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Application of water-saving irrigation technologies in the irrigation of fodder beets grown as the main crop

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Abstract: Soil reclamation conditions are the main factor in the growth and high yield of fodder beetroot and its crops. Therefore, in the care of agricultural crops, it is important to selectively plant and place crops according to soil reclamation and fertility. A number of research scientists in this regard, including A.S. Bolkunov [100 pp. 149–154], K.K. Gedroys [101; p. 247], I.V. Tyurin [102; p. 320], W.R. Williams [103; p. 311], V.V. Dokuchaev [104; p. 45], N.K. Baliabo [105; p. 446], A.K. Kashkarov [106; pp. 175–182], V.P. Kondratyuk [107; pp. 122-130], V.A. Kovda [108; p. 324], P.P. Vavilov [109; pp. 438–457], R. Oripov [110; p. 95–40], Hamraev K [111; p. 39–40], and other scientists have carried out a lot of scientific work on the effects of irrigation and feeding regimes and methods of maintaining soil fertility and improving its reclamation condition. Our experimental field is located in the sandy zone of the Bukhara region, so it belongs to the lower regions with sandy and loamy soil. The hydrogeological conditions of the areas controlled by the Shahrud Dostlik Main Canal are changing; therefore, the level of seepage water is changing in these areas.

The soils of the experimental field were gray in the initial period, and the subsequent rise of flood waters required that they correspond to meadow-alluvial soils..

The "Record Pole" variety is a medium-sized fodder beet variety with foam. The vegetation period is 115–120 days. Cylindrical, large rhizomes grow partially buried underground. Easy to assemble by hand. The color of the skin of the smooth rhizome changes from red (the lower part of the root). The leaves are upright and slightly spreading, and the flesh is purple. Productivity is 1000–1500 c/hectare. The variety has a positive effect on nutrition, is resistant to diseases, and flowers. Serunum shows good results on the ground.

Key words; beet, Record pole, cylinder, variety, leaf, yield, root, vegetation

In the conditions of meadow-alluvial, saline, and salinity-prone soils of the Bukhara region, a late-season "Rekord Poli" variety of fodder beet with a limited field moisture capacity of 70–80–75% according to water-saving drip irrigation field experiments Field research was carried out in 2021–2022, in the medium mechanical composition soils of the "Zarif Ota" farm, located in the territory of the Bukhara district, Bukhara region..

Field experiments were conducted in the following system in order to determine the optimal irrigation procedures of the scientifically based water-saving drip irrigation technology of the above-mentioned beetroot variety..

Table 1.
Experience system

Options	Irrigation method	The length of the furrow, m	Furrow interval, sm	Watering procedure
Type of "**Rekord poli**"				
1	Irrigation by furrow	100	60	fact-based measurements
2	drip irrigation from under polyethylene	100		70-80-75
3	Drip irrigation	100		

Based on the experimental system, field experiments were carried out in 3 options and 4 returns. The dimensions of the plots are as follows: The length of the furrow is 100 m, the distance between the furrows is 0.6 m, and the number of rows is 8, of which 4 are calculation rows. The rest are protective rows. The area of one option is 8x0.6x100=480 m2, one return area is 480x4=1920 m2, the total experimental area is 1920x3=0.576 hectare, and the scheme of the experimental system. The "Record Pole" variety is a medium-sized fodder beet variety with foam. The vegetation period is 115–120 days. Cylindrical, large rhizomes grow partially buried underground. Easy to assemble by hand. The color of the skin of the smooth rhizome changes from red (the lower part of the root). The leaves are upright, slightly spreading, and the flesh is purple. Productivity is 1000–1500 c/h. The variety has a positive effect on nutrition, is resistant to diseases, and flowers. Serunum shows good results on the ground..

During the experiment, the amount of humus in the 0–40 cm layer of the experimental field planted with beetroot was 1.201%, and in the sub-field layer it was 0.868%. The amount of total nitrogen was 0.093-0.086%, phosphorus was 0.162-0.084%, nitrate nitrogen was 26.7–18.3 mg/kg, mobile phosphorus was 35.7–24.3 mg/kg, and exchangeable potassium was 267.0–184.0 mg/kg. During the monitoring, the amount of humus and mobile phosphorus in the plow layer (0–40 cm) of the field planted with fodder beetroot was sufficient, and the amount of exchangeable potassium was provided at a medium level. (Table 2).

In the course of the research, the fertilizer norm N-200 recommended for the region by the Bukhara branch of the Scientific-Research Institute of Cotton Selection, Seeding, and Cultivation in the "Bukhara-6" variety of fodder beet, P-150, and K-100 kg/he, was applied..

The agrochemical description of the soil of the observation field was analyzed by taking soil samples from the 0–40 cm and 40–70 cm layers of each option at the end of the season..

Table 2.

