



IRRIGATION RATES AND SEASONAL WATER CONSUMPTION OF SOYBEAN VARIETIES UNDER FURROW AND DRIP IRRIGATION

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Abstract

This study examines furrow and drip irrigation regimes for second-crop soybean grown on meadow alluvial soils in Uzbekistan's Bukhara region. Field experiments assessed irrigation water application and soil water permeability under different pre-irrigation moisture levels. The reported results indicate the potential of drip irrigation to reduce irrigation water use and support resource-saving soybean cultivation.

Keywords: Soybean, drip irrigation, furrow irrigation, soil moisture, water conservation, soil permeability.

Introduction

Today, meeting the world population's demand for vegetable oil and protein is very important. According to the Food and Agriculture Organization, the largest soybean grain yields in the world were obtained in Brazil (163 million tonnes), the USA (111 million tonnes) and Argentina (48 million tonnes), and these countries are the leaders in soybean grain export. China, Korea and other Asian countries are the main importing countries. In 2022, world soybean grain production was 370.24 million tonnes, and 399.5 million tonnes of grain were planned for 2024. At a time



when the problem of water scarcity in the world is growing day by day, the development of resource-saving irrigation regimes for obtaining high and good-quality grain yields from soybean varieties is of great scientific and practical importance. In the world, special attention is paid to using resource-saving irrigation methods and correctly setting irrigation regimes, taking into account natural soil and climate conditions, in order to increase the volume and quality of grain production and to use irrigation water efficiently.

According to D. Yormatova [1; P. 13], M. Hamraeva, A. Nodirov [2; P. 32–33], N. Mirzaev, A. Abdiev and M. Shakhobova [3; P. 239–241], soybean varieties are adapted to main and repeated (second-crop) sowing in all regions of our republic, and the agrotechnology of their cultivation has been developed. No new machinery is needed for sowing and caring for this crop. Soybean seeds are sown with maize and vegetable seeders. Existing machinery is used for inter-row cultivation, and the grain is harvested with grain combines. Due to its biological features, soybean is less demanding on soil than other crops. Soybean belongs to the legume family, and its place of origin is considered to be Central Asia. Its grain contains 37–55% protein, 18–27% oil, various compounds rich in carbohydrates, microelements and vitamins. The favourable soil reaction for soybean is pH 6.0–6.5. As it is a heat-loving crop, it does not grow well on saline, swampy and heavy-textured soils, according to I. Sodiqov, N. Sodiqova and R. Saitkanova [4; P. 20]. In the studies of A. Abduazimov, M. Ismatova and M. Chuliev [5; P. 11–12], the results obtained under the agrobbackground where soybean was irrigated with plastic film laid between the rows were higher than those of the control (furrow irrigation) variant. Depending on pre-irrigation soil moisture, plant height was 26.0–36.9 cm, which was 10.8–14.8 cm taller than in the control variant.

Research Methods

During the field experiments, the agrophysical and agrochemical properties of the soil and phenological observations of the plants were studied using the methodological manuals of UzCSRI (Uzbek Cotton Scientific Research Institute) “Methods of Conducting Field Experiments” and “Methods of Agrophysical,



Agrochemical and Microbiological Research in Irrigated Cotton-Growing Areas”. The variation and statistical analysis of the obtained data was carried out according to B.A. Dospekhov’s “Methodology of Field Experiment”.

Research results

In the experimental field, furrow and drip irrigation measures were carried out for the sown soybean varieties. In the control variant for both varieties of the experiment, furrow irrigation was applied. The data for 2024 are presented. Variant 1 was the control. Under the irrigation regime of 70-70-60% of pre-irrigation soil moisture relative to the limited field moisture capacity (LFMC), the amount of water used in the 1st irrigation was 475.5 m³/ha of irrigation water, and in the 2nd irrigation 660.3 m³/ha of irrigation water was used. In the control variant with furrow irrigation, irrigation water consumption was 690.5 m³/ha, and at the ripening phase of soybean the amount of water used for the fourth irrigation was 614.4 m³/ha.

Under the irrigation regime of 70-70-60% of pre-irrigation soil moisture relative to LFMC, drip irrigation was carried out, and all irrigation rates were as follows. In the experiment, together with irrigation, the annual rates of nitrogen, phosphorus and potassium fertilizers – 60, 90 and 60 kg/ha – were applied equally in all variants, and in all drip-irrigated variants, silicon at 150 g/ha and naturamin at 200 g/ha were additionally applied. In the second variant of the experiment, 202.4 m³/ha of water was applied in the first irrigation, and 193.8 and 323.4 m³/ha of water was used in the second and third irrigations. In the following irrigations, 337.6 m³/ha was applied in the fourth irrigation, 313.7 m³/ha in the fifth irrigation, 333.1 m³/ha in the sixth, and 290.0 m³/ha in the last, seventh irrigation.

In the third variant of the experiment, under the irrigation regime of 65-70-65% of pre-irrigation soil moisture relative to LFMC, one additional feeding was applied on top of the fertilizer rates, in accordance with the irrigation variant above. The irrigation water consumption was 222.8 m³/ha in the first irrigation and 333.1 m³/ha in the second irrigation, while in the following, third and fourth irrigations



it was 327.3 and 313.3 m³/ha; the amount of water used in the fifth irrigation was 308.2 m³/ha, and in the last, sixth irrigation 245.9 m³/ha was applied.

