INFLUENCE OF PREDECESSORS ON YIELD AND GRAIN QUALITY OF WINTER WHEAT ON THE RIGHT-BANK FOREST-STEPPE OF UKRAINE

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It was found that the worst precursors for winter wheat are corn on silage and soybean. Their yield harvested later, and it causes to significant decrease reserves of available moisture in the soil, which leads to a reduction in crop yield. Buckwheat and winter oilseed rape provide obtaining productivity and quality of grain at the level of the control.

Key words: *winter wheat, predecessor, available moisture, varieties, yield, protein content, gluten content.*

Introduction. In modern terms increases the role of crop rotation as the primary and most effective way for stabilize the ecological environment and getting high, sustained, economic- and energy-adequate yields of winter wheat. The agricultural production today sets up new requirements for the selection of predecessors for this crop, especially if the crop rotation is saturated cultures that are similar in biology and cultivation technology [8, 2]. Because it is one of crops, demanding good growing conditions. However, in spite of this, much of the winter wheat crop are placed after the precursors that do not provide optimal conditions for its growth and development, leading to depletion of productive moisture in the soil, unilateral use of nutrient, accumulation in it of pests and toxic substances and the consequent to reduction in yield [5, 6].

Due to significant changes in market conditions, ratio between the crop and livestock sectors changed the structure of sown areas, which led to significant reduction in the areas under peas and perennial legumes grasses. Moreover, these cultures at correct soil tillage are the best precursors for winter wheat [1, 4]. Therefore, taking into account the trend of narrowing specialization of most farms, precursor role as one of the least costly ways to optimize growing conditions of winter crops, will only increase [7].

The aim of the research was the selection of precursors that would ensure obtaining of winter wheat crop high quality and adequate for resource potential of the Right-Bank Forest-Steppe zone of Ukraine.

Materials and methods research. Research carried out during the 2012–2014 in scientific laboratories of the agricultural enterprise «Rasava», Skvira district of Kyiv region. Soil on field – typical black soil on loess. Humus content (by Turin) in the topsoil – 4.0–4.2 %, available nitrogen (N-NO3 + N-NH4) – 22.3 mg / 1000 g soil, mobile phosphorus (by Machihin) – 38 mg / 1000 g of soil, rolling potassium (by Machihin) – 203 mg / 1000 g soil, pH saline – 6.5–7.0.

In the two-factor field experiment investigated the following predecessors of winter wheat (factor A): peas (control); corn on silage; soybean (early ripening); buckwheat; winter rape, as well – winter wheat varieties (factor B): Poliska 90 (control); Podolanka; Myronivsky 65; Smuglyanka.

The accounting area – 50 m^2, repetition – triple, experiment laid down by split plots method. The technology of growing winter wheat – common for the zone (ДСТУ 3768:2010).

Statistical analysis of data was performed using the «Statistica 10».

Results and analysis. Sufficient amounts of moisture in the soil throughout the growing season is one of the main criteria for plant growth and development of winter wheat. Moisture deficit during the critical phases of wheat can cause significant yield losses even with optimal moistening in later periods. As a rule, high yields of crops can be obtained if the spring reserves of available water in the meter soil layer are at 180–200 mm, and the earing period – not less than 80–100 mm at constant soil moisture 70–80 % of the smallest water capacity. When soil moisture above 80 %, the gas exchange of the root system is deteriorating due to lack of air in the soil. Therefore, predecessors under winter wheat have meet at least one of requirement – to accumulate a sufficient amount of productive moisture at the beginning of sowing (at least 10 mm of productive moisture in the 10 cm soil layer).

Placing winter crops after different predecessors puts them in uneven conditions of growth and development. This is due primarily to the different amounts

of nutrients and moisture they leave. Differences in ensuring water winter wheat plants during the autumn growing season caused by the influence of various precursors. As is known, the main replenishment of moisture in the soil in the sowings of this crop in terms of forest-steppe zone occurs primarily during the autumn and winter.

The research found that precursors significantly effect on soil moisture, both at the time of sowing winter wheat, and during the growing season (Table. 1). According to research reserves of productive moisture in the 0–10 cm layer at the time of sowing winter wheat were sufficient in control variant and after buckwheat, but after silage corn, soybeans and winter rape moisture was significantly less than control variant. After later collected predecessors (corn on silage, soybean) ladders winter crops appear 3–4 days later.

