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The Influence Of Farming Activities On Seeds Productivity Of Winter Wheat Varieties In The Conditions Of The South Of Ukraine.

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ABSTRACT

The article reflects research results on the study of seeds productivity of winter wheat varieties, depending on schemes of plant protection and microfertilizers, in the conditions of the South of Ukraine. Photosynthetic productivity of winter wheat for seeds essentially depends on the stages of plants growth, varietal composition, ways of protection and micronutrients. The largest leaf surface area – 42.5 thousand m^2/ha was noted in the Konka variety in the variant with use of bio preparations Trihodermin and Gaupsin and micro fertilizer Avatar. In the case with the Khersonska 99 variety, with of chemical protection and without microfertilizers, this indicator decreased by 38.3%. The average daily growth of the leaf surface area reached its maximum in the interphase period "vegetation recovery – stem elongation". The Konka variety formed a yield at the level of 3.59 t/ha, which is 8.2% greater compared to the Khersonska 99 variety. Application of chemical and biological protection influenced the seeds productivity of winter wheat in different ways, with the most effective – combined use of bio preparations Trihodermin and Gaupsin.

Keywords: winter wheat, varieties, plant protection, micro fertilizer, productivity indicators, seed output, share of exposure.

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INTRODUCTION

In modern farming systems, the effectiveness of fertilizers has decreased due to many factors, which sets new challenges for agrarian science to improve plant protection and fertilizer systems by rationing of resources, ensuring maximum economic efficiency and environmental safety. Fungal pathogens damages various organs of winter wheat plants, that leads to premature drying of the leaf mass, causes lower productivity and quality of products, worsens the economic efficiency of grain production. At the present, the effectiveness of micro fertilizers with using of different plant protection schemes in the cultivation of different varieties of winter wheat is not sufficiently studied.

In the formation of high yields of winter wheat a major role belongs to the variety, which largely determines the level of yield, grain quality and production efficiency. Specific gravity of the variety in the growth of yield over the past 25-30 years is 45-50%. At the same time, it is important to ensure the integrity of the system from the variety creation by breeders, its reproduction and widespread distribution [5]. The increase in wheat yield in Ukraine was due to changes in some varieties – more productive, resistant to diseases and pests. The use of intensive type varieties and modern technologies makes it possible to collect high-quality yields on large areas at the level of 5-6 t/ha, but by using high-quality seeds and scientifically based cultivation technologies it is possible to implement potential at the level of 8-9 t/ha or more.

MATERIALS AND METHODS

The field trials were carried out during 2013-2016 years at the experimental field of the Institute of Irrigated Farming (Kherson region of Ukraine; geographical coordinates: latitude 46°38’34”N and longitude 32°36’27”E; altitude – 51 m).

The soil of the field is represented by the dark-chestnut middle-loamy soil, contains 2.28% humus, nitrogen, phosphorus and potassium – 0.18, 0.16, 2.7% respectively, including nitrates – 0.89, mobile phosphorus – 3.4, exchangeable potassium – 25 mg per 100 g of the soil, pH of water extract 7,0-7,2. The mechanical properties of the soil are characterized by high dust content, which causes low water permeability and high viscosity at drying. Content of the main nutrients in the soil of the experimental field is represented in the Table 1.

Table 1: Content of the main nutrients in the soil of the experimental field, mg/kg

Soil layer, cm	Nutrients		
	Nitrate nitrogen (detrmined by Grandval-Liazhu method)	Mobile phosphorus (determined by Machyhin method)	Exchangeable potassium (determined by photometric method)
0-30	10.9	47.5	741
30-50	14.0	49.3	697
50-100	18.7	33.8	623

The climate of the zone is characterized as moderately continental, warm in general and with drought periods in the summer. Weather conditions in the years of the trials – air temperature, relative humidity and rainfall are given in the Table 2.

