

Investigating irrigation system by using drainage water in the cultivation of repeated millet crop

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Abstract. This scientific article shows the results and results of research on harvesting quality crops efficiently and repeatedly in the condition of water shortage, as well as irrigating system with supply of different quality water in order to improve the reclamation of lands. The study shows the results of experiments of the irrigating systems and the impact of irrigation water on the growth and yield of replanted millet in the grassland alluvial soils of Bukhara region, where the groundwater level is 1.5–2.0 meters. In the first experiment the mineralization of the drainage water was 4.1 g/l in the field that has been controlled and the seasonal irrigation rate of millet was 2580 cbm/ha. In the second experiment, the mineralization of irrigation water which has been taken from river was 0.9 g/l, and the seasonal irrigation norm was 2372 cbm/ha. In the third experiment, the mineralization of irrigation water which has been combined river water with the ditch water was 2.3 g/l and the seasonal irrigation norm was 2485 cbm/ha, while in the fourth experiment, the mineralization of irrigation water to which biosolvent has been added for the seasonal irrigation norm was 2464 cbm/ha. The yield of replanted millet was 2.6 t/ha in first experiment, 2.71 t/ha in second one, 2.66 t/ha in third experiment, and the yield of millet in the last experiment was 2.68 t/ha. High economic efficiency was observed in the third experiment.

1 Introduction

Global climate change indicates the emergence of water scarcity and the fact that drinking water consumption has increased 8 times over the last 70 years. Irrigated lands are estimated at 307.955 mln. hectares, which consumes 2.8 million km³ of fresh water per year in agriculture, uses 70% of the available fresh water consumption, with 40% of food and 60% of cereals coming from irrigated land. Scientific research is needed to address water scarcity while maintaining the water use model.

Planning the use of water in conditions of water scarcity in the world is aimed at the development of modern agromeliorative water – saving irrigation technologies [1] that will ensure the near and far future stability of the ecological-melioration situation of the regions. Reduce water scarcity and improve land melioration, ensure [4] sustainable and high yield from agricultural crops. One of the topical issues is the increase in the efficiency of the waters used for irrigation, as well as the implementation of scientific research on the use of collector-trench waters as an additional source of water [2].

In recent years in our Republic the government has established several laws and resolutions about introducing [9] economical water supplying technology in order to improve the reclamation of irrigating lands.

Furthermore, in the development strategy of Uzbekistan Republic during 2017–2021 years “improving conditions of reclamation land, increasing fertility of soil and the most important one is utilization of agro technologies which economics water and natural resources” is indicated as one of the most urgent task.

2 Materials and Methods

From the researches of foreign and scientists from other countries on the use of collector-ditch and groundwater in the irrigation of agricultural crops [3] to determine the impact of groundwater and collector-ditch water on productivity, the following S.F. Averyanov, V.A. Kovda, B.A. Shumakov, I.A. Engulatov, D.M. Kats [15], A.V. Lebedev, N.I. Parfenova, P.S. Panin, Kelli, Libuhu, Gapona, Bauera, Messlenda, Villah, G. Sabolcha, K. Daraba, K. Mirzajonov, N.N. Khodjiboev, V.G. Samoylenko, I.S. Rabochev, L.V. Kireycheva, V.S. Mgeladze, E.V. Ovchinnikova, A.A. Rachinskiy [6], F.A. Raximbaev, N.F. Bepalov [19], V.A. Dukhovnyy, R.K. Ikramov, V. Nasonov, E.I. Chembarisov, O.R. Ramazanov, E. Kurbanbaev, X.E. Yakubov, T.P. Gluxova, G.A. Ibragimov, M.A. Yakubov, The works of Sh. X. Yakubov, A.H. Karimov [5, 10] and others have

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been covered in detail and certain positive results have been achieved [11, 13].

The research was carried out according to the method of PSUEAITI in the meadow-alluvial, moderately saline, groundwater at a depth of 1.5–2.0 meters of the farm "Agrofayz ziynati" in Vobkent district of Bukhara region.

The experimental variants were placed in one tier, 3 ditches, the area of each ditch was 240 m² (length 50 m, width 4.8 m), the calculated area of the experimental field was (960 m²) and the total area was 8640 m². Irrigation in scientific research, except for the amount of fertilizer, all agro-technical measures were carried out on the basis of the approved technological map for Bukhara region.

In the experiment, after winter wheat, the Saratovskaya-853 variety of millet was placed as a secondary crop according to the following scheme (Table 1): 1st variant irrigation with ditch water as a control, 2nd variant irrigation with river water, 3rd variant irrigation with river water to ditch water in the last variant, field research was carried out by irrigating the millet crop by adding a biosolvent compound to the ditch water. If the order of fertilization was N₁₅₀, P₁₀₀, K₆₀, pre-irrigation soil moisture was carried out at LFMC 70-70-65%.

