2=8960 m^2.In the sprinkler irrigation variant (with a 10 m sprinkling range), the total area was 40x100= 4000 m^2. The total experimental area was 12980 m^2 or approximately 1.3 hectares. The experimental setup, calculations, analyses, and phenological observations followed the guidelines of the Research Institute of Cotton Selection, Seed Breeding and Cultivation Agrotechnologies "Methodology for conducting field experiments" [9]. Analysis of variance (ANOVA) of the obtained yield data was performed according to B.A. Dospekhov.

Results and Discussion

One of the critical parameters of irrigation technologies in the cultivation of potatoes and all other agricultural crops is a correctly established irrigation regime. Based on long-term research and the biological characteristics of the potato plant, it is recommended to limit irrigation norms to 20–30 mm [10]. In the experiment, to determine the optimal field moisture capacity, biometric measurements of the growth, development, and formation of vegetative organs of "Zarafshan" and "Romano" potato varieties were conducted every ten days from the 25–30th to the 70–80th days of the development period under three moisture control levels relative to the Soil Field Capacity (SFC): 65–75–75% (control); 75–75–85% and 75–85–85% (sprinkler and furrow irrigation)[11].

In the early planting period, seed tubers fully germinated 25 days after planting. It was noted that their growth and development changed consistently from the third decade of the growing season until the 80th day. Changes in development were observed in early potato varieties grown under different irrigation methods at 75–75–85% and 75–85–85% moisture control (variants 2, 4 with sprinkler irrigation and variants 3, 5 with furrow irrigation) compared to the control variant[12].

According to the analysis, in variants 2 and 4 (sprinkler irrigation), on the 47–48th day of the growing season (April 21–22), the plant height reached 34.2–37.5 cm, which was 2.0–4.4 cm higher than the control. In the furrow-irrigated variant 3, the average height was 36.4 cm, and in variant 4, it was 34.7 cm, or 3.8–2.0 cm higher than the control, respectively. When planted as a late-season crop, plant height in sprinkler-irrigated variants on the 47–48th day reached 29.8–30.9 cm (5.9–7.3 cm higher than control), while in furrow-irrigated variants, it averaged 27.8 cm (variant 3) and 28.4 cm (variant 4), which was 3.2–3.8 cm higher than the control. At the end of phenological observations, the highest parameters were recorded in sprinkler-irrigated variants: 82.6–82.8 cm for early potatoes (7.0–7.5 cm higher than control) and 78.9–79.5 cm for late potatoes (6.8–6.6 cm higher than control). Overall, based

on the development periods from day 32 to 82, potatoes planted in the early period (83.7 cm) were taller than those planted in the late period (79.8 cm)[13].

In variants managed with sprinkler irrigation, the growth rate reached its peak on the 42nd day compared to the 32nd day, increasing by 15.7 cm (a 47% increase relative to the previous observation). During the subsequent 52–62 days, growth was 13.5 cm (30%), and in the final ten-day observation period, it was 7.6 cm (10%). Using furrow irrigation with 75–75–85% SFC moisture control, the average plant height of early varieties on the 40th day was 31.3–33.8 cm; by the 80th day, the average height reached 81.9–82.1 cm, providing an increase of 6.7–7.7 cm over the control. In variant 5 (furrow irrigation at 75–85–85% SFC), plant height on the 40th day was 40.4–44.2 cm (10.7 cm higher than control), and by the 82–83rd day, it reached 76.9–78.7 cm (5.3 cm higher than control).

Irrigation methods play a vital role in tuber germination, growth, and development phases. Specifically, sprinkler irrigation combined with a 75–75–85% SFC regime positively influenced the duration of the growing season and the formation of vegetative organs in early potato cultivation. It was noted that tuber germination occurred earlier, and germination rates were higher compared to furrow-irrigated variants[14].