Table 2: Weather conditions in the years of the trials

Month	Decade	Air temperature, ºC				Relative humidity, %				Rainfall, mm			
		2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
April	I	9.3	7.6	5.5	11.3	75.1	60.3	82.3	62.9	0.0	0.0	77.0	1.0
	II	10.7	12.3	11.1	14.3	65.1	73.5	70.7	77.5	4.0	31.2	2.8	64.4
	III	15.6	14.5	11.0	12.4	59.5	62.7	72.2	73.6	0.0	0.6	16.3	18.5
May	I	20.0	13.7	13.8	14.5	53.4	75.2	77.9	71.8	0.0	44.4	19.9	13.3
	II	20.6	17.8	17.3	15.3	60.9	75.4	61.7	79.2	0.6	6.5	2.4	55.7

	III	21.4	22.1	19.6	18.5	60.4	61.3	68.8	77.1	0.0	0.0	113.6	34.4
June	I	19.7	22.4	21.2	17.8	72.1	64.5	61.9	70.5	33.7	24.9	7.3	26.1
	II	23.6	20.0	21.4	21.9	56.9	58.7	66.4	74.5	39.4	53.0	3.3	25.0
	III	25.6	20.0	20.1	26.5	58.6	64.2	72.9	61.6	38.0	33.5	42.7	19.4
July	I	23.7	23.5	22.7	22.4	66.8	52.7	73.8	61.3	55.4	0.0	119.4	30.9
	II	23.4	25.4	20.9	25.8	59.5	55.5	66.5	58.9	3.7	11.0	24.8	0.0
	III	22.4	26.1	25.9	25.0	53.5	48.7	66.7	54.3	0.0	10.0	0.0	25.0
August	I	24.6	27.8	25.9	26.0	48.6	44.3	49.1	55.4	0.0	18.2	0.0	1.2
	II	26.1	25.1	24.1	23.3	45.9	56.4	53.0	58.0	0.0	1.6	12.5	0.0
	III	22.1	21.0	22.7	24.7	59.7	56.1	46.8	62.1	13.0	9.0	0.0	44.5
September	I	16.6	23.0	22.5	21.9	63.2	49.1	58.5	56.7	6.0	0.8	10.0	0.0
	II	16.8	18.6	19.2	18.7	78.8	50.5	54.1	61.8	54.2	1.0	0.0	41.0
	III	11.8	13.7	21.2	13.2	72.3	70.1	67.7	71.3	16.0	69.8	0.0	0.1
October	I	5.7	10.8	13.0	13.9	77.4	58.9	60.0	83.4	29.3	0.0	0.4	52.3
	II	11.4	11.8	8.9	6.3	84.1	74.3	67.1	81.8	62.0	31.8	13.1	60.0
	III	10.7	5.6	6.7	5.3	89.0	79.0	81.9	74.7	0.4	23.5	21.2	0.2

The field trials were devoted to investigation of the reaction of winter wheat varieties to the application of trace elements and methods of plant protection from pathogens. The trials were carried out in four replications using the split plot design method. The area of sown of the first order was – 2500 m^2, the second – 625, the third – 275, accounting – 92 m^2. Studied in the field trials factors are represented below.

Factor A – Varieties: Khersonska 99; Konka.

Factor B – Micronutrients: control (no treatment); “Riverm“ in dose of 0.5 kg/ha; “Nanovit Micro“ in dose of
1.5 l/ha; “Avatar“ in dose of 0.2 l/ha.

Factor C – Plant protection: control (no treatment); “Trihodermin“ and “Gaupsin“ in doses of 3.0 kg/ha and 3.5 kg/ha respectively; “Gaupsin“ in dose of 3.5 kg/ha; fungicide “Unikal“ in dose of 1.0 l/ha.

The characteristics of the studied winter wheat varieties are given below.

The Khersonska 99 is originated by Institute of Irrigated Farming. The height of plants is 90-95 cm. The variety is early maturing. The grains are red, weight of 1000 grains 42.3-45.0 g. Yield in a competitive variety tested in un-irrigated conditions – 5,5-6,7 t/ha and with irrigation 8,0-9,5 t/ha. The Khersonska 99 is resistant to powdery mildew, septoriosis and root rot, its winter resistance is above average, has high drought tolerance.

The Konka is originated by Institute of Irrigated Farming. Drought-tolerance is high. Infectious diseases as a percentage: powdery mildew – 12,5; brown rust – 7,0; root rot – 2,7; septoriosis – 18.3. Weight of 1000 grains 41-43 g.

