Quality of winter soft wheat grain under the influence of repeated and intermediate sowing in cotton-grain rotation

N N Bakhramova[1*], *F D* Mamadiyorov[1], *D H* Aminova[1], *M E* Azimova[2], and *N P* Kakhorova[2]

[1]Southern Research Institute of Agricultural, Karshi, 180100, Uzbekistan
[2]Karshi Engineering and Economic Institute, 225, Mustakillik avenue, Kashkadarya region, 180100, Uzbekistan

Abstract. Research work was carried out in 2017-2020 in a system of cotton-grain crop rotation on light gray soils of the Kashkadarya region of the Republic of Uzbekistan. This article describes the results of the positive effect of root and crop residues of mash and corn sown as repeat crops, as well as the sowing of intermediate crops of perco, rye as a green fertilizer in the soil on the quality of soft wheat grain in the crop rotation system.Grain quality improved due to the impact of a re-crop of mung bean sown after winter wheat and an intercrop of perco in a cotton-grain rotation system. Qualitative indicators of grain from year to year decreased as a result of the chronic sowing of wheat.

1 Introduction

The efficiency of wheat production is related not only to gross production but also to qualitative indicators, which depend on the price and market competitiveness of the output. Meteorological conditions, soil fertility, applied agrotechnological measures, biological features of the variety affect the quality indicators of winter wheat grain. The above factors can be divided into two groups, the first being uncontrollable factors (weather and climatic conditions during the growing season) and the second-managed factors (plant nutrition, protection against weeds, diseases, pests). At the same time, one of the main factors is the increase in grain yield and the quality of winter wheat in the future due to the preservation and improvement of soil fertility.

According to scientists, the yield and quality of wheat grain depend on the influence of the external environment, agrotechnical measures, plant species. Chronic grain treatment leads to an increase in weeds, pests and diseases. This necessitates the use of a large amount of pesticides, which in turn leads to a significant increase in the cost of production. Further impacts include negative changes in the soil, including a decrease in organic matter, carbon and total nitrogen. Scientists also note that the influence of root residues on soil fertility can be much higher than in other organic fertilizers. The Russian scientist Chibis

* Corresponding author: bakhromova.nilufar@mail.ru

notes that with incorrect crop rotation and chronic processing, the soil is subject to severe degradation, as a result of which yield and quality are reduced.

In studies carried out by the Russian scientist Tikhonov, after 2 years of growing wiki+white mustard and alfalfa as a siderat, the quality of gluten improved in the cultivation of winter wheat compared to the control option (pure plow) and the highest result was the gluten quality of 2-yearold alfalfa seeding, that is, IDK 77.5 which is defined as class 2 (good). In studies conducted by Somova the amount of protein was 17.0%, and the amount of gluten was 34.0% when using rapeseed seeds as siderata in the spring wheat rotation system in the northern region of Kazakhstan. In works show that the quality of winter wheat grain is strongly influenced by previous crops, which affects its cost. According to their data, the protein and gluten content of grain is high when winter wheat is cultivated after buckwheat and soybean, protein content is 12.4-13.3%, gluten is 23.5-27.9%, and when sowing chronic winter wheat is 9.2-9.6%, gluten is low–17.5-17.8%. In a similar study Wozniak reported that the production of winter wheat in the monoculture system resulted in a 10% reduction in the mass of 1000 grains, a 4.7% decrease in the gluten content and a 32% decrease in yield compared to the system of crop rotation. In the article "Yield and quality of wheat in crop rotation in the southern forest steppe of Western Siberia" in the system of rapeseed and soy rotation influence the technological indicators of grain quality, protein in soybean cultivation increased by 6.7% compared to rapeseed and gluten by 8.4%. It has been noted that this depends on the nitrogen enrichment of soybean as a precursor crop.

In the experiments a favorable precursor crop for wheat yielded a high yield when sowing in a mixture ofmash, perco+ rapes. Due to favorable precursors, the protein content in grains increased by 2.0-2.1%, gluten by 0.8-1.1%. In Dzhizak desert experience, when sowing cotton and winter wheat after mash, grain content was 15.1% or 0.88 t/ha protein, 28.1% or 1.8 t/ha gluten, t.k and 68.4 kg/ha feed unit and 6.8 kg/ha protein digestion. In the experiment, it was studied that as a result of crop rotation cotton-wheat, alfalfa-wheat, soybean-wheat, protein content after soybean 0.2%, after alfalfa 0.9%, gluten content increased by 0.9-3.1%. In the experiments of Oripov in winter wheat production after mash and rapeseed the quality of grain improved, the quality of grain was 18-33 g/l, the mass of 1000 grains-2.9-3.6 g, the protein content 2.0- 2.1% the amount of gluten was above 1.1-1.2%.