Table 1. Experimental system of cultivation of millet variety "Saratovskaya-853"

variants	Irrigation water	Crop type	Nutritional norms			Irrigation received relative to LFMC
			N	P	K	
1	Irrigation with drainage water (control)	Saratovskaya-853 variety of millet	150	100	60	70-70-65
2	Irrigation with river water		150	100	60	70-70-65
3	Irrigation by adding river water to the ditch water		150	100	60	70-70-65
4	Irrigation by adding a biosolvent compound to the ditch water		150	100	60	70-70-65

Soil work during the experiment:

1. The mechanical composition of the soil is determined by the method of N.A. Kachinsky [12, 20] on samples taken from soil shears at a depth of up to 1 meter layer on the genetic layers [24].

2. In determining the timing and norms of irrigation is calculated according to the experimental scheme according to the formula SN Ryjov [8, 21] on the difference between soil LFMC and pre-irrigation moisture [7, 18].

3. The amount of water supplied to the experimental field for irrigation and saline washing is calculated using Chipoletti (VCh-50) water meters [23].

4. Determining the level of mineralization of groundwater. All saline wells are identified before and after the complete saline leaching, as well as at the

beginning and end of the growth period [14] (dry residue and chlorine ion) [22].

Agrochemical properties of soil:

1. The amount of humus I.V. Tyurin method [16];
2. Total amounts of nitrogen and phosphorus in the soil L.P.Gritsenko, I.M. Maltseva method [25];
3. Nitrate nitrogen by calorimeter method; mobile phosphorus B.P. Machigin, exchangeable potassium is determined by the method of P.V. Protasov [17].

3 Results and Discussion

In Variant I (control) of the experiment, 880 cbm/ha was irrigated before sowing, 818 cbm/ha was used in the first irrigation, 682 cbm/ha in the second irrigation, and seasonal irrigation was used, directly using irrigation water with a mineralization of 4.1 g/l. The norm was 2580 cbm/ha.

In variant II, river water with a mineralization of 0.9 g/l was initially irrigated at 880 cbm/ha before planting, while 768 cbm/ha was used for the first irrigation and 724 cbm/ha for the second irrigation. The seasonal irrigation rate was 2372 cbm/ha (Table 2).

Table 2. In the reproduction of millet variety "Saratovskaya-853" irrigation regime

variants	The type of water used for irrigation	Qualities of water used for irrigation g/l	Irrigation schedule	Seasonal irrigation rate cbm/ha
1	Irrigation with drainage water (control)	4.1	0-1-1	2580
2	Irrigation with river water	1.6	0-1-1	2372
3	Irrigation by adding river water to the ditch water	2.3	0-1-1	2485
4	Irrigation by adding a biosolvent compound to the ditch water	4.1	0-1-1	2464

In the third variant of the study, 880 cbm/ha of water was used before irrigation, 833 cbm/ha in the first irrigation and 772 cbm/ha in the second irrigation. The seasonal irrigation norm was 2485 cbm/ha.

In the last variant IV, when a biosolvent compound was added to the ditch water with a mineralization of 4.1, 880 cbm/ha of water was initially applied before planting. 866 cbm/ha was used for the first irrigation and 718 cbm/ha for the second irrigation. The seasonal irrigation norm was 2464 cbm/ha.

The amount of water given in all experiments was measured using a Chipoletti water meter mounted on the head of the ditch in the experimental area.

In variant I (control) of the experimental field, the volume weight of the soil at the beginning of the growing season is 0–30 sm while the layer was 1.31

g/sm³, 0–100 sm. in the layer was 1.34 g/sm³. The salt regime is 0–30 cm on the dry residue. while the layer was 0.287%, 0–100 cm in the layer was 0.196 g/sm³. As a result of irrigation given during the cultivation of millet, the volume weight of the experimental field soil at the end of the growing season was 1.35 g/sm³ in the 0–30 sm layer, 0–100 sm. in the layer was 1.39 g/sm³. The salt regime is 0–30 sm on the dry residue. 0.100 sm while the layer was 0.432%. in the stratum it was 0.428%.

