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Effectiveness of A Field Rotation Link In The Technology Of Spring Wheat Cultivation.

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ABSTRACT

The article describes the efficiency the various links of the field crop rotation systems and the basic soil cultivation in the technology of cultivation of spring wheat. It shows the role of biologization factors in the formation of yield and quality of spring wheat. Biologizing links of a crop rotation increased yield, quality and profitability indicators of grain of spring wheat production. Primary tillage systems had no significant effect on the quality of performance of spring wheat.

Keywords: spring wheat, crop rotation link, green manuring, tillage system, the mass fraction of wet gluten, glassiness, productivity, economic evaluation.

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INTRODUCTION

The analysis of the current state of agriculture showed that escalated in recent years economic and environmental challenges require significant changes in the technologies used in the direction of their biological function [2, 3, 4]. Among measures of agriculture biologization, leading to a saving of resources and energy in the plant, an important place is occupied by crop rotation. Biologizing rotations have a positive impact on the recovery of the energy balance in agro-ecosystems, and are based on agroecological principles, providing at the same time to produce a high crop productivity and environmentally friendly products, reproduction of soil fertility [1, 6, 9, 12, 14, 15, 16].

Mechanical tillage makes changes to the soil structure, physical and chemical processes occurring in it. The use of rational soil cultivation under spring wheat in the links of the grain-fallow-grass crop rotation creates optimal conditions for the growth and development of a culture that has a beneficial effect on the quantity and quality of the crop [5, 7, 8, 10, 11, 13]. In this connection, an evaluation of the effectiveness of cultivation of spring wheat in biologizing links of crop rotation systems and the basic soil cultivation is important.

RESEARCH TECHNIQUE

The studies were conducted in 2013-2015 at a stationary field experiment of the Department of General Agriculture and Landuse of Penza State Agricultural Academy in eight-field grain-fallow-grass crop rotation with the following crops alternation: 1. Black couples – 0.3 hectares, green manure pairs – 0.3 hectares; 2. Winter wheat – 0.6 hectares, intercrop – mustard; 3. Spring wheat – 0.6 hectares; 4. Vico sowing oats with clover – 0.6 hectares; 5. Red clover of the first year of use – 0.6 hectares; 6. Red clover of the second year of use – 0.6 hectares; 7. Winter wheat – 0.6 hectares, intercrop – mustard; 8. Spring wheat – 0.6 hectares.

Pilot area soil is represented by granulometric composition leached loamy black earth soil. The average humus content in the arable layer is 5.92 %, the reaction of the soil solution in the arable horizon is weakly acid (pHsol 5.0–5.1), the content of alkali-hydrolyzed nitrogen is from 81 to 98 mg per 1 kg of soil, of mobile phosphorus is average, of exchangeable potassium is (according to Chirikov) increased.

The object of the study was the spring wheat Tulaykovskaya 10. Seeding norm was 5.0 mln. of germinating seeds per hectare.

The layout of a 2-factorial experiment (A × B) with the following factors and graduations:

Factor A – Link rotation:

A_0 – Net fallow - winter wheat - spring wheat (control);
A_1 – Net fallow - winter wheat - intermediate green manure (mustard) - spring wheat;
A_2 – green manure fallows (vetch + mustard) - winter wheat - spring wheat;
A_3 – green manure fallow - (vetch + mustard) - winter wheat - intermediate green manuring (mustard) - spring wheat
A_4 – 2nd year clover - Winter wheat - spring wheat
A_5 – 2nd year clover - Winter wheat - intermediate green manuring (mustard) - spring wheat.

Factor B – basic tillage system:

B_0 – A two-phase moldboard autumn treatment, which includes harvesting before disking to a depth of 10-12 cm and plowing to a depth of 20-22 cm (control);
B_1 – A two-phase moldboardless autumn treatment, including disking to a depth of 10-12 cm after harvesting and moldboard tilling to a depth of 20-22 cm;
B_2 – Minimum autumn treatment, including disking to a depth of 10-12 cm after harvesting and cultivation to a depth of 12-14 cm, as weeds appear.

Options are available by randomized repetitions. Repeatance of the experiment is fourfold.

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THE RESULTS OF THE RESEARCH

The main criterion of the effectiveness of agricultural practices is crop yields. Hydrothermal conditions during vegetation period had the greatest influence on the yield of spring wheat, the correlation coefficient amounted to 0.79, and the regression equation had the form Y=1.31+1.45×H. Between the yield of spring wheat and crop rotation is a direct weak relationship. The correlation coefficient amounted to 0.38, and the regression equation had the form Y=2.3573 + 0.03219×H.

The cultivation of spring wheat in the biologized links of crop rotation led to an increase in its yield (figure 1). The highest yield was observed in crop rotation with green manure fallow and the intermediate green manuring. The yield increase compared to the fallow link was 0.17 t/ha. For primary treatment in an average of three years, the lowest yield was observed in the minimal small plowed fields. Compared to conventional two-phase primary processing yield of spring wheat was reduced by 0.11 t/ha.

