MICROHUMIN EFFICIENCY AT GROWING OF HULLESS OAT OF SKARB UKRAINY VARIETY AT DIFFERENT LEVELS OF NITROGEN NUTRITION OF PLANTS

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It was shown that pre-sowing seeds treatment of hulless oat with Microhumin preparation can reduce the dose of nitrogen fertilizer on 20 kg/ha by reactant. The highest yield increase – 0.65–0.77 t/ha was received in the variants with $N_{20}P_{60}K_{60}$ and $N_{40}P_{60}K_{60}$ background. Additional yield in variants with inoculation and under $N_{60}P_{60}K_{60}$ dose of fertilizer was 0.5 t/ha. It was established that yield increase was obtained mainly due to the higher grain mass and index of productive tillering.

Keywords: sod-podzol light cultivated soils, hulless oat, Microhumin, mineral fertilizers.

Currently the world area under oat exceeds 25 million hectares. In Ukraine oat are grown as supporting fodder grains. Sown area of oats during the recent years has ranged within 300 – 450 thousand hectares, while its main growing areas are concentrated in Polyssia and the Carpathian Mountains. The largest producers of grain oats for many years had remained Chernihiv region – about 130 thousand tons per year, Zhytomyr region – 85–90 tons and Sumy region – 80–85 tons [1].

Along with hulled oats the hulless oat is becoming more important for agricultural production and processing industry. The yield potential of modern varieties of hulless oat is about 5–6 t/ha. Crops can be used for food and fodder purposes without processing, which reduces labor and production costs.

The high price of commodity grain of hulless oats in foreign markets (200–240 USD/t), and the big importance of this crop on the Ukrainian market, including baby foods, requires optimization of cultivation technologies, including fertilization system, maximizing the level of its biologization.

Thus, the aim of our study was to determine the possibility of using microbial preparation Mikrohumin as an alternative to certain fertilizers dose in cultivation technology of hulless oats.

Materials and methods. Experiments were carried out on sod-podzol loamy light cultivated soils of Institute of Agricultural Microbiology and Agricultural Manufacture NAAS. The soils were formed on the layered water-glacial deposits. By the particle-size composition of parent-material horizons of sod-podzol soils of the area are sandy loam and light sandy loam soils.

A characteristic feature of sod-podzol sandy loam soils is homogeneous of its mineralogical composition with quartz domination. It results in significant permeability of the soil profile, low buffering, poorness of parent-material horizons with mineral nutrients, magnesium and calcium, low absorbing ability in relation to exchange cations, unstable structure, tendency to crust formation, soil capping and poor microbiological activity. That causes significant cost of farming practices, including cost of fertilizers.

Basic physical, chemical and agrochemical parameters of soil used for stationary experiments in the department of scientific support of agricultural manufacture are shown in the table below (Table 1).

TABLE 1. Physical, chemical and agrochemical parameters of sod- podzol sandy loam soils of experimental plots

Parameters	Soil layer, cm	
	0–20	20–40
pH of salt extract	4,9	4,6
Hydrolytic acidity, mg-equiv./100 g soil	2,8	3,1
Sum of soaked bases, mg-equiv./100 g soil	5,4	4,8
Humus (by Tyurin), %	1,1	0,7
Easily hydrolyzed nitrogen, mg/100 g soil (by Tyurin-Kononova)	9,7	5,9
Labile forms of phosphorous, mg P ₂ O ₅ /100 g soil (by Kirsanov)	17,9	17,9
Exchangeable potassium, mg K ₂ O/100 g soil (by Maslova)	7,0–9,0	7,0–10,0

The experimental scheme was as following:

I. Without inoculation:

1. without fertilizer (control);

2. N₀P₆₀K₆₀;

3. N₂₀P₆₀K₆₀;

4. N₄₀P₆₀K₆₀;

5. N₆₀P₆₀K₆₀;

II. Inoculation with Mikrohummin:

6–10 – same fertilization options.

Fertilizers were applied in the form of ammonium nitrate, superphosphate and potassium chloride. Phosphorus-potassium fertilizers were applied in autumn, while nitrogen – at crop cultivation.

Mikrohummin, used in the experiment, is a complex biological preparation based on the bacteria of *Azospirillum* genus and extract of vermicompost, which contains physiologically active substances. Besides compounds of hormonal action, vermicompost contains vitamins, macro elements and trace elements in chelate forms due to their interaction with the available in vermicompost amino acids and organic acids, including humic and fulvic acids. It should also be noted, that due to the intensive development of microorganisms substrate accumulate polysaccharides of bacterial origin during vermicomposting of organic matter. Preparation dosage – 200 grams per hectare seed rate.

Cultivation techniques for hullless oats were common for the area. Variety – Skarb Ukrainy. Seeding period – second decade of April. Seeding rate – 4 500 000 seeds / ha. Record area – 48 sq.m, repetition – 4-fold. Harvesting – continuous per plot. Experiments were carried during 2010–2012.

Results and discussion. The average data for three years of research indicate that complete application of mineral fertilizers $N_{60}P_{60}K_{60}$ had ensured 3.4 t/ha of oats yield which was 2.4 times above the productivity in control variants – 1.44 t/ha. Reducing of nitrogen dose to N_{40} had caused yield decrease on 0.38 t/ha or 11 %, while lowering of nitrogen fertilization dose to N_{20} had resulted in – 0.87 t/ha or 26 % decrease.

