Influence of fertilization on changes of structural elements and wheat yield

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Abstract
The study was conducted in the period 2019 - 2020 in the experimental field of Agricultural Institute Shumen with variety "Venka" - 1 on carbonate black soil (chernozem). The influence of different forms of fertilization on wheat productivity was studied, as well as the possibility for partial replacement of mineral fertilizers with the Siapton product. Several fertilization systems were tested in the experiment, including the participation of mineral fertilizers and combinations of mineral fertilizers with Siapton in the following variants: T_0 - control, without fertilization; T_1 - $N_{180}P_{140}K_{100}$, kg/da active substance; T_2- $N_{90}P_{70}K_{50}$ + Siapton - 2 l/da; T_3 - N_0P_{70} K_0 + Siapton - 3l/ha. It was found that the best indicators of the elements of yield in wheat were obtained by mineral fertilization with $N_{180}P_{140}K_{100}$ kg/ha. By reducing the fertilizer rate by half plus foliar fertilization with Siapton, as well as fertilization only with phosphorus fertilizer at P_2O_5 rate - 70 kg/ha + Siapton, the indicators of the structural elements of the yield were significantly reduced, which also affected the yield.

Key words: wheat; yield; mineral fertilization; structural elements

INTRODUKTION

Obtaining more, higher quality and lower cost of grain from soft wheat varieties introduced in the production is directly related to the application of appropriate technology for their cultivation (Davidkov & Tosheva, 2005; Samodova, 2008, 2019; Yordanova 2020; Gerdzhikova, 2015). Studies were made locally and abroad to establish the optimal parameters of the main agro-technical factors and their impact on productivity and the quality of wheat grown in different regions, characterized by great agro ecological diversity (Dochev & Atanasov, 2013; Dochev et al., 2016a, b; Koteva & Marcheva. 2012; Samodova, 2020, Arduini et al., 2006, Prystupa et al., 2004). Grain and protein yields are strongly related to the structural elements of the yield and the quality indicators of the grain without the mass of 1000 grains and the hectolitre mass. In the conditions of warm and moderately dry year and with drought during the period of flowering, the use of nitrogen norm 18 kg N/da was energy inefficient (Almaliev et al., 2014). According to Panayotova et al. (2012), in years with insufficient rainfall during the growing season, in case of late sowing and late germination, fertilization with moderate nitrogen norms is recommended. The increase in temperature reduces the export of nutrients in the flowering phase, as the export of N, P and K decreases by 19.3%, 21.3% and 12.9%, respectively (Kostadinova et al., 2013). Maximum agronomic efficiency (Panayotova et al., 2013) - 27.6 kg of grain/kg N was obtained by applying fertilizer with 8 kg N/da in combination with 8 kg P/da. Almaliev et al. (2014) found that with the N12 P12 fertilization system - 3.84 kg N the highest nitrogen consumption was obtained for the formation of 100 kg of grain in wheat. Total nitrogen exports to aboveground biomass in wheat increase with increasing nitrogen input (Panayotova et al., 2017).The aim of the study

was to determine the effect of different forms of fertilization on wheat productivity, as well as the possibility of partial replacement of mineral fertilizers with the product Siapton.

MATERIALS AND METHODS

The study was conducted in the period 2019 - 2020 in the experimental field of Agricultural Institute Shumen with variety "Venka" - 1. The soil in the experimental area was carbonate black soil (chernozem). It is characterized by a high content of carbonates, pH - 7.4 - 7.8. The soil is poor in nitrogen (35 mg/kg soil), poorly stocked with phosphorus (4.7 mg/100g soil) and rich in potassium (34 mg/kg soil), humus - 3.3%. Several fertilization systems were tested in the experiment, including the participation of mineral fertilizers and combinations of mineral fertilizers with Siapton in the following variants: T_0 - control, without fertilization; T_1 - $N_{180}P_{14}K_{100}$, kg/ha active substance.; T_2 - $N_{90}P_{70}K_{50}$ + Siapton – 2 l/ha; T_3 - $N_0P_{70}K_0$ + Siapton - 3 l/ha. Phosphorus and potassium fertilizers were imported with the pre-sowing treatement, which was done by double disking at 10 - 12 cm and 6 - 8 cm depth, (at the end of September to the beginning of October) At the first available moment, Nitrogen fertilizer and Siaptona were imported early in the spring for use in the field (at the end of February till the beginning of March). Siaptonn is a liquid fertilizer and bio stimulant for foliar and soil application, increases yields and quality, reduces production losses caused by abiotic stressors. It contains total nitrogen - 9.1%, of which organic nitrogen - 8.7% and ammonium nitrogen - 0.4%; organic carbon - 25%; Total amino acids of animal origin - 54.4%, free amino acids - 10.0%, dry matter - 63%, ph - 6.4 and others. During the study, the yield and the structural elements of the wheat yield were taken into account. Statistical data processing was done using the Biosat program.

RESULTS AND DISCUSSION

Obtaining high and sustainable yields of agricultural crops is closely dependent on both the agrotechnical activities and the specific meteorological conditions of the year. The amount of precipitation for the vegetation period of wheat during the years of the study differs significantly from each other (Fig. 1). For the harvest year of 2018/2019 it was 334 mm, and for 2019/2020 it is 226 mm, the difference between them was 108 mm in favour of the 2018/2019 harvest. The amounts of both harvest years were significantly smaller compared to those of the multi-year period (419 mm), compared to the amount for the harvest 2018/2019 was 84 mm smaller and the amount for 2019/2020 was 193 mm. The air temperature also affected the structural elements of the wheat yield. The sum of the average daily temperatures of the air during the vegetation period for the economic 2018-2019 was 96.0 °C. During the following period of 2019-2020, the sum was 96.0 °C. The values for the average daily temperatures during the vegetation period for the both economic periods were close to the yearly values for separate months (the norm) (Fig 2).