In the fourth variant of the experiment, when irrigation was carried out under the regime of 70-75-65% of pre-irrigation soil moisture relative to LFMC, 169.9 m³/ha was used in the first irrigation, and the amount of water used in the second and third irrigations was 191.1 and 264.0 m³/ha. In the fourth irrigation, it was 274.4 m³/ha; in the fifth and sixth irrigations, 279.3 and 269.5 m³/ha of water was used; in the seventh irrigation, 227.5 m³/ha; and in the last, eighth irrigation, 214.3 m³/ha. In the experimental field, for the variants of the soybean variety Tashkent with furrow and drip irrigation, the irrigation rates under the regime of pre-irrigation soil moisture relative to LFMC of 70-70-60% with furrow irrigation were as follows: 533.9 m³/ha of water was used in the first irrigation and 639.7 m³/ha in the second irrigation. In the third and fourth irrigations, the amount of water used was 660.3 and 599.3 m³/ha. In variant 6 with drip irrigation, under the regime of 70-70-60% of pre-irrigation soil moisture relative to LFMC, 194.0 m³/ha of water was used in the first irrigation, 191.1 and 308.7 m³/ha in the second and third irrigations, 328.3 m³/ha in the fourth irrigation, 303.8 m³/ha in the fifth irrigation, and 338.1 and 257.7 m³/ha in the sixth and seventh irrigations. In variant 7, when irrigation was carried out under the regime of 65-70-70% of pre-irrigation soil moisture relative to LFMC, 228.8 m³/ha of water was used in the first irrigation, 339.5 and 303.8 m³/ha in the second and third irrigations, 318.6 and 331.1 m³/ha in the remaining fourth and fifth irrigations, and 263.5 m³/ha in the last, seventh irrigation. In the most optimal variant 8, when irrigation was carried out under the regime of 70-75-65% of pre-irrigation soil moisture relative to LFMC, 202.7 m³/ha was used in the first irrigation, 185.3 and 254.9 m³/ha in the second and third irrigations, 269.5 and 259.7 m³/ha in the fourth and fifth irrigations, 268.3 m³/ha in the following, seventh irrigation, and 214.3 m³/ha in the last, 8th irrigation. The irrigation rates for 2025/206 are shown in Figure 1.

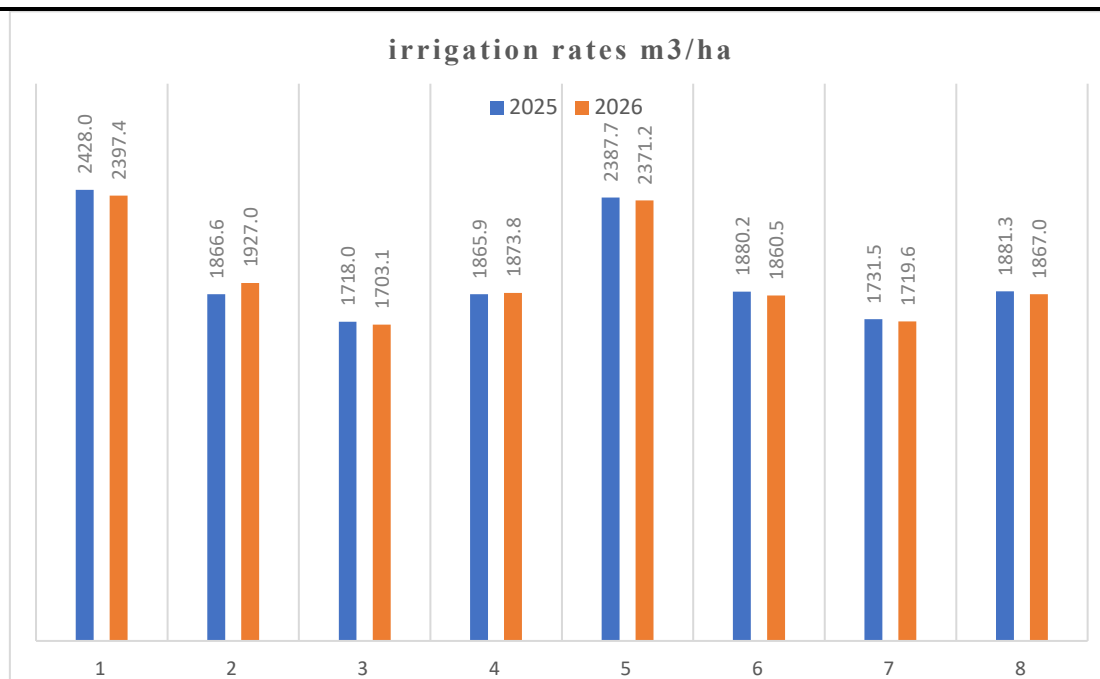


Figure 1

Conclusion

Under the conditions of meadow alluvial soils of Bukhara region, when soybean varieties were sown as a repeated (second) crop, at the beginning of the growing season 813.8 m³/ha of water passed through on the general background of the experimental field, while by the end of the growing season, water permeability over 6 hours was 678.3 m³/ha in variant 4, where the drip-irrigated soybean variety Tashkent was sown, and 703.4 m³/ha in the drip-irrigated variant 8, where the high-yielding soybean variety was sown.

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