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Influence of systems of soil cultivation and protection against diseases and weeds on the yield of winter wheat

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Goal. To study the influence of different systems of soil cultivation on the impurity species and the development of diseases of winter wheat in the area of Western Polissia. **Methods.** The research is based on field experiments using the methods: visual — to determine the phenological phases of growth and development of culture; calculation — to determine the development of diseases, pests, parameters of crop structure and crop yield; chemical — to determine the content of nutrients in the soil; mathematical-and-statistical — to estimate the reliability of research results; comparative — to analyze economic efficiency. **Results.** It is established that at deep cultivation of soil the number of weeds in 2.7 times less than at the shallow one. A smaller influence of soil cultivation can be traced to the development and spread of diseases. However, the downward trend still remains at the use of deep tillage and intensive protection system. **Conclusions.** Tillage significantly influences the accumulation of weeds. So, for shallow tillage, the number of weeds did not exceed 254 plants/m^2, at the same time for shallow cultivation of soil that indicator was 2.1 times higher. A smaller influence was fixed for soil tillage on the development and spread of diseases. However, the downward trend in the development and dissemination still remains for deep tillage. Soil cultivation allowed to increase the yield at the level of 0.24 – 0.39 t/ha, however, its combination with the intensive system of protection against diseases and weeds has led to increased yields in the range of 1.71 – 2,43 t/ha.

Key words: *agriculture, deep tillage, small, shallow cultivation, herbicides, fungicides.*
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Effective plant protection is possible only on the basis of a high culture of agriculture, which today does not quite tally modern requirements. In this aspect, it's time to give a scientifically based answer to the many factors involved in the development of harmful organisms, in particular, different soil cultivation systems [1-4].

The practice of agriculture shows that in certain soil-climatic zones, in the absence of moisture, the subsurface tillage soil cultivation can save moisture while reducing energy costs. However, due to this method of soil cultivation there are also disadvantages: the lack of turnover of the leads to the fact that all plant remains from the previous culture, together with pests and pathogens of diseases remain on the surface of the soil. They do not fall into the bottom of the soil, where the soil homeostasis destroys most of them. This leads to the preservation and accumulation of harmful organisms. This negative impact is exacerbated by non-compliance of agro-enterprises with scientifically grounded crop rotation [5-8].

Recently, crop cultivation has become widespread only in market conditions, which, ignoring environmental requirements, dictates production, first of all, "profitable crops".

All that has well-known negative effects it creates a unique environment for the development and multiplication of harmful organisms, which, due to mass reproduction, leads to extremely high losses of crops and require intensification of plant protection, which in turn leads to an increase in the pesticide load on agrocenosis and the environment.

Only crop rotation and scientifically grounded cultivation systems are the basis of agricultural stability, they have a positive effect on all important soil regimes, first of all nutrient and water, as well as air and heat, promote active detoxification of harmful substances, defining the whole complex of conditions for the development of complex agrobiocenosis [9-12].

The purpose of the research is to study the influence of different soil cultivation on the species of weed population and the development of winter wheat diseases.

Materials and methods of research. Experiments were conducted at the Institute of Agriculture of Western Polissya of the NAAS.

The square of the registration area – 50 m^2, three-time repetition. Winter wheat crops – the sort is Astarta. The predecessor is spring rape.

Deep plowing soil included peeling of stubble with BDT-3 discs, plowing plow PLH-5-35 at a depth of 20-22 cm, cultivating AG-2.4 and pre-planting with RVK-3.6.

Subsurface tillage soil included peeling the stubble with BDT-3 discs, cultivating AG-2,4 and pre-planting with the RVC-3.6 aggregate.

Subsurface tillage of the soil included only cultivation with Ag-2.4.