The characteristics of the studied micronutrients are given below.

“Riverm“ is a liquid organic fertilizer. Useful substances accelerate the transformation of nitrogen compounds, activate the processes of decay of cellulose on biologically active substances that promote the fixation of nitrogen and the transformation of organic compounds of phosphorus into mineral digestible forms and produce a number of biologically active substances (vitamins, amino acids, auxins), which contribute to growth and the development of plants. It is environmentally friendly for plants, animals and people, does not require special safety measures. This preparation is recognized by international organization of the System of Independent Certification (SIC) as an ecologically pure fertilizer, compliant with international standard ISO 14024:1999.

“Nanovit Micro“ is a highly effective multicomponent concentrate of trace elements: nitrogen (N), magnesium (Mg) and sulfur (S) on the basis of the biologically active complex NANOACTIV. The preparation activates the process of germination of seeds and the absorption of nutrients from the soil, promotes the formation of a powerful root system, and stimulates the processes of growth and development of plants. Also, “Nanovit Micro“ helps to increase the resistance of plants to diseases, pests and adverse weather conditions, increases productivity and grains quality (protein content, sugars, vitamins).

“Avatar“ is a multicomponent microelement preparation, its main purpose is to improve nitrogen-phosphorous nutrition, increase stress and plant productivity. The microelement complex has 20 biogenic micro- and ultra-micronutrients important for plants. It provides not only to increase the productivity of agricultural crops by 15-60%, but also to obtain high quality, environmentally friendly crop products.

The characteristics of the studied preparation for plant protection are given below.

“Trihodermin“ contains spores and mycelium of the fungus antagonist Trichoderma lignorum, as well as biologically active substances. They inhibit the development of phytopathogens by direct parasitism, competition for the substrate, as well as the separation of biologically active substances that inhibit the development of many types of pathogens and inhibit their reproductive capacity. It is recommended for the protection of plants from a wide range of fungal and bacterial diseases.

“Gaupsin“ is a universal preparation, does not accumulate in plants and soil, does not affect the taste of cultivated products. The effectiveness of the fight against fungal diseases is 90-92%, with pests 92-94%.

Winter wheat was placed in the crop rotation on the predecessor – steam. Pre-sowing cultivation (MTZ-82 + KPS-4) was made at a depth of 5-6 cm. The seeds were pickled by preparation Lamardor 1.5 l/ton. Sowing was carried out in optimum terms in the third decade of September with the tractor MTZ-82 and seeders SSZ-3.6 with a seeding rate of 220 kg/ha.

In the spring weed control was carried out by herbicides: Dezor (0.5 l/ha), Esteron (250 ml/ha), Granstar (15 g/ha). In the period of maturation, the crops were protected from Eurygaster integriceps by insecticide Fastak (0.1 l/ha). The harvesting was carried out in the second half of July with the help of the combine “Sampo-130“. Dates of sowing and harvesting of the crop in the trials are given in the Table 3.

Table 3: Dates of sowing and harvesting of winter wheat in the trials

Variety	Year	Dates of	
		Sowing	harvesting
Khersonska 99	2013	September 19th	–
Konka		September 19th	–
Khersonska 99	2014	September 15th	June 29th
Konka		September 15th	June 29th
Khersonska 99	2015	September 28th	July 3th
Konka		September 28th	July 3th
Khersonska 99	2016	–	July 12th
Konka		–	July 12th

RESULTS AND DISCUSSION

The seeds of winter wheat contain pathogens like Septoria tritici and Erysiphe graminis. The phytosanitary monitoring recorded a different degree of pathogens distribution and their maximum level in control variants without using chemical or biological preparations. In different stages of growth the impact of plant protection substances and microfertilizers on the intensity of the spread of diseases on winter wheat plants significantly differed. Influence of biological fungicides on the degree of winter wheat damage is represented in the Table 4.