The highest additional yield in early-planted potato varieties was recorded in variants 2 and 4 (sprinkler irrigation), averaging 31.5–32.0 t/ha, which is 8.2–8.7 tons (approx. 29.0%) higher than the control. In 2023, the highest additional yield with sprinkler irrigation was observed in the early-planted "Romano" variety at 32.7 t/ha (8.4 t/ha or 28.0% above control); in 2024, the "Zarafshan" variety yielded 32.1 t/ha (8.7 t/ha or 30.0% above control). In furrow-irrigated variants, a relatively high additional yield was found in variant 3 (75–75–85% SFC) for the early-planted "Serhosil" variety at 3.5 t/ha (13.5% above control), and in variant 5 (75–85–85% SFC) for late-planted "Zarafshan" at 2.3 t/ha (10.0% above control). Furthermore, in the 2023 experiments, the highest overall yields were recorded with the 75–75–85% SFC regime for both early and late potatoes ("Romano" at 32.7 t/ha and "Zarafshan" at 32.0 t/ha)[15].

Conclusion

The growth and development of early potato varieties cultivated under various irrigation methods in the meadow-gray soils of the Samarkand region showed significant differences. In the variants managed with furrow irrigation at 75–75–85% and 75–85–85% SFC (Soil Field Capacity) regimes, plants were observed to be taller, more robust, and characterized by higher stem and leaf density compared to the control. Furthermore, it was determined that the parameters in the sprinkler-irrigated variant under the 75–75–85% SFC regime were superior to all other tested variants. Specifically, compared to the control, plant height increased by an average of 8.7–6.1 cm across planting dates, tuber yield per plant increased by 115–114 g, and the average tuber weight was 13–8 g higher. In the early potato variants under furrow irrigation at a 75–75–85% regime, the average weight of the vegetative mass (haulm) per plant was 39–36 g higher, and plant height was 7–4 cm greater than the control. The highest overall productivity was recorded in variant 2, utilizing the sprinkler irrigation method. In this variant, the haulm weight per plant reached 361.0–363.5 g, tuber yield per plant was 595.7–579.2 g, the number of tubers per plant was 8.5–7.8, and the average tuber weight ranged from 71.8 to 75.9 g. Regarding water use efficiency, while the yield obtained per m^3 of water consumed in furrow irrigation (control) was 5.8 kg, this indicator reached 9.3 kg under sprinkler irrigation, representing an increase of 3.5 kg compared to the control variant.

REFERENCES

[1] Republic of Uzbekistan, “Water resources management strategy of Uzbekistan,” Tashkent, 2021, pp. 12–18.

[2] A. R. Karimov, “Efficient use of irrigation water in agriculture,” *Journal of Agricultural Sciences of Uzbekistan*, vol. 3, no. 2, pp. 45–52, 2020.

[3] B. T. Yusupov and M. K. Rakhimov, “Modern irrigation technologies and their effectiveness,” Tashkent: Fan Publishing, 2019, pp. 78–85.

[4] FAO, “Irrigation in Central Asia in figures,” Rome, Italy, 2018, pp. 33–40.

[5] S. A. Abdullaev, “Water-saving irrigation methods in arid regions,” *International Journal of Water Resources*, vol. 5, no. 1, pp. 21–29, 2021.

[6] N. Q. Mamatov, "Potato cultivation technology under irrigated conditions," Samarkand: Zarafshan Publishing, 2020, pp. 55–63.
[7] I. S. Ergashev and D. B. Tursunov, "Impact of irrigation regimes on crop productivity," *Agricultural Engineering Journal*, vol. 7, no. 3, pp. 90–97, 2019.
[8] World Bank, "Improving irrigation efficiency in Uzbekistan," Washington, DC, 2022, pp. 14–22.
[9] H. P. Singh, "Irrigation management for potato production," *International Potato Center Report*, Lima, Peru, 2017, pp. 66–72.
[10] R. K. Gupta and S. Sharma, "Water use efficiency in crop production," *Journal of Sustainable Agriculture*, vol. 12, no. 4, pp. 101–110, 2018.
[11] M. A. Rasulov, "Soil moisture dynamics under different irrigation methods," *Uzbek Journal of Soil Science*, vol. 6, no. 2, pp. 39–46, 2021.
[12] A. K. Kadirov, "Drip irrigation and its advantages in crop yield," Tashkent: AgroScience Press, 2020, pp. 88–95.
[13] International Water Management Institute, "Water productivity in agriculture," Colombo, Sri Lanka, 2019, pp. 25–31.
[14] D. Z. Norov, "Climate conditions of the Zarafshan Valley and their impact on agriculture," Samarkand, 2018, pp. 11–19.
[15] European Commission, "Sustainable irrigation practices in agriculture," Brussels, 2021, pp. 40–48.