The accounting of weeds was carried out in the bloom phase for winter wheat (15.04.2017, 12.04.2018 of 18.04.2019) before the introduction of herbicides, as well as through the 7th (22.04.2017, 19.04.2018 of 25.04.2019) and 14 (29.04.2017, 28.04.2018 of 02.05.2019) days after spraying. It were determined the species composition of the weeds, the phase of development and the amount per 1 m^2.

The accounting of the defeat of winter wheat (powdery mildew, septoriosis of leaves, perinofroz) were carried out according to the technique of V.P. Omeluty [13] on 10 ground for 10 plants and for the actually occupied mycelium or spot on the area of leaves, stalks on the scale of E.E. Geshel [14] before spraying (16.05.2017 of 12.05.2018) through 7 (23.05.2017 of 19.05.2018) and 14 (30.05.2017 of 27.05.2018) days after spraying. It determined the technical effectiveness of the preparation and their cost-effectiveness by the method of S.O. Tribel, D.D. Sigarov, M.P. Sekun [15].

It were determined, the structural analysis of winter wheat and accounting of crop in the period of harvest. The data of agricultural crops are calculated by the method of dispersion analysis by B.O. Dospekhov [16] using a computer program.

The results of research. The results of research showed that on the deep plowing soil spring bunch of winter wheat occurs 4-5 days earlier than the surface. That is, the application of deep plowing and shallow plowing promotes acceleration of plant growth.

During the years of research, the largest number of weeds was observed for surface cultivation of soil – 549 pcs./m^2, which is 2,1 times higher than for deep plowing.

1. The effectiveness of application of herbicides on winter wheat crops (2017-2019)

Variant		The number of weeds, pcs / m^2			Technical efficiency,%	The weight of weeds, g/m^2
		1 accounting	2 accounting	3 accounting		
Deep plowing on 20-22 cm	No pesticides (control)	193,0	212,0	254,0	0	413,1
	Integrated system of protection	94,5	24,0	12,5	95,1	19,8
Subsurface tillage on 10-12 cm	No pesticides (control)	296,0	327,5	368,0	0	522,5
	Integrated system of protection	304,9	52,0	33,0	91,1	68,9
Subsurface tillage on 6-8 cm	No pesticides (control)	451,0	525,0	549,0	0	607,0
	Integrated system of protection	436,5	61,5	52,0	90,5	109,0

The research revealed that the highest technical efficiency was observed during spraying of crops with a herbicide triathlon on the 14th day after spraying and for deep plowing of soil (95.1%) (table 1).

The weight of weeds at the time of harvesting, in variants without herbicides was 413.1-607.0 g/m^2 depending on the cultivation of soil, whereas in variants where herbicides were applied the weight had been 12.5-52.0 g/m^2.

The most widespread and harmful diseases in winter wheat, in spite of soil cultivation, were powdery mildew (Erysiphe graminis) and septoriosis (Septoria tritici) in the bunch phase. The development of these diseases is closely linked to weather conditions during the growing season.

In the research area in April and the first decade of May, usually, there are variations in temperature at day and night, which creates unfavorable conditions for the early development of diseases. The incubation phase at the control of the development of the disease is 4.9-5.5% with a prevalence of 71.2-79.0%, the septoriosis wasn't detected. It should be noted that during the years of research the first signs of septoriosis appeared only at the end of the third decade of May. After 14 days after spraying on the variants cultivated with fungicide Rex Duo (0.5 l/ha), the development of powdery mildew is 2.2-2.8%, septophoriosis in these variants was not detected. In variants without fungicides on the date of accounting, the development of powdery mildew was within the range of 32.0-38.5%, septeriosis 1.5-2.5% with a spread of 22.0-26.5%.

The result of the research showed that the technical efficiency of Rex Duos fungicide against diseases was the highest at 14 days (89.9-93.8%) and there wasn't observe significant dependence on soil cultivation (table 2).