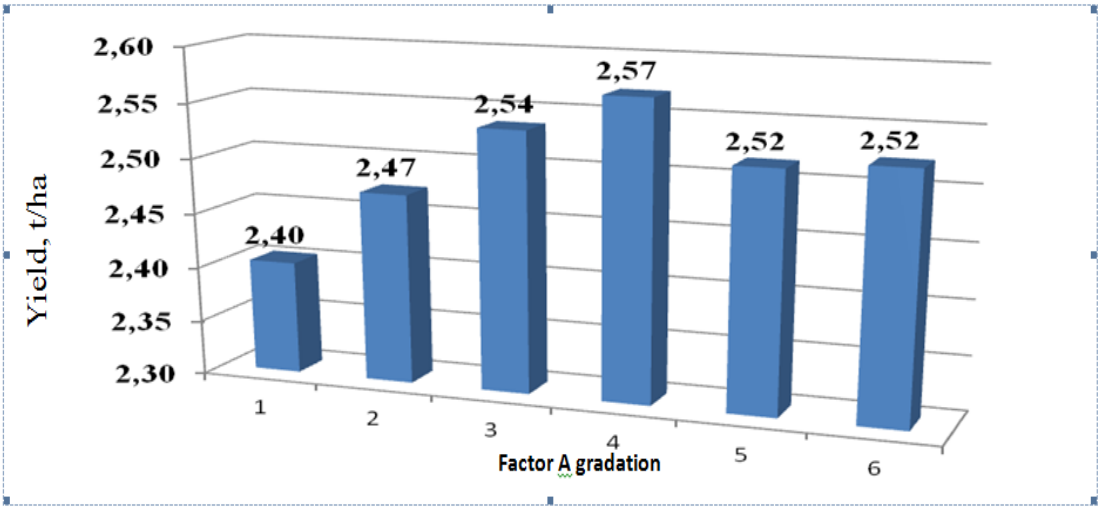

Figure 1 – The yield of spring wheat under different links of crop rotation, t/ha (2013-2015).

Curvilinear analysis of productivity of one hectare of crop rotation showed a weak correlation between the links of crop rotation. Correlation ratio indicator was 0.04 (figure 2).

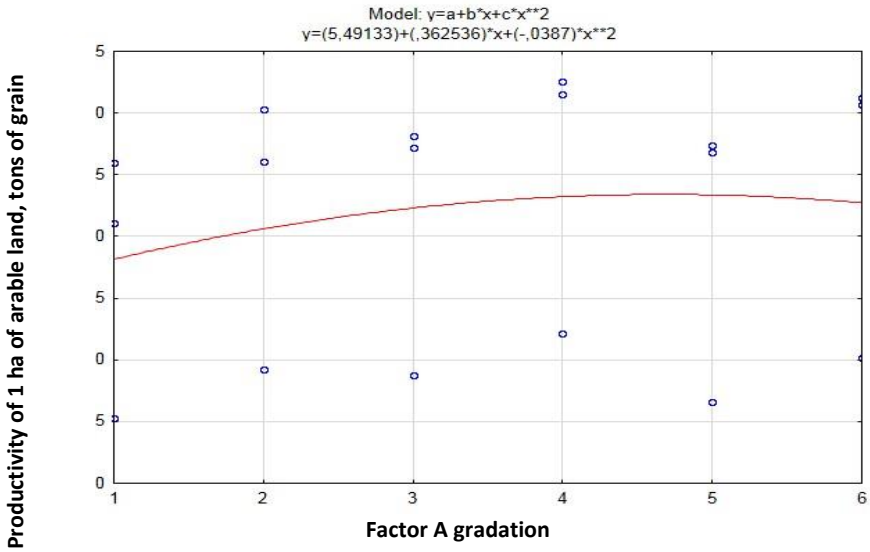

Figure 2 – The dependence of productivity of crop rotation link from gradations of factor A

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Quality indicators of spring wheat grain are presented in table 1.

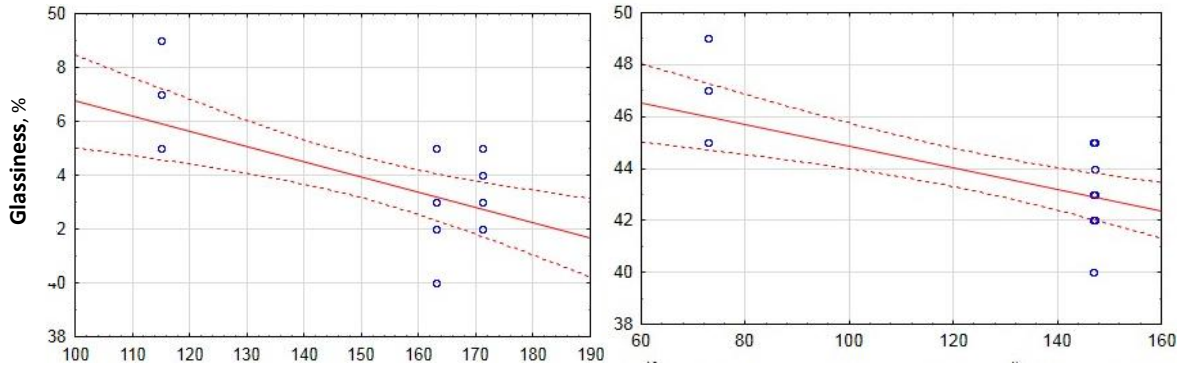
Table 1 – Indicators of quality of spring wheat grain (2013-2015).

