



[DOI: 10.22620/agrisci.2021.29.005](https://doi.org/10.22620/agrisci.2021.29.005)

PRODUCTIVITY OF WHEAT GROWN IN CONDITIONS OF UNCONVENTIONAL AGRICULTURE

Vesselin Dochev¹, Atanas Atanassov², Krasimira Uzunova³

¹Agricultural Institute – Shumen, ²“Angel Kanchev” University of Ruse,

³Agricultural University - Plovdiv

*E-mail: vdotchev@abv.bg

Abstract

The production of clean, healthy and high quality agricultural products is becoming increasingly important. In modern wheat agriculture, research with biological and biodynamic preparations is increasingly presented. With the common variety of winter wheat Venka 1, a study was conducted in the period 2019 - 2020 on carbonate, chernozem soil type, in the experimental field of Agricultural Institute Shumen. The experiment is based on the block method, in four replications with the size of the experimental plot 10 m². Sowing was carried out in October with a sowing rate of 500 sprouts / m² after the predecessor sugar flower. In the appropriate periods, treatments were made in 4 variants: 1) Control – untreated variant; 2) Treatment with biodynamic preparations: Preparation 500 + Fladen preparation + preparation 501; 3) Treatment with biological preparations: Heliosulfur + Free N; 4) Combined treatment with the same biodynamic and biological preparations.

After the readings of the biometric indicators and the statistical analysis for the first year of the study, a proven positive difference was found in the variant treated with biological preparations on the length of the spike, number and weight of grains per spike. In the second year, a proven positive difference was obtained in the variants treated with biological and biodynamic preparations and in their combination on the length of the spike, number and weight of grains per spike. A difference in the number of spikelets per spike was substantially demonstrated only in the variant treated with biological preparations in the second year of the study. For a proven positive effect in the variant treated with biodynamic preparations, technological time is needed in order to show the real effect of their action on the yield in wheat.

Keywords: Wheat, yield, biodynamic and biological preparations

INTRODUCTION

In modern crop production, an intensive approach to agriculture has been imposed in order to increase crop productivity. Chemical fertilizers in high doses and plant protection products are used, to which the plants eventually acquire resistance. It has come to the point of using genetically modified hybrids that tolerate high doses of chemicals and are selectively tolerant to them. The lower and stronger stalk in cereals is a prerequisite for the

introduction of large amounts of chemical fertilizers. In the race for high yields, control over their quality was lost. In the last few years, the production of clean, healthy and high quality agricultural products has become increasingly popular. In response to the increased demand and supply of organically produced products, various ecological fertilizers and bio-stimulants have appeared on the market. The application of bio fertilizers has emerged as a promising component of an integrated food supply system in agriculture



(Shehata and El-Khawas, 2003). Bulgarian and foreign bio-preparations have been tested in the past and continue to be tested today. There are data on the beneficial effects of some Bulgarian products tested in different cultures such as wine varieties, winter barley variety and winter oilseed rape (Stoyanova et al., 2014; Dyakova et al., 2015; Stoyanova et al., 2015; Dyakova, et al., 2017; Mincheva et al., 2017). Experimentation and analysis of the integrated use of organic fertilizers would provide farmers with valuable information on organic products for the effective use of these fertilizers to improve soil fertility (Enchev et al., 2018; Enchev and Kikindonov, 2016; Enchev et al., 2017; Enchev et al., 2018). The use of organic fertilizers helps to increase productivity by stimulating nutrient transport and improving the architecture of the root system (Nardi et al., 2002). In modern agriculture with wheat, studies with biological and biodynamic preparations are increasingly presented (Dochev and Atanasov, 2013; Dochev et al., 2016 a; Dochev et al., 2016 b; Dochev et al., 2019 a; Dochev et al., 2019 b; Mincheva et al., 2015 a; Mincheva et al., 2015 b).

The aim of the present study is to establish the influence of fertilization with biological and biodynamic preparations and their joint influence on the elements of grain yield in wheat.