This pattern has also been observed in our experiments, and it has been observed that the technological quality of wheat grain has improved as a result of the impact of repeated and intermediate crops, They are planted after winter wheat in systems of rotation of winter wheat crops and absence of sowing of any crop. sowing and intermediate crops after winter wheat.

2 Materials and methods

2.1 Experiment scheme

Research work was carried out in 2017-2020 in a system of cotton-grain crop rotation on light gray soils of the Kashkadarya region of the Republic of Uzbekistan.

In the cotton-grain alternating system Gozgon winter wheat, Buhoro-8 cotton, mashs of Durdon, hybrid corn Karasuv-350AMV, rye Vahshskay 116, and Perco PBH were planted.

The field experience was conducted on a total area of 0.79 hectares, the area of each plot is 180 m^2, the number of options 11, and the number of replacements 4 in time and space. Our research was conducted according to generally accepted recommendations and guidelines (Table 1).

Table 1. Experiencestructure.

No.	Years Per With Factory Type			
	2017	**2018**	**2019**	**2020**
1	Wheat	Cotton	Wheat	Cotton
2	Cotton	Cotton	Cotton	Cotton
3	Wheat	Wheat	Wheat	Wheat
4	Wheat+mash+perco	Cotton	Wheat+mash+perco	Cotton
5	Wheat+mash+rye	Cotton	Wheat+mash+rye	Cotton
6	Wheat+corn+ perco	Cotton	Wheat+corn+ perco	Cotton
7	Wheat+corn+rye	Cotton	Wheat+corn+rye	Cotton
8	Cotton	Wheat+mash+perco	Cotton	Wheat
9	Cotton	Wheat+mash+rye	Cotton	Wheat
10	Cotton	Wheat+corn+ perco	Cotton	Wheat
11	Cotton	Wheat+corn+rye	Cotton	Wheat

The quality of winter soft wheat was studied in a system of cotton-grain crop rotation as a result of repeated and intermediate crops after winter wheat.

2.2 Methods for determining the quality indicators of winter wheat grain

To determine the quality of soft wheat seeds collected from the field, samples are taken from each variant and repetition following the requirements of GOST 13586.3-83 (GOST 13586.3-83, 2009), determination of 1000 kernels or seeds weight GOST 10842-89 (GOST 10842-89, 2009), determining of hectoliter weight GOST 10840-64 (GOST 10840-64, 2009), determining of vitreousnes GOST 10987-76 (GOST 10987-76, 2009), protein determination method GOST 10846-91 (GOST 10846-91, 2009), determining the quantity and quality of gluten (IDK) in wheat GOST 13586.1-68 (GOST 13586.1-68, 2009), following the requirement, the technological quality of grain was determined in the laboratory of indicators and the results of the analysis were compared for compliance with the requirements of Oz DST 880:2015 (State standard, 2015).

3 Results and Discussion

One of the most important indicators that determine the grain quality of winter soft wheat varieties grown in various soil and climatic conditions of our republic is hectoliter, which determines the fullness of grain and flour yield. Accordingly, the nature of grain is included in the list of state standards as one of the indicators that determine its grain quality.

Grain nature is a certain volume of purified grain mass, brought to the basic state, and its volumetric mass is expressed in g/l (GOST 10840-64, 2009).

According to the data obtained in the first year of research (2018), it was noted that the hectoliter weight of the experimental variants was 777.8-785.7 g/l. In our experiments conducted in 2019, where repeated and intermediate crops are not sown, and in the 1st and 3rd options, the hectoliter weight was 772.5-778.0 g/l, but due to the influence of repeated mung bean and intermediate crops perco sown after winter wheat, these hectoliter weights to 793.3-790.1 g/l, under the influence of repeated mung bean and intermediate rye, under the action of repeated corn and intermediate culture of perco 789.4 g/l and the action of repeated corn and intermediate culture of rye 787.9 g/l (Figure 1). These grain indicators in 2020 due to the influence of re-sowing mung bean and catch crops (cotton (C); wheat + mash + perco; cotton (WMP; C) and cotton C; wheat + mash + rye; cotton WMR; C) are 790.7-788.0 g/l, under the influence of repeated sowing of corn and intermediate sowing of

perco and rye (cotton; wheat + corn + perco; cotton (C; WCrP; C) and cotton; wheat + corn + rye; cotton (C; WCrR; C)) amounted to 787.2-785.6 g/l.