The difference between the variants and control in meter layer of soil only increased. The best moisture conditions observed after buckwheat, which left by 7.8 % more moisture in the meter layer of soil. That is, a short growing season and earliest harvesting of buckwheat affect the duration of the period for which the accumulated moisture.

1. Reserves of available soil moisture in field of winter wheat depending on predecessors, mm (average 2 years)

Predecessor	Soil layer, cm	Sowing		Spring regrowth		Flowering	
		moisture reserves	interaction effects, (± %)	moisture reserves	interaction effects, (± %)	moisture reserves	interaction effects, (± %)
Peas (control)	0–10	15,9	0	20,3	0	6,3	0
	0–100	125,9	0	188,4	0	77,5	0
Corn on silage	0–10	13,9	-12,6	20,6	1,5	4,6	-27,0
	0–100	105,1	-16,5	167	-11,4	62,1	-19,9
Soybean (early ripening)	0–10	11,1	-30,2	17,7	-12,8	5,6	-11,1
	0–100	83	-34,1	156,2	-17,1	61	-21,3
Buckwheat	0–10	18,4	15,7	19	-6,4	6,8	7,9
	0–100	138,6	10,1	177,3	-5,9	87,9	13,4
Winter rape	0–10	13,7	-13,8	20	-1,5	4,9	-22,2
	0–100	122,7	-2,5	175,5	-6,8	68,3	-11,9
LSD_{05}(%) 0–10 cm		8,29		7,7		13,49	
LSD_{05}(%) 0–100 cm		4,55		3,65		4,98	

Corn on silage and soybean were on 30–35 days longer growing season and somewhat later date harvesting (I–III decade of August), the use of such predecessors

caused significantly less (on 16.8–34.1 %) restocking of moisture in the soil to sowing winter compared to the control. Winter rape due to early harvesting and the big root system that penetrates deep into the soil, loosens subsurface layer, allowed to keep moisture in the deeper layers of the soil at the level of control.

The obtained data of moisture reserves in meter layer in the period of spring vegetation revealed that they were the lowest after soybean and corn on silage. Buckwheat and winter rape create favorable conditions for the accumulation of productive moisture in the soil, although after winter rape its contents compared with control tended to decrease. This is because the loose soil had better absorb rainfall in autumn and winter. In the spring and summer in the flowering stage of winter wheat moisture reserves fell by more than half. Decrease of available moisture in the soil was due to the intense accumulation of vegetative mass of plants and increase of water consumption. The dynamics of reserves available moisture in the soil in average years of research has been satisfactory, except for the period of flowering plants when it was critically low. Maximum retain moisture in the soil layer 0–10 cm and meter thick was observed on plots of wheat sown after buckwheat, where its contents were by 7.9 and 13.4 % more than control. Predecessors who later freed field, leading to a significant reduction in inventories of available moisture in the soil and its significant deficit in the ninth and tenth stages of organogenesis winter wheat.

Results of this research indicate about significant effect investigated factors on yield of winter wheat and grain quality. Also, grain yield of winter wheat significantly dependent on its varietal characteristics. Thus, on average, 27 % higher than the control (Poliska 90) productivity had a wheat Smuglyanka due to resistance to moisture deficiency during critical periods of development. Varieties Podolanka and Myronivsky 65 ensure respectively on 14 and 16 % higher yield, compared with control. Winter wheat varieties respond differently to the selection of precursors (Table. 2). For example, productivity of Smuglyanka not significantly different from control (LSD_{05} (%) = 9.06), and after predecessor corn on silage it decreased by 10.1 %. Other varieties reacts more strongly to the use of different precursors. The difference in yield, depending on the predecessor in the rest of the varieties ranged

from four to 18 %. The defining here are harvesting terms predecessor and its impact on the stocks of available moisture in the soil, which is certainly significantly affected the yield of crops. Corn on silage and soy reduce the wheat yields by 14 and 12 % compared to control, but buckwheat and winter rape does not reduce its value. This confirms a strong correlation between the effects predecessor on moisture content of the soil and yields of winter wheat (r = 0.84).

