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Analysis of some quality indicators for wheat grown under biological conditions

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Abstract: *On soil type calcic chernozem, in the period 2018-2022. an experiment with common winter wheat (Triticum aestivum L.) variety "Venka 1" was carried out. The experiment was set up in 4 replications in a randomized block design. The size of the experimental plot is 10 m^{-2}. In October, the sowing was carried out after the predecessor sugar beet (Beta vulgaris L.), with 500 germinating seeds/m^{-2}. Treatments in 4 variants are applied in the appropriate periods according to Maria Thun's calendar. The first variant is an untreated Control; the second was treated only with biodynamic preparations: VD (biodynamic preparation) 500 + VD 501 + Fladen preparation; The third option is treated only with biological preparations: Free N + Heliosulfur, and the treatment in the fourth option is a combination of the above two options: VD (biodynamic preparation) 500 + VD 501 + Flaten preparation + Free N + Heliosulfur. Growth phases indicated are according to the Zadoks scale. Data were processed using SPSS using the method of variance statistics. Student's criterion was used for assessment. It was found that wheat treated variants performed better in terms of some biochemical parameters.*

Keywords: wheat, biological, biodynamic, biochemical indicators

Introduction

In recent years, man's influence on the environment has become more and more noticeable. Quality food, clean water, air and soil are decisive factories for human health. The issue of environmental protection is posed on the agenda. The application of intensive technology in agriculture requires the use of a wide range of plant protection products and large amounts of mineral fertilizers. One part of these products falls into the environment, is retained in the soil, washed with surface or groundwater flow, and another part falls into agricultural products and hence in the food [1].

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With the increase in the consumption of agricultural production, the need to increase its production arises. In the pursuit of higher yields, control over the quality of production is lost. The desire to increase the amount requires an increase in chemical protection in plant protection practices and the introduction of high doses of mineral fertilizers. This, in turn, implies the use of hybrids that tolerate high doses of chemicals and are selectively tolerant to them. The production of clean, healthy and high-quality agricultural products is becoming more important.

Approaches to increase yield are being sought. In some crops, the beneficial effect of pre-sowing treatment of seeds with an electromagnetic field has been proven [2-5]. Various biofertilizers and biostimulants have appeared on the market. Their application is an important component of the integrated system for organic food production [6].

There are more and more reports on the testing of such bioproducts that have a beneficial effect on different crops [7, 8]. According to Nardi et al., application of organic fertilizers increases productivity, improves root system architecture and stimulates nutrient transport [9].

There are data on testing biological and biodynamic preparations, the results of which are also beneficial to farmers, for their correct and more effective application. According to some authors, the application of a biodynamic approach in agriculture increases the content of organic matter in the soil and helps to use nitrogen more efficiently [10, 11].

As one of the main cereals, wheat (*Triticum aestivum* L.) is of interest to researchers, where biological and biodynamic preparations are tested [12-15]. Organic farming is a higher form of organic farming, in which ecosystems are harmonized and ecologically clean food is obtained [16]. According to Brock et al., organic food production aims to nourish not only the human body, but also his soul and spirit, thereby supporting human development [17]. In the scientific literature, there is little information about this kind of research, and for the field, the author has not come across any.

The aim of the present study is to determine the joint influence of fertilization with biological and biodynamic preparations and their influence separately on some chemical and biochemical elements of wheat grain grown under organic farming conditions.

Materials and Methods

On soil type calcic chernozem, in the period 2018-2022 an experiment with common winter wheat (*Triticum aestivum* L.) variety "Venka 1" was carried out. The experiment performed in 4 replications in using a randomized block method. The size of the experimental plot is 10 m^{-2}. In October, the sowing was carried out after the predecessor sugar beet (*Beta vulgaris* L.), with 500 germinating seeds/m^{-2}.

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Treatments in 4 variants are applied in the appropriate periods according to Maria Thun's calendar. The first variant is an untreated Control; the second was treated only with biodynamic preparations: VD (biodynamic preparation) 500 + VD 501 + Fladen preparation; The third option is treated only with biological preparations: Free N + Heliosulfur, and the treatment in the fourth option is a combination of the above two options: VD (biodynamic preparation) 500 + VD 501 + Flaten preparation + Free N + Heliosulfur.

BD 500 is applied as a 5% solution in the spring and autumn in crop growth corresponding to Growth Stages (GS 20–22) and (GS 22–25) respectively. The preparation is prepared from fresh cow manure, which is filled into a cow's horn and placed in the soil at a depth of 40 cm, where it remains from autumn to spring. The content is removed from the horn in the spring and it is ready for use if it has a pleasant smell of humus. In the class formation phase (GS 50–55), the other biodynamic preparation 501 is applied, in a dose of 1.5 g per 300 l of water ha^{-1}. The preparation of this preparation is done by placing quartz crystal powder in a cow's horn and burying it again in the ground at a depth of 40 cm. BD 501 is planted in the spring and in the fall, it is taken out and ready for use.

