

**INFLUENCE OF IRRIGATION METHODS AND REGIMES OF WINTER
WHEAT ON SOIL STRUCTURE**

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A.X.Rakhimov

Doctor of Agricultural Sciences, Associate Professor (TSAU).

M.Shodmanov

Docent (TSAU)

B.B.Tukhtashev

Docent (TSAU)

N.J.Niymatov

student (TSAU)

K.H.Qo'ldashov

student (TSAU)

Abstract. *Data are presented on the amount of water-stable macroaggregates in the 0–30 cm and 30–50 cm soil layers depending on the irrigation regimes and methods of winter wheat varieties Davr and Vekha under conditions of typical gray soils subject to irrigation erosion (*the slope is 1.5°*) in the Fergana region*

Keywords. *Typical gray soils, irrigation erosion, winter wheat, Davr and Vekha varieties, irrigation regime, furrow irrigation, flexible hose (or flexible pipe), irrigation methods, beginning of the season, end of the season, soil layers, amount of water-stable macroaggregates.*

**ВЛИЯНИЕ СПОСОБОВ И РЕЖИМОВ ОРОШЕНИЯ ОЗИМОЙ
ПШЕНИЦЫ НА СТРУКТУРУ ПОЧВЫ**

А.Х.Рахимов д.с.х.н, доцент Ташкентского

государственного аграрного университета (ТДАУ)

М.Шодманов доцент (ТДАУ)

Б.Б. Тухташев доцент (ТДАУ)

Н.Ж Нематов студент (ТДАУ)

К.Х Кулдашов студент (ТДАУ)

Аннотация. *Приведены данные о количестве водопрочных макроагрегатов в слоях почвы 0–30 см и 30–50 см в зависимости от режимов и способов орошения сортов озимой пшеницы Давр и Веха в условиях типичных серозёмов, подверженных ирригационной эрозии (уклон составляет 1,5°) в Ферганской области.*

Ключевые слова. *Типичные серозёмы, ирригационная эрозия, озимая пшеница, сорта Давр и Веха, режим орошения, полив по бороздам, гибкий шланг (или: гибкая*

труба), способы орошения, начало сезона, конец сезона, слои почвы, количество водопрочных макроагрегатов.

1. INTRODUCTION

In accordance with the tasks set out in Decree No. PF-5742 of the President of the Republic of Uzbekistan dated June 17, 2019 On the Efficient Use of Land and Water Resources in Agriculture Resolution No. PQ-4499 dated October 25, 2019 On Measures to Expand the Mechanisms for Encouraging the Introduction of Water-Saving Technologies in Agriculture, and Decree No. PQ-4575 dated January 28, 2020 On Approving the Strategy for the Development of Agriculture of the Republic of Uzbekistan for 2020–2030, a number of measures are being implemented to increase the productivity of agricultural crops and soil fertility, ensure efficient use of land, water, fertilizers and other resources, and introduce advanced agrotechnologies¹.

Today, in the agrotechnological system for growing agricultural crops in our republic, high results are being achieved through the use of water- and resource-saving technologies in irrigation and fertilization with local and mineral fertilizers. In particular, in recent years, irrigation methods such as drip irrigation, sprinkler irrigation, furrow irrigation with polyethylene film mulching between rows, and the distribution of irrigation water to furrows through flexible artificial pipes have created opportunities for water saving. In this regard, it is considered appropriate to expand the scope of scientific research on irrigating spring cereal crops by using flexible artificial pipes for furrow irrigation, in order to make efficient use of available water resources in our republic.

2 Materials and Methods.

From this point of view, scientific research on developing irrigation regimes for cultivating winter wheat varieties Davr and Vekha was carried out in the field areas of the Gulshan Yangi Bog massif in Fergana district, Fergana region, during 2021–2024, under conditions of typical gray soils affected by irrigation erosion. The slope of the field is 1.5 degrees, and the groundwater level is at a depth of 8–10 meters. The experiment consisted of 8 variants, with 4 replications, arranged in 1 tier. Each plot is 100 m long and 4.8 m wide. Each variant consists of 8 rows, with an area of 480 m², and the calculated (record) area is 240 m². The field experiments were conducted according to the methods described in the sources Methods of Conducting Field Experiments [1] and Methods of Agrochemical, Agrophysical, and Microbiological Research in Irrigated Cotton-Growing Regions [2; p. 124]. The experimental design is presented in Table 1.