The formation of grain quality indicators significantly depend on predecessors and varieties of winter wheat. The content of protein and gluten are crucial indicators

2. Yield and quality of winter wheat depending on the varietal characteristics and precursors (average 2 years)

Predecessor	Yield, t/ha	Interaction effects, ± %	Protein, %	Interaction effects, ± %	Gluten, %	Interaction effects, ± %
Poliska 90 (control)						
Peas (control)	5	0	11,3	0	22,9	0
Corn on silage	4,3	-14,0	10,8	-4,4	20,2	-11,8
Soybean (early ripening)	4,4	-12,0	11,2	-0,9	21,6	-5,7
Buckwheat	5,2	4,0	11	-2,7	21	-8,3
Winter rape	4,8	-4,0	11,1	-1,8	21,1	-7,9
LSD_{05} (%)	-	9,04	-	3,54	-	2,3
Podolanka						
Peas (control)	5,7	0	10,8	0	20,5	0
Corn on silage	4,9	-14,0	10	-7,4	19,4	-5,4
Soybean (early ripening)	4,9	-14,0	10,4	-3,7	20	-2,4
Buckwheat	6,2	8,8	10	-7,4	19,8	-3,4
Winter rape	5,4	-5,3	10,2	-5,6	19,9	-2,9
LSD_{05} (%)	-	12,61	-	6,7	-	2,52
Myronivsky 65						
Peas (control)	6	0	12,5	0	24,4	0
Corn on silage	4,9	-18,3	11,1	-11,2	21,3	-12,7
Soybean (early ripening)	5,1	-15,0	11,9	-4,8	21,9	-10,2
Buckwheat	5,8	-3,3	11,3	-9,6	21,7	-11,1
Winter rape	5,7	-5,0	11,5	-8,0	21,7	-11,1
LSD_{05} (%)	-	9,61	-	7,2	-	3,45
Smuglyanka						
Peas (control)	6,9	0	12,7	0	25	0
Corn on silage	6,2	-10,1	11	-13,4	21,1	-15,6
Soybean (early ripening)	6,5	-5,8	12	-5,5	22	-12,0
Buckwheat	6,6	-4,3	11,8	-7,1	21,6	-13,6
Winter rape	6,4	-7,2	11,8	-7,1	21,3	-14,8
LSD_{05} (%)	-	9,06	-	7,8	-	3,78

of the quality of grain. Under current standards for wheat (ДСТУ–3768: 2009) in Ukraine food grain class III include grain with protein content of not less than 11 %, and gluten – 18 %.

The quality of winter wheat that grown after soybeans, buckwheat and winter rape did not differ from controls, although there was a tendency to reduce it. Grain grown after corn on silage – significantly inferior to the control. The highest quality grains formed in plants of variety Smuglyanka, whose protein content increased by 7 %, and gluten – 3.9 %.

Conclusions. Predecessors and varieties must be selected carefully for more complete realization of the genetic potential of winter wheat with minimal negative impact of soil moisture deficit on its yield and grain quality. In particular, in a Right-Bank Forest-Steppe Ukraine, buckwheat and winter rape are predecessors that allow save the reserves of available moisture in the soil and get a high yield of winter wheat with high quality indicators. Variety Smuglyanka compared to control was the more plastic to the growing conditions that allowed us to obtain on 18 % higher yield of grain with high quality.

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ВЛИЯНИЕ ПРЕДШЕСТВЕННИКОВ НА УРОЖАЙНОСТЬ И КАЧЕСТВО ЗЕРНА ПШЕНИЦЫ ОЗИМОЙ В ПРАВОБЕРЕЖНОЙ ЛЕСОСТЕПИ УКРАИНЫ

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Установлено, что худшими предшественниками для пшеницы озимой являются кукуруза на силос и соя, которые позже освобождают поле и вызывают значительное уменьшение запасов доступной влаги в почве, что приводит к снижению урожайности культуры. После гречихи и рапса озимого урожайность и качество зерна пшеницы не отличалась от контроля.

Ключевые слова: *пшеница озимая, предшественник, продуктивная влага, сорта, урожайность, содержание белка и клейковины*

ВПЛИВ ПОПЕРЕДНИКІВ НА УРОЖАЙНІСТЬ ТА ЯКІСТЬ ЗЕРНА ПШЕНИЦІ ОЗИМОЇ В ПРАВОБЕРЕЖНОМУ ЛІСОСТЕПУ УКРАЇНИ

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З’ясовано, що найгіршими попередниками для пшениці озимої є кукурудза на силос та соя, які найпізніше звільняють поле й спричиняють істотне зменшення запасів доступної вологи у ґрунті, що призводить до зниження урожайності культури. Після гречки і ріпаку озимого урожайність та якість зерна пшениці озимої не відрізнялись від контролю.

Ключові слова: *пшениця озима, попередник, продуктивна волога, сорти, урожайність, уміст білка та клейковини.*