Table 4: Influence of biological fungicides on the degree of winter wheat damage

Variety (factor A)	Plant protection (factor B)	Disease and degree of pathogens spread,%							
		Septoria tritici				Erysiphe graminis			
		stage of growth				stage of growth			
		autumn tillering	spring tillering	flag leaf	Booting	autumn tillering	spring tillering	flag leaf	booting
Khersonska 99	Fungicide	12.3	16.0	20.9	25.2	3.5	5.0	10.2	12.7
	Gaupsin	11.1	16.2	21.2	23.4	3.8	5.8	9.7	9.9
	Trihodermin + Gaupsin	9.1	16.1	17.7	20.1	2.9	5.4	8.2	9.2
Average		10.8	16.1	19.9	22.9	3.4	5.4	9.4	10.6
Konka	Fungicide	7.3	14.4	17.5	21.0	2.5	4.9	9.1	11.3
	Gaupsin	7.9	15.1	15.9	24.5	3.1	6.3	10.5	10.0
	Trihodermin + Gaupsin	7.7	12.5	13.6	15.7	2.3	4.8	7.3	9.5
Average		7.6	14.0	15.7	20.4	2.6	5.3	9.0	10.3

Note. The LSD at $p < 0.05$ by the studied factors: A – 0.55; B – 0.39.

Impact of the Septoria triticium was recorded in all stages of growth, especially in the stem elongation on the Khersonska 99 variety, when extent of the pathogen spread increased to 15.7-25.2%. Among the biological preparations used for plant protection, the best one was the combine use of Trihodermin and Gaupsin.

Compared to Khersonska 99, the Konka variety was infected by Septoria triticium to a lesser degree – by 2.1-4.3%, and 0.1-0.8% by Erysiphe graminis, which can be attributed to the better genetic resistance.

Experiments proved that the investigated factors to varying degrees influenced the dynamics of the leaf surface area formation in different stages of growth. The maximum level was reached in the booting stage, when the optimum combination of variants exceeded 40 thousand m^2/ha. Results are reflected in the Table 5.

Table 5: Leaf surface area of the winter wheat plants in the booting stage depending on the varietal composition, plant protection and micro elements, thousand m^2/ha (average for 2014-2016)

Variety (factor A)	Plant protection (factor B)	Microelements (factor C)					Average on factors	
		control	Riverm	Nanovit Micro	Avatar	Average	A	B
Khersonska 99	Fungicide	30.7	32.2	33.9	35.8	33.1	34.9	34.3
	Gaupsin	32.8	34.3	36.2	38.3	35.4		36.0
	Trihodermin + Gaupsin	33.1	34.9	37.0	39.3	36.1		37.2
Konka	Fungicide	32.8	34.5	36.4	38.5	35.5	36.9	
	Gaupsin	33.5	35.4	37.5	40.1	36.6		
	Trihodermin +	34.9	37.0	39.3	42.5	38.4		

	Gaupsin							
Average on factor C		33.0	34.7	36.7	39.1	35.9		

Note. The LSD at $p < 0.05$ for partial differences on factors: A – 0.73; B – 0.52; C – 0.68

The largest assimilation leaf surface area – 42.5 thousand m^2/ha was formed in the variant with the Konka variety with the joint plants protection by Trihodermin and Gaupsin preparations and use of micro fertilizer Avatar. The smallest index of the investigated indicator – 30.7 thousand m^2/ha was recorded in the variant with the Khersonska 99 variety with using fungicides and without microfertilizers, which is 38.3% lower than the best result.

The average daily gain of the leaf surface area reached its maximum in the interphase period "vegetation recovery – stem elongation" and fluctuated from 0.45 to 0.81 thousand m^2/day, depending on the varietal composition, plant protection and micronutrient fertilization. There was noticed a tendency of a gradual decrease. In the stage of milk was observed a decrease in the area of the leaf index in all variants due to the dying off of the lower leaves.

A special criterion for the characteristics of yield is the net productivity of photosynthesis, which affects the overall level of productivity. In our experiment, we calculated it by separate interphase periods of winter wheat growth. Research has shown that the quantity of photosynthesis net productivity of winter wheat plants was largely dependent on microfertilizers, the effectiveness of which was studied in trials.