It is known that the irrigation methods and regimes for winter wheat, along with the agrophysical properties of the soil such as bulk density and porosity, are also influenced by its granularity (structure). Every agrotechnical practice carried out in the field during crop cultivation (crop types, tillage, application of mineral and local fertilizers, irrigation methods, regimes, and others) affects the soil's granularity.

1. Decree No. PF-5853 of the President of the Republic of Uzbekistan dated October 23, 2019 'On Approving the Strategy for the Development of the Republic of Uzbekistan for 2020–2030

Table 1
Experiment scheme

Variant number	Winter wheat varieties	Irrigation method	Pre-irrigation soil moisture, % of LFMC
1	Davr	Furrow irrigation	60-70-60
2		Flexible pipe	
3		Furrow irrigation	70-75-70
4		Flexible pipe	
5	Vekh a	Furrow irrigation	60-70-60
6		Flexible pipe	
7		Furrow irrigation	70-75-70
8		Flexible pipe	

Furthermore, under the influence of humus and mineral nutrients on the soil particles, a granular (structured) state is formed in the soil.

The granular characteristics of the soil create conditions for positive changes in its water, air, thermal, and nutrient regimes, as well as for the intensification of microbiological processes.

According to data from Munyanziza et al. [3; pp. 77–85] and Lupwayi et al. [4; pp. 251–261], soil granularity (structure) affects the movement of soil water. It protects soil nutrients from being washed away by erosion and prevents a decline in crop yields.

Chan et al. [5; pp. 325–334] note that a decrease in soil granularity is a form of soil degradation.

3 Results and Discussion

According to the results obtained in 2021–2022, for the winter wheat variety Davr under furrow irrigation in Variant 1, where pre-irrigation soil moisture relative to field capacity (FC) was maintained at 60-70-60%, the amount of water-resistant macroaggregates in the 0–30 cm and 30–50 cm soil layers at the beginning of the season was 20.0% and 12.2%, respectively. By the end of the season, these values decreased to 10.8% and 8.4% in the respective soil layers, showing a reduction of 9.2% and 3.7% compared to the beginning of the season. When comparing these data with Variant 2, which had the same irrigation regime but a different irrigation method — namely irrigation through a flexible pipe — by the end of the season the amount of water-resistant macroaggregates in the 0–30 cm and 30–50 cm soil layers amounted to 11.4% and 8.7%, respectively. Thus, due to irrigation of winter wheat using a flexible pipe, the macroaggregate content was found to be 0.6% and 0.3% higher, respectively, compared to Variant 1 (Table 2).

Table 2

Change in soil structure depending on irrigation methods and regimes of winter wheat, %

Variant number	Winter wheat varieties	Irrigation method	Pre-irrigation soil moisture, % of LFMC	Soil layers, cm	Year 2021		Year 2022		Year 2023	
					at the beginning of the season	at the end of the season	at the beginning of the season	at the end of the season	at the beginning of the season	at the end of the season
1	Vekha	Furrow irrigation	60-70-60	0-30	20,0	10,8	19,5	10,7	18,4	11,5
				30-50	12,1	8,4	11,6	8,9	10,6	10,1
2		Flexible pipe irrigation		0-30	19,9	11,4	19,2	11,0	19,0	13,3
				30-50	11,5	8,7	10,1	9,3	11,1	10,2
3		Furrow irrigation	70-75-70	0-30	19,8	13,9	18,9	13,5	18,1	14,1
				30-50	12,3	11,1	12,1	10,9	11,6	10,2
4		Flexible pipe irrigation		0-30	20,0	14,8	18,3	13,9	20,1	14,8
				30-50	12,9	11,5	12,1	11,1	11,1	10,8
5	Vekha	Furrow irrigation	60-70-60	0-30	19,8	10,3	19,7	10,2	18,1	11,2
				30-50	12,4	8,2	11,3	8,6	12,1	10,3
6		Flexible pipe irrigation		0-30	19,8	11,0	19,1	10,8	19,3	13,1
				30-50	11,3	8,4	10,4	9,1	10,8	10,1
7		Furrow irrigation	70-75-70	0-30	20,0	13,1	18,6	12,0	19,3	11,9
				30-50	13,2	9,9	11,4	9,8	11,4	10,2
8		Flexible pipe irrigation		0-30	20,0	13,9	18,8	12,8	19,9	12,1
				30-50	13,2	10,2	11,6	10,3	11,2	10,5