2. The efficiency of application of fungicides on winter wheat crops in the bunching phase (2017-2019)

Variant		Technical efficiency, %	
		7 days after spraying	14 days after spraying
Deep plowing on 20-22 cm	No pesticides (control)	-	-
	Integrated system of protection	81,8	93,8
Shallow plowing on 10-12 cm	No pesticides (control)	-	-
	Integrated system of protection	77,5	91,3
Subsurface tillage on 6-8 cm	No pesticides (control)	-	-
	Integrated system of protection	79,5	89,9

The period of earing of winter wheat over the years of research has fallen to the beginning of the second decade of June in the context of 3-4 days depending on the year. After 14 days after spraying with fungicide Abacus (1.25 l/ha), the development of septoriosis is 6.2-7.1% with a dissemination of 61.8-65.5%, pyrogenosporosis 3.0-3.8%, while as in variants without fungicidal protection, this figure exceeded 39.5% with a dissemination of 100% and 23.5% from 50.1%. It should be noted that there wasn't significant dependence of disease development on soil cultivation, somewhat lower development and distribution in the deep plowing.

3. The efficiency of application of fungicides on winter wheat crops in phase of earing (2017-2019)

Variant		Technical efficiency, %			
		7 days after spraying		14 days after spraying	
		septoriosis	pyreneophore	septoriosis	pyreneophore
Deep plowing on 20-22 cm	No pesticides (control)	-	-	-	-
	Integrated system of protection	89,8	65,9	86,7	75,0
Shallow plowing on 10-12 cm	No pesticides (control)	-	-	-	-
	Integrated system of protection	90,5	63,0	88,2	73,3
Subsurface tillage on 6-8 cm	No pesticides (control)	-	-	-	-
	Integrated system of protection	89,6	67,0	86,5	71,8

According to research in the phase of earing, the technical efficiency of the Abacus fungicide for 14 days after spraying against septoriosis was 86,5-88,2% and pyrenephrosis was 71.8-75.0% (table 3).

The research showed that the spraying of winter wheat crops with herbicides and fungicides promoted to the development of productive stems and the preservation of the leaf surface of the flag leaf, which greatly effected the yield and quality of the grain. The weight of 1000 grains on cultivated variants was 42.34-45.12 g, which is 10.54-8.69 g higher than in the case without pesticides (31.75-36.43 g).

The highest yield (7.49 t/ha) was observed for field cultivation of soil and intensive protection system (table 4).

4. The crop capacity of winter wheat depending on soil cultivation and plant protection (2017-2019)

Variant		Reiteration, t/ha				± to control	
		2017	2018	2019	Average	Factor A	Factor B
Deep plowing on 20-22 cm	No pesticides (control)	5,17	5,19	4,82	5,06	-	-
	Integrated system of protection	7,37	7,91	7,19	7,49	-	+2,43

Shallow plowing on 10-12 cm	No pesticides (control)	4,97	5,01	4,47	4,82	-0,24	-
	Integrated system of protection	6,90	7,18	6,35	6,81	-0,68	+1,99
Subsurface tillage on 6-8 cm	No pesticides (control)	4,89	4,88	4,23	4,67	-0,39	-
	Integrated system of protection	6,78	5,99	5,21	6,38	-1,11	+1,71

HIP_{05} cultivation factor A 0,16
HIP_{05} system of protection factor B 0,14
HIP_{05} interactions 0,21

Conclusion

The researches showed that soil cultivation has a significant impact on the accumulation of harmful organisms, in particular, it is clearly traceable to the number of weeds. Thus, for the deep plowing of soil, the number of weeds did not exceed 254.0 pc./m^2, while for the deep plowing this indicator was 2.1 times higher. A slightly less difference in the effect of cultivating the soil was observed on the development and spread of diseases. However, the tendency to decrease development and its distribution still remains for the deep plowing of the soil. It should be noted that the soil cultivation allowed to obtain a yield increase of 0.24-0.39 t/ha, but its combination with the intensive protection system resulted in an increase in yields within the range of 1.71-2.43 t/ha.

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