Agrochemical description of the soil of the experimental field

Soil layer, cm	Nutrient content (at the beginning of the 2021 season)					
	gross amount, %			mobile form, mg/kg		
	Muck	N	P	$N\text{-}NO_3$	P_2O	K_2O
1	2	3	4	5	6	7
2021						
0-40	1,201	0,084	0,138	26,8	34,3	273,0
40-70	0,868	0,073	0,071	18,4	22,6	189,0
2022						
0-40	1,217	0,087	0,144	27,9	35,4	278,0
40-70	0,932	0,075	0,083	18,8	23,4	194,0

At the end of the experiment, in the 0-40 cm layer of the field soil planted with fodder beets, the total muck content increased to 0.016-0.018% compared to the initial state, and the total nitrogen decreased to 0.011-0.013%..

The limited field moisture capacity of the experimental field soil is 0–50 cm. 19.25% (in the 1st option), 20.06% (in the 2nd option), and 21.55% (in the 3rd option) compared to the dry mass of the soil in the layer (0–70 cm). 19.34% (in option 1), 20.26% (in option 2), and 21.83% (in option 3) in the layer; accordingly, 19.35% in the 0-100 cm layer of the soil of the experimental fields; 20.43% and 22.17%.

From the above analysis, it can be concluded that an increase in limited field moisture capacity was observed in all experimental fields with the deepening of the layer.

The water permeability of the soil is determined depending on the weight and mechanical composition of the soil, the soil layer, the type and degree of salinity of the soil, the condition of the field ditches, and the level of seepage water. The dependence of different irrigation technologies on the water permeability of the soil was studied. In the experimental area, the water permeability of the soil was determined for 6 hours by the "inner and outer rings" method for the beet field every spring before seeding..

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Terms and norms of watering fodder beets

The application of different irrigation technologies in the field of experimentation varies according to options during the development periods of beetroot. Taking into account its biological characteristics, the maximum yield of beets can be achieved by providing continuous water, taking into account LFMC, during all periods of plant growth and development..

In calculating the rate of irrigation of fodder beet [123; p. 25-29] we used the formula recommended by S.N. Rizhov:

$m_{nt} = 100 \cdot h \cdot d \cdot (W_{ns} – W_{so}) + K.$

There, *h* - calculation layer thickness, m;

d - volumetric mass of the soil calculation layer, g/cm3;

W_{ns} - limit field moisture capacity of soil, relative to weight, %;
W_{co} - pre-irrigation soil moisture by weight, %;
K - amount of water used for evaporation during irrigation (10 %).
The growth and development of beets and yield depend on the irrigation method.
Irrigation procedures for fodder beet in different irrigation technologies Table 4 shows.
Irrigation procedures for fodder beet in different irrigation technologies

Table 4.

Option number	Number of watering	Duration of irrigation, hours	Irrigation norm, m3/ha	Watering period, day	Seasonal irrigation norm, m3/ha
1	2	3	4	5	6
1	1	17	1160		**5911**
	2	19	1190	27	
	3	20	1203	29	
	4	18	1175	25	
	5	18	1183	21	
2	1	5,1	332		**3706**
	2	5,2	338	8	
	3	5,3	345	8	
	4	4,3	279	6	
	5	4,4	286	6	
	6	4,5	293	6	
	7	4,3	279	6	
	8	4,4	286	6	
	9	4,6	299	6	
	10	4,6	299	6	
	11	5,1	332	8	
	12	5,2	338	8	
3	1	4,8	312		**3891**
	2	4,7	306	8	
	3	4,9	319	8	
	4	3,9	254	5	
	5	3,8	247	6	
	6	3,9	254	6	
	7	4,1	267	6	
	8	3,7	241	5	

	9	3,6	234	5	
	10	3,9	254	5	
	11	4,0	260	5	
	12	5,0	325	8	
	13	4,7	306	8	
	14	4,8	312	8	

In our experiments carried out in the Bukhara district according to option 1 (2022), beets were irrigated five times in the 1-3-1 irrigation system according to the growth and development phases. The rate of irrigation was 1190–1203 m3 per hectare during the flowering period and 1183 m3 during the ripening period, and the rate of normal irrigation was 5911 m3 per hectare. The period between waterings was 21–29 days, according to the growth and development phases of the beets..

In option 2, with 70–80–75% of the soil compared to LFMC in drip irrigation of fodder beets, beets were irrigated twelve times in the 2–10–2 irrigation system according to the phases of growth and development. The rate of irrigation per hectare was different according to the growth phases of the beets. It can be explained by the fact that the standard of one-time watering during the flowering period is less than the standard of one-time watering in other phases and the short period between waterings. The period between waterings was 6–8 days, according to the growth and development phases of the beets.