Fladen preparation is applied as a solution with a working dose of 1.5%, in the same phases of crop development in which VD 500 is applied (GS 20–22) and (GS 22–25). This preparation is prepared by adding eggshells and basalt flour to fresh cow dung. In the spring, the horns prepared in this way are placed in a wooden container and buried at a depth of 40 cm. In the fall, the preparation is ready for use. During this time, the compost DBs are added: chamomile - (*Matricaria chamomilla* L.) - flowers, yarrow (*Achillea millefolium* L.) - flowers, oak (*Quercus robur* L.) - bark, nettle (*Urtica dioica* L.) - roots, valerian (*Valeriana officinalis* L.) – extract, dandelion (*Taraxacum officinale* Weber) – flowers.

At an appropriate date of the biodynamic calendar, in the phase of class formation (GS 50–55) - flowering, Heliosulfur (pine terpenes + liquid sulfur) is applied at a dose of 500 ml/ha^{-1}. In addition to being a fungicide, this preparation also acts as a growth stimulator.

Free N (strains, mainly *Azotobacter chroococcum*, 2% manganese in the form of water-soluble sulfates and 0.02% molybdenum).

It is applied to the soil according to the biodynamic calendar of Maria Tun in a dose of 500 mL ha^{-1}. This preparation enriches the soil and contributes to the assimilation of atmospheric nitrogen.

Growth phases indicated are according to the Zadoks scale [18]. Data were processed using SPSS using the method of variance statistics. Student's criterion was used for assessment. All treatments were carried out on the appropriate days according to Maria Thun's sowing calendar.

Results and Discussion

In the first year of the experiment, sowing was done on time, but in conditions of soil and air drying. The wheat did not sprout until the beginning of the following year. In practice, the yield of grain is formed

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only from the spring tillering. The first significant precipitation fell in May, but remained well below normal (64 mm) (Fig. 1). In June, the amount of precipitation is around the norm. During the spring vegetation period of wheat, the air temperature approaches the corresponding norm. It can be said that in terms of cultural development, the year is moderately favorable.

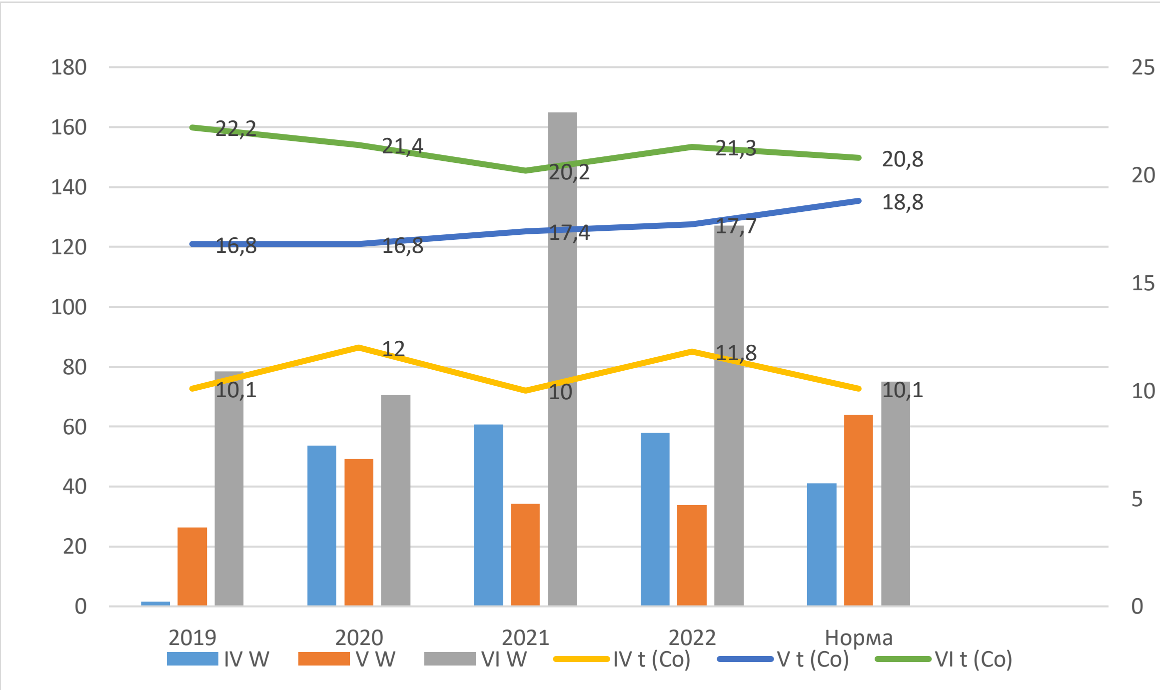

Figure 1. Precipitation and average daily air temperature

For the growth and development of the culture, the following year from the experience is also favorable. During the spring vegetation period of wheat, the air temperature for the month of April is 2°C above the norm, and 2°C below the norm for the month of May.

Meteorologically, the year 2021 differs from the previous 2 years. Precipitation in the months of April and June is significantly above the norm and exceeds it by 19.8 mm and 89.8 mm, respectively.