In Experiment Field II, at the beginning of the growing season, the bulk density of the soil is 0–30 sm. while the layer was 1.31 g/sm³, 0–100 sm. in the layer was 1.34 g/sm³. The salt regime is 0–30 cm on the dry residue. while the layer was 0.287%, 0–100 sm. in the layer was 0.196 g/sm³. As a result of irrigation given during the cultivation of millet, the volume weight of the experimental field soil at the end of the growing season was 1.32 g/sm³ in the 0–30 sm layer, while 0–100 sm. in the layer was 1.36 g/sm³. The salt regime is 0–30 sm on the dry residue. 0.100 sm while the layer was 0.328%. in the stratum was 0.304% (Table 3).

Table 3. Effect of irrigation water on soil volume mass, g/sm³

variants	Soil layer, sm	Volume weight g/sm ³		Change of salts (dry residue) %	
		At the beginning of the vegetation	At the end of the vegetation	At the beginning of the vegetation	At the end of the vegetation
1	0–30	1.31	1.35	0.287	0.432
	0–100	1.34	1.39	0.196	0.428
2	0–30	1.31	1.32	0.287	0.328
	0–100	1.34	1.36	0.196	0.304
3	0–30	1.31	1.33	0.287	0.396
	0–100	1.34	1.37	0.196	0.388
4	0–30	1.31	1.34	0.287	0.382
	0–100	1.34	1.38	0.196	0.374

At Experimental Field III, at the beginning of the growing season, the bulk density of the soil is 0–30 sm. while the layer was 1.31 g/sm³, 0–100 sm. in the layer was 1.34 g/sm³. The salt regime is 0–30 sm on the dry residue. while the layer was 0.287%, 0–100 sm. in the stratum it was 0.196%. As a result of irrigation given during the cultivation of millet, the volume weight of the experimental field soil at the end of the growing season was 1.33 g/sm³ in the 0–30 sm layer, while 0–100 sm. in the layer was 1.37 g/sm³. The salt regime is 0–30 sm on the dry residue. 0.19 sm while the layer was 0.396%. in the stratum it was 0.388%.

At the beginning of the growing season in Experimental Field IV, the volume weight of the soil was 0–30 sm. while the layer was 1.31 g/sm³, 0–100 sm. in the layer was 1.34 g/sm³. The salt regime is 0–30 sm on the dry residue. while the layer was 0.287%, 0–100 sm. in the stratum it was 0.196%. As a result of irrigation given during the cultivation of millet, the volume weight of the experimental field soil at the end of the growing season was 1.34 g/sm³ in the 0–30 sm layer, 0–100 cm. in the layer was 1.38 g/sm³. The salt regime is 0–30 cm

on the dry residue. 0.18 sm, while the layer was 0.382%. in the stratum, it was 0.374%.

The results of the analysis of millet yield showed that the highest value was used in variant 2 with seasonal river water consumption of 2372 cbm/ha and an average yield of 2.71 t/ha obtained in three repetitions (Table 4).

The second indicator was observed in variant 4, which was irrigated 2464 cbm/ha seasonally by adding a biosolvent compound to the ditch water. The average yield obtained in three repetitions was 2.68 t/ha.

The third indicator was the 3rd variant, which was irrigated 2485 cbm/ha seasonally by adding river water to the ditch water, ie the average yield of 2.66 t/ha obtained in three repetitions.

The lowest rate among the variants was observed in variant 1, which was considered as a control variant for seasonal irrigation with 2580 cbm/ha of ditch water, and an average of 2.6 t/ha was obtained, obtained in three repetitions.

Table 4. Yields of re-grown millet "Saratovskaya-853"

Irrigation water qualities	On returns productivity t/ha			Average productivity, t/ha
	1	2	3	
Irrigation with drainage water (control)	2.58	26	2.64	2.60
Irrigation with river water	2.68	2.72	2.74	2.71
Irrigation by adding river water to the ditch water	2.62	2.67	2.71	2.66
Irrigation by adding a biosolvent compound to the ditch water	2.66	2.69	27	2.68

4 Conclusions

In the re-cultivation of millet in the alluvial soils of the meadows of Bukhara region, direct irrigation with ditch and river water, mixed irrigation of river water with ditch water and irrigation water with a mixture of biosolvents in ditch water were used and the following conclusions were drawn:

1. All variants were irrigated in the experimental field with repeated crops, pre-irrigation soil moisture was 70-70-65% relative to LFMC, pre-sowing irrigation was 880 cbm/ha and a total of 3 times according to the scheme 0-1-1 2580 cbm/ha. formed.

2. The possibility of using ditch water directly or mixed with river water has been introduced experimentally in fields with medium sandy soils. Experiments have shown that when water with a mineralization of 2.3–4.1 g/l is used for irrigation, the amount of slightly soluble salts in the soil increases from 0.287 to 0.428% during the season.

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