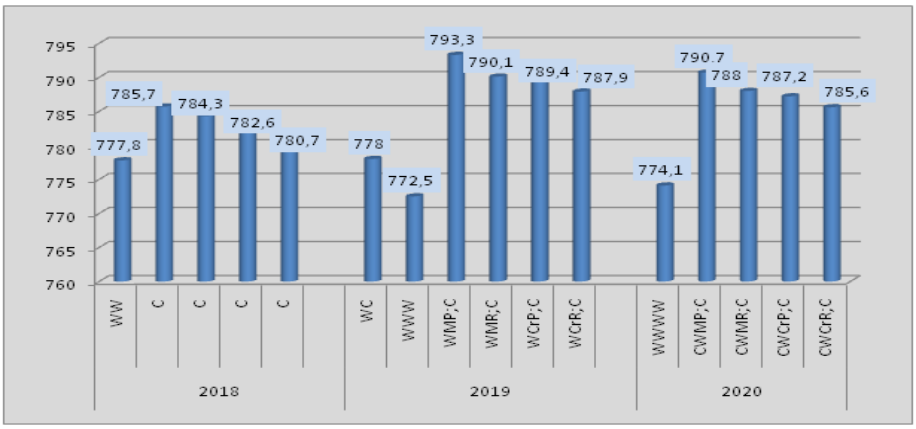

Fig. 1. Influence of repeated and intermediate crops on the hectoliter weight of winter wheat grain.

Vitreous grain is directly related to the amount of protein and gluten in its composition. Therefore, glass-like grains usually have the highest sealing properties. For this reason, our experiments have shown that the vitreous content of the grain was high in variants with high protein and gluten content. These figures were 75.5-71.6% in 2019, and similar figures (73.4-70.0%) were received in 2020.

The analysis of the obtained data on the influence of re-exploited and intermediate crops studied in the experience on the glassiness of grains shows that all repeated and siderata tested had an impact on the improvement of the quality of grains during re-sowing of wort and intermediate crops. In the cotton crop rotation region, they were used as siderats (Figure 2). In 2019, the parameters of these indicators are 75.5; 73.8; 72.3 to 71.6%, and in 2020 it was equal to 73.4; 73.4; 71.8; 70.0%.

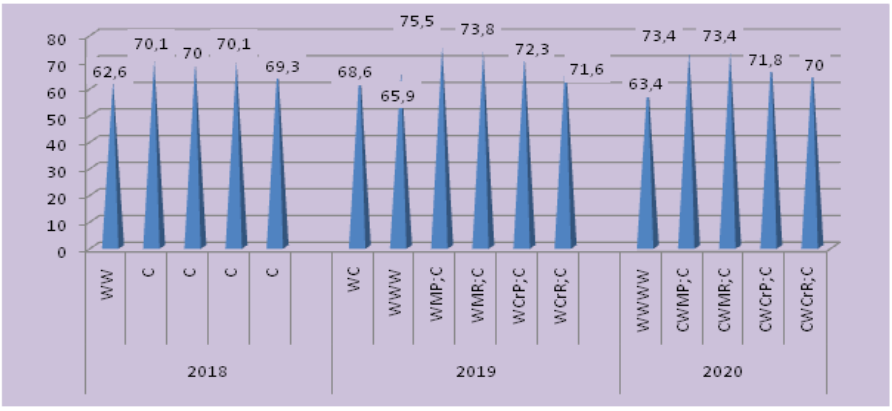

Fig. 2. Influence of repeated and intermediate crops on the degree of vitreousness of winter wheat grain.

Bread from wheat flour is a unique food product, its chemical composition depends on its beautiful appearance, softness, good taste, nutritional value, and good digestibility in the human body. The amount of protein and gluten in grains is one of the main indicators of grain quality.

In our experiments, the influence of repeated and intermediate crops on crop rotation affected the amount of protein and gluten in winter soft wheat in different ways in 2019-2020 (Table 2).

The smallest amount of protein (13.0%; 12.4%) and gluten (25.3%; 23.8%) in the grain was observed in the variant where wheat was sown instead of wheat. It was determined that the protein content (2019) was 13.5%, and the gluten content was 25.8% in the variant without sowing repeated and intermediate crops from winter wheat (Table 2).

Table 2. Influence of cotton-grain crop rotation system on quality indicators of winter wheat grain (2018-2020).