The maximum index of photosynthesis net productivity was reached in the interphase period from booting to flowering in the variant with the introduction of micro fertilizers, where it varied in the range from 6.65 to 6.90 g/m^2 per day. Subsequently, this figure was gradually reduced to 3.08 and 3.01 g/m^2 per day. This can be explained by the fact that plants used the reserves of productive moisture in the soil during the first stages of growth, and precipitation fall during the spring-summer period did not compensate the deficit of moisture content, which led to a sharp decrease in the indices of photosynthesis net productivity from the interphase period "jointing – booting" and until the end of vegetation.

The growth of photosynthetic potential was noted by comparing the control variant and variant with micro fertilizers, especially Avatar. Furthermore, it has been proved that the increase vegetative mass and the improvement of its productivity by using micro fertilizers and plant protection from pathogens increase the increment of dry matter.

It was established that the photosynthetic activity influenced the production processes of plants and ensured the formation of a seed yield at the level of 3.45 t/ha. Information of seeds yield, depending on varietal composition, plants protection and microelements is given in the Table 6.

Table 6: Yield of winter wheat seeds depending on varietal composition, plants protection and microelements, t/ha (average for 2014-2016)

Variety (factor A)	Plant protection (factor B)	Microelements (factor C)					Average on factors	
		control	Riverm	Nanovit Micro	Avatar	Average	A	B
Khersonska 99	Fungicide	2.81	3.02	3.24	3.56	3.16	3.32	3.27
	Gaupsin	2.89	3.21	3.38	3.60	3.27		3.42
	Trihodermin + Gaupsin	3.13	3.40	3.67	3.87	3.52		3.65
Konka	Fungicide	3.01	3.25	3.48	3.82	3.39	3.59	
	Gaupsin	3.21	3.50	3.68	3.93	3.58		
	Trihodermin + Gaupsin	3.42	3.69	3.90	4.14	3.79		
Average on factor C			3.35	3.56	3.82	3.45		

Note. The LSD at $p < 0.05$ by the studied factors: A – 0.09; B – 0.03; C – 0.05.

The Konka variety formed an average seed yield at the level of 3.59 t/ha, and in Khersonska 99 this indicator was 3.32 t/ha or 8.2% less.

The use of chemical and biological protection to varying degrees influenced the seed yield of studied crop. In the case with traditional fungicidal protection, on average, the factor B was 3.27 t/ha. The use of Gaupsin allowed an increase of this indicator by 6.7%, and combine use of Trihodermin and Gaupsin produced the maximum seeds yield – 3.65 t/ha, which is 6.7-11.6% higher than results in other variants.

The application of micro elements provided increase in the seed yield from 3.08 t/ha in the control variant to 3.35-3.82 t/ha - in the case with the introduction of Riverm, Nanovit Micro and Avatar. Consequently, the use of these preparations contributed to a significant increasing of yield by 8.7-24.1%. Among studied micronutrients, the Avatar had the advantage because it was possible to get on 7.3-14.2% more seeds than with the use of Riverm and Nanovit Micro.

The seeds yield of winter wheat for the grain was minimal – in the variant with the Khersonska 99 variety, the use of Trihodermin and Gaupsin for the plant protection and micro fertilizer Riverm. The maximum level of the investigated parameter – 69.7% was recorded in the variant with the Konka variety with fungicidal protection and introduction of micro-fertilizer Avatar.

CONCLUSIONS

The photosynthetic productivity of winter wheat plants significantly depended on stage of growth, varietal composition, fungi-protection and micro fertilizers. The largest assimilation leaf surface area – 42.5 thousand m^2/ha was formed in the variant with the Konka variety with the joint plants protection by Trihodermin and Gaupsin and use of micro fertilizer Avatar, while on the Khersonska 99 variety with chemical protection and without micro fertilizers this this figure decreased by 38.3 %. The average daily growth of the leaf surface area reached its maximum in the interphase period "vegetation recovery – stem elongation". Seed yields reflect trends as grain. The Konka variety formed yield – 3.59 t/ha, which is 8.2% more than Khersonska 99. The use of chemical and biological protection unequally influenced the seed productivity of winter wheat, with the most effective use of bio preparations Trihodermin and Gaupsin. Among studied micronutrients, the Avatar had the advantage because it was possible to get on 7.3-14.2% more seeds than with the use of Riverm and Nanovit Micro. The dispersion analysis proved that micronutrients had the biggest influence on the formation of yield.

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