MATERIALS AND METHODS

The study was conducted in two consecutive years, 2019 and 2020, with ordinary winter wheat variety Venka 1, on soil type carbonate chernozem, in the experimental field of the Agricultural Institute Shumen. The experiment is based on the block method, in four repetitions with the size of the experimental plot 10 m². Sowing was carried out in October with a sowing rate of 500 seedlings / m², after the predecessor sugar beet. 30 plants were reported from each replication.

In the appropriate phases of wheat development, treatments were made with different preparations, thus the experiment is set with 4 variants:

- **I-st variant – control**, untreated variant,
- **II-nd variant** - treatment with **biodynamic** preparations:
Preparation 500 (5% solution) + **Fladen preparation** (1,5% solution) + **Preparation 501** (1,5 g for 30 l H₂O /da),
- **III-rd variant** - treatment with **biological** preparations:
Heliosulfur (50 ml/da)+ **Free N** (50 ml/da),
- **IV-rth variant** – combined treatment with biodynamic and biological preparations, in the same concentrations.

In order to establish a better effect on the preparations on the productive traits of wheat, the individual preparations are used in different phenological phases, namely:

- Preparation 500 is applied in the autumn and spring phase tilling of wheat.
- Preparation 501 - applied in the full boot phase
- Fladen preparation is applied in the autumn and spring tilling phase
- Heliosulfur - applied in the full boot – flowering phase
- Free N is soil applied in the phase of autumn and spring tilling of wheat.

The last two preparations are used at appropriate dates, according to the biodynamic calendar, of the respective year.

The following growth and production traits in wheat were reported:

- plant height (cm)
- spike length (cm)
- number of spikelets per spike
- number of grains per spike
- grain weight per spike (g)



The initial data were processed using SPSS 19, according to the method of variation statistics, and the Student's criterion was used for evaluation. No significant differences were reported between the individual variants, so only the comparisons with the control variant are presented in the summary tables.

RESULTS AND DISCUSSION

The amount of precipitation and the average temperatures for the two reporting

years are presented in Figure 1. Moisture storage during the autumn-winter period of the first year of the experiment was extremely low. As a result of the drought, the mass germination of wheat was reported only in early January. The air temperature during the winter months was higher than the norm for the region. For the period of spring vegetation the precipitation and the average daily temperature were around the norm, as only in April the average daily temperature was lower than the norm (Fig. 1).