In order to grow a rich crop of beetroot, the irrigation periods and norms of each irrigation card should be determined, taking into account the water supply of the area, the physical properties of the soil, and the depth of seepage water. These standards ensure that beetroot grows at the same rate and gathers an early and abundant harvest. If the plant is not supplied with enough water or if it is given more water than usual, beetroot will not grow and develop normally, and as a result, productivity will be low. The seasonal water content of fodder beet is 13–15% from germination to flowering, 54-63% from flowering to harvesting, and 17–22% during ripening. In the current irrigation system, water is given at a high rate of 1.4–1.8 thousand m3/ha, extending the period between irrigations, and watering is often done without taking into account the level of seepage waters. It worsens land reclamation and sharply reduces beet yield and water use coefficients. For this reason, it is important to study the water demand of beetroot in connection with planting in the fields, taking into account the appropriate irrigation method and the level of groundwater, and, as a result, applying technologies that improve soil agrophysics. One such technology is drip irrigation. Since the drip irrigation system is new in the conditions of our Republic, it requires the development of scientifically based irrigation norms and procedures. 190-meter-long main pipe made of black polyethylene with a diameter of 110 mm and a depth of 70 cm, and 270-meter-long water pipes were installed.

The fodder beet was considered a moisture-loving plant. During our experiments, we conducted phenological observations of 300 plants based on 3 variants of beet cultivation and 4 repetitions of each variant. As a result of our research, it became clear that sufficient moisture for the plant and timely watering were considered the most important factors for increasing crop productivity. As a result of our observations, the sorghum beet shed its leaves and produced new leaves. According to the options, in 2022, in the 1st option, i.e., with direct irrigation (in control), a yield of 121 tons/hectare was achieved, in the 2nd option, 132 tons/hectare in the drip irrigation option, and in the 3rd option, drip irrigation. It was shown as a result of our research that the yield (when moisture changes in relation to the limited field moisture capacity) was 134 tons/hectare. The difference in yield of 11–13 tons/hectare compared to the control variant can be explained by the fact that in the drip-irrigated variants, water is given to the plant itself and not to the field, and nutrients are given in a timely manner. In table 3.8.1, the yield obtained from fodder beet in the experimental field in 2021-2022 is presented in the section of options.

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Table 3.10.1. Effects of different irrigation methods on beet yield in tons/hectare

№	Variants	Productivity, according to returns, tons/hectare				Average of returns, tons/hectare
		Q_1	Q_2	Q_3	Q_4	
2021						
1	Furrow irrigation (control)	121	120	119,9	121,5	120,6
2	Drip irrigation from under polyethylene	133	131	134,5	133,5	133
3	Drip irrigation	130	131	130	129	130
2022						
1	Furrow irrigation (control)	122	118	123	121	121
2	Drip irrigation from under polyethylene	132	135	134	135	134
3	Drip irrigation	132	133	132	131	132

Conclusion

1. In the conditions of the alluvial, weakly saline soils of the Bukhara region, before planting fodder beet as the main crop, the volume mass of the soil at the beginning of the operation period was 1.27 g/cm3 in the 0–30 cm layer and 1.32 g/cm3 in the 0–50 cm layer. cm3, it was found to increase by 0.02–0.04 g/cm3 by the end of the period of operation..
2. For the agrochemical characterization of the soil of the experimental field, before setting up the field experiments (in February 2021) and after the completion of the research (in October 2022), humus, total nitrogen, total phosphorus, nitrate nitrogen, mobile phosphorus, and exchangeable potassium (mg/kg) amounts were determined. During the experiment, the amount of fodder reets in the 0–40 cm layer of the experimental field planted with beetroot was 1.201%, and in the sub-field layer it was 0.868%. The amount of total nitrogen was 0.093-0.086%, phosphorus was 0.162-0.084%, nitrate nitrogen was 26.7–18.3 mg/kg, mobile phosphorus was 35.7–24.3 mg/kg, and exchangeable potassium was 267.0–184.0 mg/kg..
3. The water carrying capacity of the soil is affected by its volume mass, hydrogeological conditions of the place, soil moisture, water level, and soil temperature, its salinity, the number of tillage operations, and seasonal irrigation. At the beginning of the growing period of beetroot, the water permeability is higher than in the fall. It was 6-5.0 mm/s, and by autumn it was 29.2 in the 1st hour, 15.1 in the 2nd hour, and 4-6 mm/s in the following hours..
4. In the conditions of alluvial, weakly saline soils, the meadow of the Bukhara region was irrigated five times during the season with an average of 5911 m3/ha, while in the second option, drip-irrigated under polyethylene, it was 12 times 3706 m3/ha. 3891 m3/ha were irrigated during the season in the 3rd option with drip irrigation. It was watered twice as much as the variant that was drip-irrigated from under polyethylene. Drip irrigation under polyethylene used 38% less water compared to the control option, and up to 2% less water was used compared to the drip irrigation option..
5. In the control variant, which irrigated the beetroot, the average yield in two years (2021–2022) was 120.8 t/ha, while in the version drip-irrigated under polyethylene, the yield was 133.5 t/ha. 131 t/ha in the drip-irrigated variant 3

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