Yield increase in variants with Mikrohummin inoculation had ranged from 0.50 to 0.77 t/ha and was the largest in variants with low doses of nitrogen $N_{20}-N_{40}$ (Table 2). Pre-sowing seeds inoculation with Mikrohummin had ensured 1.94 t/ha of yield in control variant and 3.90 t/ha in variant with full dose of fertilizer $N_{60}P_{60}K_{60}$ that was two times greater than in control. Exclusion of nitrogen had resulted in yield decrease to 2.56 t / ha (34 %), application of N_{20} dose – to 3.18 t/ha (18 %), and N_{40} dose – to 3.79 t/ha (3 %).

The hulless oats yield within 3.02–3.18 t/ha was obtained both at application of 40 kg/ha of mineral nitrogen dose and Microhummin inoculation on $N_{20}P_{60}K_{60}$ background, indicating the equivalence of the impact of the inoculant to no less than 20 kg/ha dose of mineral nitrogen. Observed features were also confirmed by grain yield ranging within the 2.56–2.53 t/ha in variants with phosphorus-potassium fertilizers ($N_0P_{60}K_{60}$) and seeds treatment with Mikrohummin and $N_{20}P_{60}K_{60}$ fertilizer dose without inoculation. At the same time, the $N_{40}P_{60}K_{60}$ dose of nitrogen combined with inoculation was more effective than application of $N_{60}P_{60}K_{60}$. At this yield increase was 0.39 t/ha (Table 2).

TABLE 2. Productivity of hulless oats at different levels of fertilization and bacterization

Variants	Yield, t/ha				Increment from inoculation		Weight of 1000 seeds		Tillering coefficient
	2010	2011	2012	Mean	t/ha	%	g	%	
Without inoculation									
Without fertilizers (control)	1.41	1.40	1.50	1.44	—	—	22.0	86	1.4
P ₆₀ K ₆₀	1.99	2.16	2.00	2.05	—	—	23.8	93	1.6
N ₂₀ P ₆₀ K ₆₀	2.39	2.80	2.40	2.53	—	—	24.0	94	2.0
N ₄₀ P ₆₀ K ₆₀	2.90	3.14	3.02	3.02	—	—	25.8	101	2.4
N ₆₀ P ₆₀ K ₆₀	3.15	3.46	3.60	3.40	—	—	25.6	100	2.4
LSD ₀₅	0.11	0.13	0.17						
Inoculation with Microhumin									
Without fertilizers (control)	1.99	1.86	1.98	1.94	0.50	38	24.0	94	1.8
P ₆₀ K ₆₀	2.68	2.40	2.6	2.56	0.51	25	25.0	98	2.0
N ₂₀ P ₆₀ K ₆₀	3.10	3.40	3.05	3.18	0.65	26	26.0	102	2.4
N ₄₀ P ₆₀ K ₆₀	3.66	4.00	3.72	3.79	0.77	25	26.2	102	2.4
N ₆₀ P ₆₀ K ₆₀	3.68	4.12	3.90	3.90	0.50	15	26.2	103	2.5
LSD ₀₅	0.17	0.13	0.15						

According to the obtained results, the productivity increase in variants with inoculation was caused by increment of tillering coefficients on 0.4 units by mean, and mass of grain on 3–8 %, whereas the mineral nitrogen had changed these values on 0.7–0.4 units and 6–14 %, respectively.

Observation of photosynthetic activity of plants in the two compared variants ($N_{60}P_{60}K_{60}$ without inoculation and $N_{20}P_{60}K_{60}$ with inoculation) had showed no substantial changes of maximum leaf area. Plants had formed 37–38 thousand sq.m/ha of leaf area. At this, their photosynthetic potential was within 2.9–3.0 million sq.m days/ha, which ensured oats yields at 3.4–3.9 t/ha level. The accumulation of dry matter per unit area per day (net productivity of photosynthesis) in variants with Mikrohummin inoculation had exceed the variant with complete application of mineral fertilizers on 5.

It also should be noted, that photochemical reactivity during the panicle earing was on the same level.

TABLE 3. Photosynthetic activity of plants depending on the level of mineral fertilization and inoculation, average for 2 years

Fertiliza- tion doses	Yield, t/ha	Maximum leaf area		Photosynthetic potential		Net productivity of photosynthesis		Photoche- mical reactivity	
		thsnd. sq.m / ha	%	mln. sq.m days / ha	%	g/sq.m per day	%	Mg	%
Without inoculation									
N ₆₀ P ₆₀ K ₆₀	3,31	38,3	100	2,9	100	3,7	100	231	100
Inoculation with Microhumín									
N ₂₀ P ₆₀ K ₆₀	3,25	37,4	98	3,0	103	3,9	105	223	97
LSD ₀₅	0,15								

Summarizing the above, the pre-sowing inoculation of hulless oats seed with Mikrohummin allow reduction of mineral nitrogen fertilization dose in oats growing technology on sod-podzol soils in the range of 20 kg/ha.