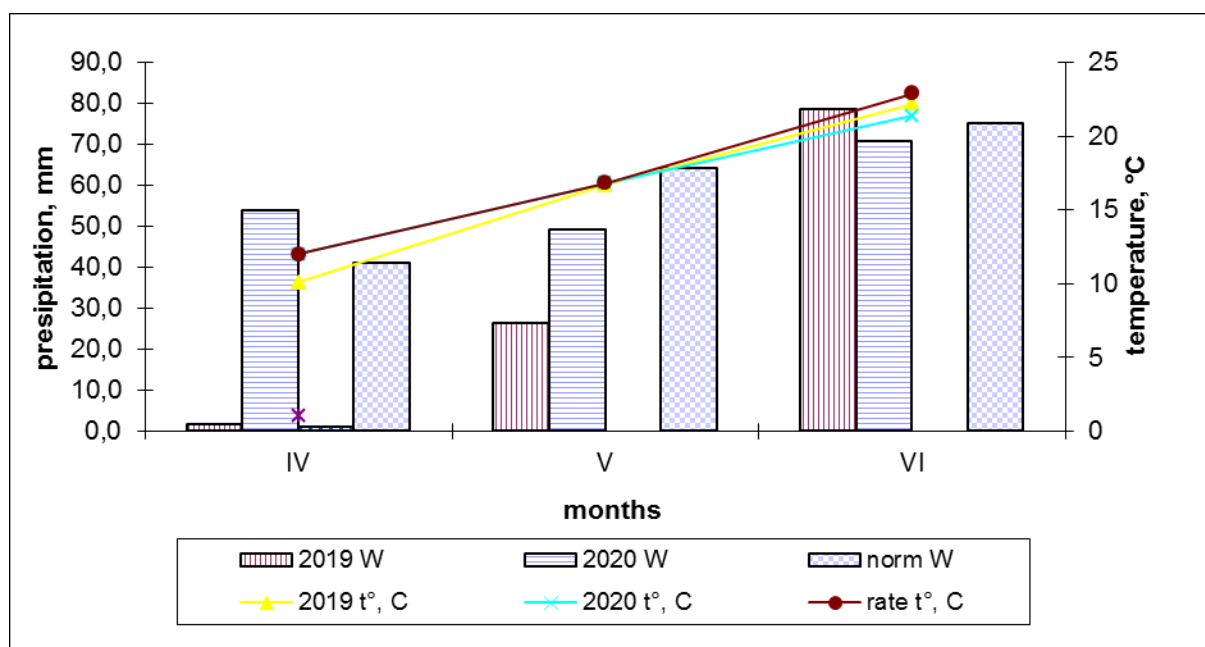


Fig. 1. Precipitation and average daily air temperature for the period 2019-2020.

In the following year of the experiment (2020), the precipitation during the autumn-winter period was insufficient, with a more significant deviation from the norm observed in the winter months. The drought continued in the spring. During the first decade of May, the first significant rains fell. Subsequent rains in late May and the second decade of June helped to better going through the ripening stage and to reach maturity of the grains. In terms of temperature, the months of spring wheat vegetation were favorable, as the month of June was slightly cooler than the norm. The lack of moisture during the spring tilling of

wheat had a negative impact on the structural elements of the yield and the grain yield itself.

Tables 1 and 2 present the results of the biometric analysis of five quantitative traits of wheat for the two reporting years. The different climatic conditions during the two consecutive years significantly affect the final results for most reported traits.

In 2019, there was a significant increase in the values of three of the important productive features - spike length, number and weight of grains in wheat treated with biological preparations (variant 3) in the probability of $p < 0.001\%$. In the other two



methods of cultivation - biodynamic and combined (biodynamic + biological), no significant change in the listed traits compared to the control was reported (table 1). In total,

for the three treated variants, nonsignificant differences were reported for the trait - number of spikes.

Table 1. Data processing from wheat variety Venka 1, grown by four different methods, in 2019

2019 г.					
plant height (cm)					
Variants	Traits				
	mean	difference	t _{exper}	significance	group
1. Contol	67,93				
2. Biodynamic	60,90	-7,03	5,87	---	VII
3. Biological	60,90	-7,03	4,99	---	VII
4. Biodynamic + Biological	59,66	-8,27	6,08	---	VII
spike length (cm)					
1. Contol	11,84				
2. Biodynamic	12,02	0,18	0,65	ns	IV
3. Biological	13,39	1,55	5,29	+++	I
4. Biodynamic + Biological	12,21	0,37	1,29	ns	IV
number of spikelets per spike					
1. Contol	15,88				
2. Biodynamic	15,02	-0,86	1,95	ns	IV
3. Biological	16,61	0,73	1,6	ns	IV
4. Biodynamic + Biological	15,01	-0,87	1,87	ns	IV
number of grains per spike					
1. Contol	30,16				
2. Biodynamic	27,55	-2,61	1,56	ns	IV
3. Biological	39,15	8,99	4,74	+++	I
4. Biodynamic + Biological	29,06	-1,1	0,62	ns	IV
grain weight per spike (g)					
1. Contol	1,38				
2. Biodynamic	1,31	-0,07	0,84	ns	IV
3. Biological	2,11	0,73	3,29	+++	I
4. Biodynamic + Biological	1,36	-0,02	0,19	ns	IV
Table values of t = 1.960; 2.576; 3.291					

In the last reporting year, the results obtained show the advantages of the three unconventional methods of cultivation

presented in three of the most important productive traits - spike length, number and weight of grains (table 2). There are significant



differences in the probability of $p < 0.001\%$ compared to the control, which determined 2020 year as favorable in terms of climate for the application of non-standard methods for wheat growing.