Numberof options	Predecessor crop type	Protein, %	Gluten, %	IDK	IDK, classroom
2018year					
1	Wheat;cotton				
3	Wheat	13.5	26.4	105.7	III
8	Cotton	14.0	27.4	90.0	II
9	Cotton	13.7	27.2	98.6	II
10	Cotton	13.7	27.0	96.0	II
11	Cotton	13.9	27.2	97.8	II
2019 year					
1	Wheat;cotton	13.5	25.8	96.6	II
3	Wheat (3 year)	13.0	25.3	109.7	III
5	Wheat+mash+perco	15.5	28.7	75.3	II
6	Wheat+mash+rye	14.9	28.4	80.0	II
7	Wheat+corn+perco	14.7	28.0	85.4	II
8	Wheat+corn+rye	14.4	27.9	87.0	II
2020year					
1	Wheat;cotton				
3	Wheat (4 year)	12.4	23.8	110.3	III
8	Cotton;wheat+mash+perco;cotton	15.0	29.1	75.0	I
9	Cotton;wheat+mash+rye;cotton	14.6	28.2	76.7	II
10	Cotton;wheat+corn+perco;cotton	14.1	28.0	80.3	II
11	Cotton;wheat +corn+rye;cotton	14.0	27.7	82.3	II

Note:In options 9, 10, 11, 12, winter wheat was cultivated after cotton in 2018

In the 2nd year of experience, i.e. in 2019, in the 1st variant, where repeated and intermediate crops were not sown after winter wheat, the protein content was 13.5%, gluten 25.8%, in the 3rd variant, where chronic wheat was planted, the protein content was 13.0%, gluten content 25.3%. It was found that the highest values of protein 15.5% and gluten 28.7% are due to the influence of the re-sowing mash after winter wheat and intermediate crop perco, re-sowing and intermediate sowing after winter wheat provided 2.0 and 2.9% higher protein content and 2.9% higher gluten content compared to no-sowing option 1 and 2.5% and 3.4% higher in compared to option 3 with monoculture wheat.

Due to the late action of repeated mung bean and intermediate rye, it was increased by 1.4%; 1.9%, and 2.6%; 3.1%. Also, due to the re-sowing of corn after winter wheat, as well as intermediate crops, perco and rye were higher by 0.9-1.2%; 2.1-2.2% and 1.4-1.7%; 2.6-2.7%.

Already in the third year of experience (2020), the amount of protein and gluten was high in all variants sown with repeated and intermediate crops according to the system, due to the influence of repeated mung bean and intermediate crops after winter wheat was 14.6-

15.0% and 28.2-29.1%, due to re-maize and catch crops 14.0-14.1% and 27.7-28.0%, in the 3rd variant, it was tested, where the wheat content is 12.4%, and the gluten content is 23.8% (Table 2).

In our studies, when we analyzed the results of gluten quality, that is, the IDK index, from the studied options in the cotton-grain crop rotation system, it was found that in option 3, where wheat was planted every year, the gluten quality corresponded to class III, and in the rest options II class. It should be noted that due to the impact of a repeated culture of mung bean sown after winter wheat andinter-mediate culture perco, the quality of gluten improved from year to year and met the requirement of class I. In particular, the final effect of the re-culture of mung bean and the intermediate culture of perco is 75.0 units. IDK, under the influence of repeated mung bean and intermediate rye 76.7; under the influence of repeated corn and intercrops perco 80.3; under the influence of repeated corn and intermediate crops of rye was 82.3.

4 Conclusion

In the cotton-grain crop rotation, the quality indicators of grain are improved due to the impact of the repeated crop of mung bean sown after winter wheat and the intermediate crop of perco, as a result of field weed control during chronic wheat care, grain quality indicators decreased year after year.

To grow a high-quality crop of winter wheat in the conditions of irrigated light gray soils of the Kashkadarya region, sowing after winter wheat, re-sowing mung bean and intermediate sowing perco or rye, and in spring plowing with green manure will have a positive effect on improving the quality of the grain, quality grain of the 1st grade was obtained with a protein content of 14.6-15.5%, gluten 28.2-29.1%, IDK 75.0-75,3.

Acknowledgement

This study was carried out as part of the fundamental project VA-KXF-5-014 "Scientific foundations for maintaining and improving soil fertility in the cotton-grain crop rotation system in the southern regions of the republic" (2017-2020) at the Southern Agricultural Research Institute. Improving the quality of winter wheat grain by increasing soil fertility.

The authors declare that they have no conflict of interest.

The work was performed at the Southern Research Institute of Agricultural.

Note

Wheat 2 year (WW), cotton (C), wheat+cotton (WC), wheat 3 year (WWW), wheat+mash+perco;cotton (WMP; C), wheat + mash + rye; cotton (WMR; C), wheat + corn + perco; cotton (WCrP; C), wheat + corn + rye; cotton (WCrR; C), wheat 4th year (WWWW), cotton; wheat + mash + perco; cotton (C; WMP; C), cotton; wheat + mash + rye; cotton (C; WMR; C), cotton; wheat + corn + perco; cotton (C; WCrP; C), cotton; wheat + corn + rye; cotton (C; WCrR; C).