In Variant 3, where the winter wheat variety Davr was irrigated by furrow irrigation with pre-irrigation soil moisture relative to field capacity (FC) at 70-75-70%, the amount of water-resistant macroaggregates in the topsoil and subsoil layers at the end of the season was 13.9% and 11.1%, respectively. Comparing these values with Variant 1, it was found that due to the change in the irrigation regime, the amount of water-resistant macroaggregates at the end of the season was higher by 3.3% and 2.8% in the respective soil layers.

In Variant 4 of the experiment, where the winter wheat variety Davr was irrigated via a flexible pipe with pre-irrigation soil moisture relative to field capacity (FC) at 70-75-70%, the amount of macroaggregates in the 0–30 cm and 30–50 cm soil layers at the beginning of the season was 20.0% and 12.9%, respectively. By the end of the season, these values were 14.2% and 11.4%, respectively. Compared to Variant 3, due to irrigation through a flexible pipe, the macroaggregate content at the end of the season was observed to be higher by 0.9% and 0.4% in the respective soil layers.

In Variant 5, where the winter wheat variety Vekha was irrigated by furrow irrigation with pre-irrigation soil moisture relative to field capacity (FC) at 60-70-60%, the amount of water-resistant macroaggregates in the 0–30 cm and 30–50 cm soil layers at the beginning and end of the season was 19.8–10.3% and 10.3–8.2%, respectively. Compared to Variant 1, where the Davr variety was cultivated, at the end of the season the amount of water-resistant macroaggregates was lower by 0.5% and 0.2% in the respective soil layers, and compared to Variant 6 (irrigated via a flexible pipe), it was lower by 0.7% and 0.2%.

In Variant 7, where the winter wheat variety Vekha was irrigated by furrow irrigation with pre-irrigation soil moisture relative to field capacity (FC) at 70-75-70%, the amount of water-resistant macroaggregates in the 0–30 cm and 30–50 cm soil layers at the beginning and end of the season was 20.1–13.2% and 13.1–9.9%, respectively. A decrease of 6.9% and 3.3%, respectively, was observed compared to the beginning of the season. Comparing

these data with Variant 8, it was found that due to the irrigation method, the amount of water-resistant macroaggregates at the end of the season was higher by 0.8% and 0.3% in the 0–30 cm and 30–50 cm soil layers, respectively.

In the experiment, relatively favorable indicators were observed in Variant 4, where the winter wheat variety Davr was irrigated via a flexible pipe with pre-irrigation soil moisture relative to field capacity (FC) at 70-75-70%. The amount of water-resistant macroaggregates at the beginning of the season in the 0–30 cm and 30–50 cm soil layers was 20.0% and 12.9%, respectively, and at the end of the season — 14.8% and 11.5%, respectively. Thus, a decrease of 5.2% and 1.4%, respectively, was found compared to the beginning of the season.

The patterns noted above were also observed in the scientific data obtained from the research in 2022 and 2023.

4 CONCLUSION

Thus, under conditions of typical gray soils affected by irrigation erosion (with a slope of 1.5°), it was determined that the preservation of water-resistant macroaggregates in the soil depends on the winter wheat varieties, their irrigation regime, and irrigation methods. Furthermore, when the Davr variety of winter wheat is irrigated via a flexible pipe with pre-irrigation soil moisture relative to field capacity (FC) at 70-75-70%, the amount of water-resistant macroaggregates in the soil is relatively maintained by the end of the season.

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