There is a general trend for the two years, when wheat cv Venka 1 was growing

with unconventional methods - the height of the stem significantly reduces its size or has nonsignificant changes compared to the control.

As a result of the study conducted with four different types of wheat cultivation Venka 1, we can make the following summary.

Table 2. Data processing from wheat variety Venka 1, grown by four different methods, in 2020

2020 г.					
plant height (cm)					
Variants	Traits				
	mean	difference	t_{exper}	significance	group
1. Contol	62.7				
2. Biodynamic	58.6	-4.1	3.97	---	VII
3. Biological	61.7	-1	0.9	ns	IV
4. Biodynamic + Biological	60.8	-1.9	1.46	ns	IV
spike length (cm)					
1. Contol	11.06				
2. Biodynamic	12,08	1.02	2.97	++	II
3. Biological	12.01	0.95	3.58	+++	I
4. Biodynamic + Biological	12,1	1.04	4.17	+++	I
number of spikelets per spike					
1. Contol	16.86				
2. Biodynamic	16.41	-0,45	1,33	ns	IV
3. Biological	17.8	0,94	2,77	++	II
4. Biodynamic + Biological	16.58	-0,28	1,03	ns	IV
number of grains per spike					
1. Contol	25.05				
2. Biodynamic	30.98	5.93	3.53	+++	I
3. Biological	32.6	7.55	5.87	+++	I
4. Biodynamic + Biological	32.41	7.36	6.11	+++	I
grain weight per spike (g)					
1. Contol	0.98				
2. Biodynamic	1.25	0.27	3.51	+++	I
3. Biological	1.27	0.29	5.01	+++	I
4. Biodynamic + Biological	1.25	0.27	5.08	+++	I
Table values of $t = 1.980; 2.617; 3.373$					



CONCLUSIONS

After the statistical analysis for the first year of the study, a proven positive difference was found in the variant treated with biological preparations on the spike length, number and weight of grains per spike, compared to the control.

In the second year, significant differences were reported in the variants treated with biological, biodynamic preparations and in their combination, on the length of the spike, number and weight of grains per spike, compared to the conventional method of growing wheat.

A significant difference in the number of spikelets per spike was found only in the variant treated with biological preparations in the second year of the study, compared to the control.

All significant differences were reported at a high level of probability ($p < 0.001\%$).

For a proven positive effect in the variant treated with biodynamic preparations, a longer technological time is needed in order to show the real effect of their action on the yield in wheat.

ACKNOWLEDGMENTS

The study was supported by contract 2020-FNI-01, funded of the University of Ruse “Angel Kanchev”.

REFERENCES

- Enchev S., A. Mehmed, G. Kikindonov*, 2019. Results from the application of mineral and organic fertilization on the economic qualities of stevia (*Stevia rebaudiana* B.). Journal of Mountain Agriculture on the Balkans, 21, (2), 236-246.
- Dochev V., A. Atanasov*, 2013. Investigation productivity of some winter wheat (*Triticum aestivum*) varieties, grown under conditions of organic and conventional agriculture. International Scientific Conference "Impact of Climate Change on the Environment and the Economy", 22 - 24 April 2013 Belgrade, Serbia, Ecologica, 70, 230-233.
- Dochev V., A. Atanasov, G. Dyakova, R. Mincheva, S. Stoyanova, K. Tanova*. 2016 (a). Study on the effects of Aminobest and Biobest organic fertilizers on the productive layering capacity and grain yield in winter common wheat (*Triticum aestivum* L.). International journal of current research. 8, (03), 277329-27331.
- Dochev V., A. Atanasov, G. Dyakova, R. Mincheva, S. Stoyanova*, 2016 (b). Effects of aminobest and biobest organic fertilizers on the technological qualities of winter common wheat (*Triticum aestivum* L.) ECOLOGICA, 84, 833-836, Belgrade.
- Dochev V., A. Atanasov, K. Slanev*, 2019 (a). Technological qualities of Venka 1 wheat variety cultivated under biological conditions. Research people and actual tasks on multidisciplinary sciences. Lozenec, Bulgaria, 12-15 june, vol. 1, 360-365.
- Dochev V., A. Atanasov, A. Mehmed*, 2019 (b). Productivity of wheat variety Venka 1, grown in biological conditions. Journal of Mountain Agriculture on the Balkans, 1, 152-159.
- Dyakova G., R. Mincheva, S. Stoyanova and V. Dochev*, 2015. Influence of bacterial fertilizer “Bio-One”- fluid concentrate on some agrobiological and technological indexes of dessert vines variety “Prista”. Zemedelie Plus, 3-4, 20-21.
- Dyakova G., R. Mincheva, S. Stoyanova, V. Dochev*. 2017. Effects of “BIO-ONE”