The fourth year of the trial is meteorologically similar to the previous year. It is noteworthy that at the time of the experiment, the amount of precipitation was significantly above the norm for the area for the months of April and June, and those in May were approximately half of the norm. Only in 2019, April has extremely little rainfall.

When using BD-500, increased levels of trace elements such as calcium, copper, magnesium, manganese are observed. This stimulates the increase of microflora and humus-forming bacteria [19].

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Table 1 shows that for all treated variants, the difference in the content of nitrogen, phosphorus, potassium and protein in the wheat grain is well proven compared to the untreated variant.

Table 1. Chemical analysis of nitrogen (N), phosphorus (P), potassium (K) and protein in common winter wheat Venka 1

Variant	N		
	Average	**Difference**	**Evidence**
1. Control	10.2		
2. Biodynamic	14.8	4.6	+++
3. Organic	18.4	8.2	+++
4. Biodynamic + Organic	21.2	11.0	+++
P			
1. Control	2.25		
2. Biodynamic	2.43	0.18	++
3. Organic	2.51	0.26	+++
4. Biodynamic + Organic	2.58	0.33	+++
K			
1. Control	0.261		
2. Biodynamic	0.302	0.041	+++
3. Organic	0.281	0.02	++
4. Biodynamic + Organic	0.282	0.02	++
Protein			
1. Control	0.365		
2. Biodynamic	0.424	0.59	+++
3. Organic	0.434	0.69	+++
4. Biodynamic + Organic	0.394	0.29	++

*Differences between variants are statistically proven at $P < 0.05$ if they have different letters

*, **, *** - Statistical significance of differences between variants and control for $P < 0.05$; 0.01 and 0.001

After the biochemical analysis of the wheat grain from the different variants, it was found that the wheat treated with the combined biological and biodynamic preparations had more dry matter, organic matter compared to the control, and the variants treated only with biological or biodynamic preparations had more raw protein and respectively raw fibers (Table 2).

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Table 2. Biochemical analysis of some parameters in winter common wheat Venka 1

Variant	Dry matter			
	Average	**Difference**	**Evidence**	**Group**
1. Control	87.26			b
2. Biodynamic	86.21	-1.05	---	a
3. Organic	87.04	-0.22	---	b
4. Biodynamic + Organic	87.54	0.28	+	c
Organic matter				
1. Control	85.35			b
2. Biodynamic	83.87	-1.48	---	a
3. Organic	85.18	-0.17	---	b
4. Biodynamic + Organic	85.85	0.50	++	c
Crude protein				
1. Control	9.63			b
2. Biodynamic	9.66	0.03	ns	a
3. Organic	10.19	0.56	+++	c
4. Biodynamic + Organic	9.55	-0.08	---	a
Raw fibers				
1. Control	2.64			b
2. Biodynamic	2.42	0.22	++	c
3. Organic	2.56	-0.08	---	a
4. Biodynamic + Organic	2.58	-0.06	---	a
Mineral substances				
1. Control	1.93			b
2. Biodynamic	1.63	-0.30	---	a
3. Organic	2.00	0.07	ns	b
4. Biodynamic + Organic	1.69	-0.24	---	a
Ca				
1. Control	0.145			b
2. Biodynamic	0.160	0.015	ns	b
3. Organic	0.148	0.003	ns	b
4. Biodynamic + Organic	0.141	-0.004	---	a

Differences between variants are statistically proven at $P < 0.05$ if they have different letters

*, **, *** - Statistical significance of differences between variants and control for $P < 0.05$; 0.01 and 0.001

In organic wheat production, the use of chemical nitrogen fertilizers is not allowed, which can lead to a decrease in the protein content of wheat grains [20]. Higher protein content (14.09%) was found in wheat grown in organic farming system than in wheat grown in conventional farming (12.09%) [21]. Other authors reported that they obtained higher protein and gluten content in conventionally farmed wheat [20].

It is known that the long-term application of biodynamic agriculture leads to an increase in total N and total soluble C in the soil [22]. According to Mader et al. in organic plots, dry matter yield was 14% lower

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than that of wheat grown under conventional farming conditions. The same author found that the protein content of the grain of organic wheat is lower than that of the grain produced under conventional conditions [20].

A study showed that root dry matter was 13% more and root length was 18% greater in winter wheat treated with BD 500, BD 501 and other herbal preparations [23].

Trials conducted to investigate the effect of BD-500 on soil and crops have shown a significant improvement in soil structure, better root development and plant growth compared to the effects of applying conventional chemical fertilizers [19]. Vaish et al. reported that wheat and maize grown under biodynamic conditions had better rooting, health, growth and increased organic carbon [24].

Conclusion

It can be said that the treated variants with wheat performed better in terms of some biochemical indicators. The research will help producers to navigate the quality of organically produced wheat and may encourage them to switch to an organic system of crop cultivation. In subsequent attempts, the author thinks to expand and deepen the research on the present topic.

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