Factor A – crop rotation links	Mass fraction of wet gluten, %	IDK-1 indicators, units	Glassiness, %	The number of fall	Quality class
A_0 – Fallow link	27.57	60.97	41.67	212.67	3
A_1 – Fallow link of a crop rotation with intermediate green manuring	28.50	57.80	44.00	216.00	3
A_2 – Fallow link of a crop rotation with green manure fallow	28.67	62.60	46.33	221.33	3
A_3 – Fallow link of a crop rotation with green manure fallow and intermediate green manuring	28.93	59.87	44.67	222.67	3
A_4 – Grass link	28.77	60.80	42.67	219.00	3
A_5 – Grass link with intermediate green manuring	28.07	63.37	42.67	218.00	3

Studies have established that the system of primary tillage did not have significant effect on the performance of grain quality of spring wheat and all the differences of the indicators were within the error of the experience, mostly influenced by crop rotation. Indicator of mass fraction of wet gluten by variants of factor A ranged from 27.57 to 28.93 %, and the quality of wet gluten from 57.8 to 63.37 units of the IDK instrument. These indicators correspond to quality class 2 according to State Standard R 52554-2006. Overall, however, the spring wheat grain corresponded to the 3rd class of quality due to low values of grain glassiness not exceeding 46.33 %.

Correlation analysis of the dependence of spring wheat grain glassiness from the crop rotation links showed the presence of a direct medium dependence (r=0.47). The analysis of weather conditions in years with different glassiness of the grain shows that the most significant influence on this quality characteristic are influenced by the supply of plants with moisture due to the spring water reserves available for plants in the root zone of the soil and rainfall during the growing season of wheat; by the tension of the transpiration during the vegetation period; by the number of wet and dry winds days.

The studies found a strong inverse dependence of grain glassiness from the total precipitation for the sowing period – wax ripeness (figure 3A) and heading – full ripeness of the grain (figure 3b). The correlation coefficient amounted to 0.7...-0.72, and the regression equation had the form y=52.379-0.0563 x and y=49.015-0.0414 x, respectively.



a .Precipitation during the sowing-wax ripeness period **b. Precipitation from earing to grain maturity**

Figure 3 – Dependence of the indicator of glassiness of spring wheat grain from the amount of precipitation for different vegetation periods.

The analysis of the role of meteorological factors in the formation of grain quality of spring wheat allows for a more purposeful use of a system of agrotechnical measures that enhance the quality of the crop.

Increasing the yield of crops has an impact not only on the grain gross yield increase, but also on the economic efficiency of production: labor productivity, production costs and profitability (table 2).

Table 2 – Economic evaluation of spring wheat by variants of experiment

Factor		Profitability, %			
A – Croprotation link	B – The system of primary tillage	2013	2014	2015	Average for 2013-2015
A_0	B_0	34.5	58.2	78.2	57.0
	B_1	34.6	68.3	86.9	63.3
	B_2	38.4	70.0	89.7	66.0
A_1	B_0	26.6	65.7	78.2	56.8
	B_1	34.6	75.9	89.1	66.5
	B_2	37.8	78.7	89.9	68.8
A_2	B_0	34.2	72.7	82.5	63.1
	B_1	39.6	82.0	88.9	70.2
	B_2	45.2	89.5	92.5	75.7
A_3	B_0	30.4	76.2	86.2	64.3
	B_1	35.3	86.6	91.5	71.1
	B_2	37.0	91.8	94.6	74.5
A_4	B_0	32.9	71.6	76.3	60.3
	B_1	43.1	86.3	84.3	71.2
	B_2	46.7	85.0	91.1	74.3
A_5	B_0	31.9	72.4	73.9	59.4
	B_1	38.9	84.0	84.4	69.1
	B_2	43.8	84.6	89.2	72.5

The greatest profitability of grain production of spring wheat (75.7 %) were obtained in crop rotation with green manure fallow and the intermediate green manuring on small minimum primary tillage.

CONCLUSION

1. Biologically links of crop rotation increased the yield of spring wheat. The highest yield of the culture (2.57 t/ha) was observed in crop rotation link with green manure fallow and the intermediate green manuring.
2. The minimum small main tillage resulted in spring wheat yields lowering by 0.11 t/ha.
3. The system of primary tillage had no significant effect on the performance of grain quality of spring wheat.
4. The spring wheat grain corresponded to the 3rd class of quality due to low values of glassiness of grain. The most significant influence on grain glassiness was provided by the weather conditions.
5. The greatest profitability of grain production of spring wheat was obtained in crop rotation with green manure fallow and the intermediate green manuring application of the minimum shallow primary tillage.

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