References

1. B. Azizov, Ch. Tashpolatov, I. Kurbanov, A. Islamov, Influence of previous crops on grain yield and technological quality indicators, Journal Agrobusinessinform, Tashkent, **10**, **129**, 37 (2017)

2. A. Boriev, A. Sanakulov, F. Sarimsokova, Influence of previous crops on the economic and biological indicators of winter wheat, Journal of Agronomy, **4**, **8**, 23-24 (2008)
3. F. Cattaneo, P. Di Gennaro, L. Barbanti, K. Giovannini, M. Labra, B. Moreno, Perennial energy crop systems influence the activity of soil enzymes and bacterial community structure in agricultural areas of southern Europe, Applied soil ecology, **84**, 213–222 (2014)
4. V.V. Chibis, Influence of the place of culture in crop rotation on the formation of quality of barley grain in the forest steppe of Western Siberia, Bulletin of the Altai State Agrarian University, **9**, **71**, 9-11 (2010).
5. V.K. Drydiger, R.S. Stukalov, R.G. Gadjiumarov, S.S. Vaytshekhovskaya, The impact of water consumption and the efficiency of pasture use in a crop field without tillage, Agriculture, **6**, 28–32 (2019)
6. K. Emmerling, Reducing and maintaining the impact of tillage on the environmental properties of soils in organic farming, Biological Agriculture and Horticulture, **24**, 363–377 (2007)
7. B. Gimir, R. Gimir, D. VanLeoven, A. Mesbach, Influence of the amount of plant residues and their quality on the mineralization of soil organic carbon, Sustainability, **9**, 14 (2017)
8. GOST 10840-64 Grain, Methods for determination of hectolitre weight (2009)
9. GOST 10842-89 Cereals, pulses and oilseeds, Method for determination of 1000 kernels or seeds weight (2009)
10. GOST 10846-91 Grain and products of its processing, Method for determination of protein (2009)
11. GOST 10987-76 Grain, Methods of determination of vitreuesness(2009)
12. GOST 13586.1-68 Grain, Methods for determination of quantity and quality of gluten in wheat (2009)
13. GOST 13586.3-83Grain, Acceptance rules and sampling methods (2009)
14. J. Hirte, J. Leifeld, S. Abiven, H.-R. Oberholzer, A. Hummelele, J. Mayer, Overestimation of the biomass of crop roots in field experiments due to foreign organic matter, Front plant in science, **8**, 284 (2017)
15. B. Izbosarov, Measures to increase the yield of cotton and related crops and improve soil fertility, Abstract of a doctoral dissertation, Tashkent, 25 (2016)
16. R. Lal, Soil health and carbon management, Food and Energy Security, **5**, 212–222 (2016)
17. A.V. Lomanovsky, I.A. Korchagina, *Productivity and quality of wheat grain in crop rotations in the southern forest-steppe of Western Siberia*, IOP Conference Series: Earth and Environmental Sciences, International Conference on Global Technology Trends in Agribusiness 4-5 July 2020, **624**, 2-7 (2020)
18. R.O. Oripov, A.A. Boriev, Influence of previous crops on the yield of winter wheat and indicators of technological quality, Journal of agriculture and water management of Uzbekistan, Tashkent, **7**, 29 (2018)
19. L. Rahon, G. Shumilo, M. Brodovska, A. Wozniak, Nutritional value and mineral composition of grain of individual types of wheat depending on the intensity of production technology, Journal of elementology, **20**,705–715 (2015)
20. A.J. Schlegel, E. Assefa, L.A. Haag, K.R. Thompson, L.R. Stone, Long-term cultivation of soil by yield and water consumption of grain sorghum and winter wheat, Agronomic journal, 110, 269–280 (2018)

21. S.V. Somova, "Productivity of field crop rotation with bright wheat in the steppe zone on the southern black earth of northern Kazakhstan", Autoff.d.s., Tyumen, 17 (2019)
22. State standard of the Republic of Uzbekistan OzDST 880:2015, Wheat, Requirements for state purchases and deliveries (2015)
23. N.N. Tikhonov, "Influence of representatives on the yield and quality of winter wheat grain in the forest of the Middle Volga region", Young scientist, **23**, **127**, 192-196 (2016)
24. A. Wozniak, M. Soroca, Influence of crop rotation and tillage system on pollution and yield of spring wheat, as well as on soil properties, Applied Ecology and Environmental Research, 16, 3087-3096 (2018)