- bacterial fertilizer – liquid concentrate, on the development of above ground parts and root system in production of vine plant material of cv Muscat Ottonel. *Journal of Mountain Agriculture on the Balkans*, 20, (6), 251-259.
- Enchev S., G. Kikindonov*, 2016. Genotypic reaction of fodder beet to organic fertilization. *Journal of Mountain Agriculture on the Balkans*, 19,(5):112-123.
- Enchev S., G. Kikindonov, K. Slanev*, 2017. Reaction of different sugar beet genotypes to organic fertilization. *Journal of Mountain Agriculture on the Balkans*, 20 (2), 182-191.
- Enchev S., A. Mehmed, G. Kikindonov*, 2018. Effect of mineral and organic fertilization on the production of Stevia (*Stevia rebaudiana* B.), *Bulg. J. Agric. Sci.*, 24 (Suppl. 2): 100-103.
- Mincheva R., S. Stoyanova, V. Dochev, G. Dyakova, A. Atanasov*, 2015 (a). Study on the effects of “BIO-ONE” bacterial fertilizer and humic acid on winter common wheat varieties under conditions of IASS “Obraztsov chiflik”–Rousse. *ECOLOGICA*, 79, 442-445, Belgrade.
- Mincheva R., S. Stoyanova, V. Dochev, G. Dyakova, A. Atanasov*, 2015 (b). Technological properties and bread baking qualities of wheat varieties, treated “BIO-ONE” bacterial fertilizer and humic acid. *Research people and actual tasks on multidisciplinary sciences*. 24-28 June, (1), 280 -284., Lozenec, Bulgaria.
- Mincheva R., G. Dyakova, S. Stoyanova, V. Dochev*. 2017. Effects of “BIO-ONE” bacterial fertilizer – liquid concentrate, on the development of above ground parts and root system in rooting of cuttings of cv. Muscat Ottonel. *Journal of Mountain Agriculture on the Balkans*, 20, (6), 269-276.
- Nardi , S, D. Pizzeghello, A. Muscolo, A. Vianello* (2002). Physiological effects of humic substances on higher plants. *Soil Biol Biochem.*, 34:1527–1536.
- Shehata M.M., S. A. El-Khawas* (2003) Effect of two biofertilizers on growth parameters, yield characters, nitrogenous components, nucleic acids content, minerals, oil content, protein profiles and DNA Banding Pattern of Sunflower (*Helianthus annuus* L. cv. Vedock) Yield. *Pakistan Journal of Biological Sciences*, 6 (14), 1257-1268.
- Stoyanova S., G. Dyakova, R. Mincheva and V. Dochev*, 2014. Test of the effect of bacterial fertilizer “Bio-one” fluid concentrate on winter oilseed rape in the conditions of IZS “Obraztsov chiflik” – Russe, National Conf. with Intern. Participation “Biological plant growing, live-stock breeding and foods”, 215-218, Agricultural Academy.
- Stoyanova S., R. Mincheva, V. Dochev, G. Dyakova and A. Atanasov*. 2015. Test of the effect of bacterial fertilizer “Bio-one” and humic acid for winter barley variety “Emon” in the conditions of IZS “Obraztsov chiflik”. In: *Proceedings of Scientists Union* 3, (7), 242-245, Russe.