The changes in the structural indicators of the yield were a result of the applied fertilization in combination with the climatic factors on the one hand, but also to a large extent by the biological endowments of the variety.

The lowest indicators were the elements of the yield in the control variant (T_0), where no fertilization has been performed, i.e. under the conditions of natural supply of soil with nutrients. When applying balanced nitrogen - phosphorus - potassium fertilization (T_1), the number of spike-bearing stems increased by 50 per m^2, the number of grains in one class by 2.8 and the mass of 1000 grains by 3 g. of the fertilizer rate by half plus the addition of Siapton 2 l/ha with 1 g. of the fertilized variants with the lowest indicators of the yield elements is T_3- $N_0P_{70}K_0$ + Siapton – 3 l/ha. The number of spike-bearing stems was 395 pcs/m^2 and the weight of 1000 grains is 39 g. The unequal yields obtained as a result of the studied fertilization rates follow a similar trend with the changes of the structural elements of the yield in wheat (Table 2).

The highest yield is obtained when applying wheat fertilizer with $N_{180}P1_{40}K_{100}$, kg/ha active substance (T_1). It increased the yield compared to the unfertilized control by 54.6% - 74.7%, or an average of 66.1%. The reduction of nitrogen, potassium and phosphorus rates plus foliar fertilization with Siapton – 2 l/ha (T_2) led to reduction of yield compared to the high fertilization rate from 17.1% to 22.1% with an average of 19.6%. With complete elimina-

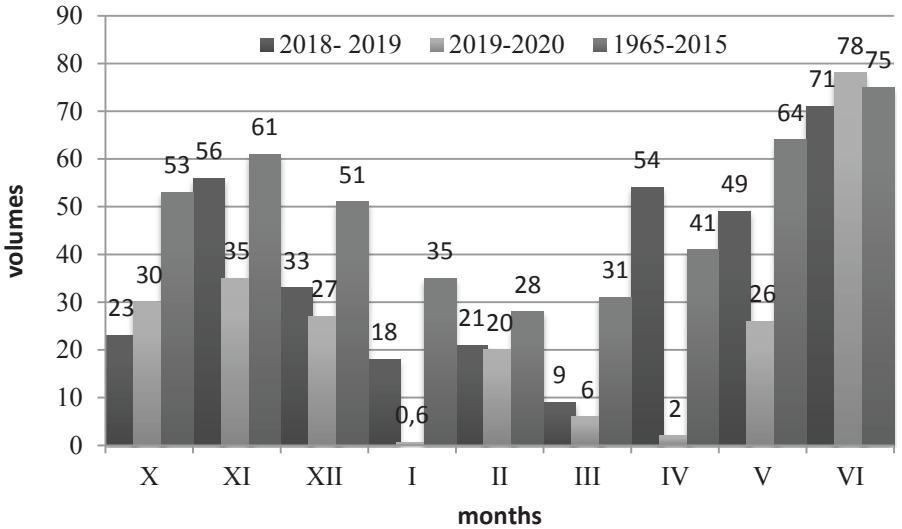

Figure 1. Sum of precipitation during the wheat growing season

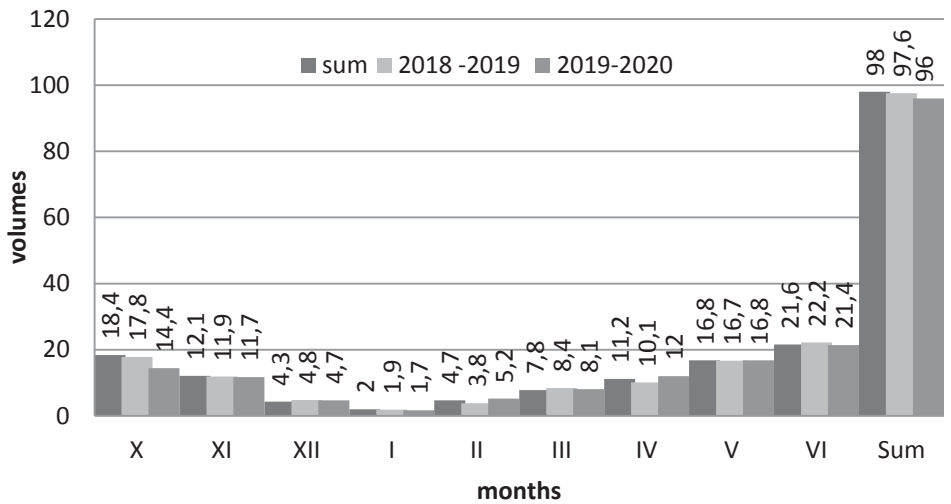

Figure 2. Average daily air temperature (°C) during the vegetation period for the economic 2019 - 2020

Table 1. Structural elements of yield from wheat for 2019-2020

Fertilization variants	Spike-bearing stems amount/m^2	Spike length, cm	Number of grains/spike	Weight of grains /spike	Mass of 1000 grains
T_0 – non-fertilized	380	10.2	27.3	1.20	38
T_1- $N_{180}P_{140}K_{100}$	530	11.3	30.1	1.33	41
T_2 $N_{90}P_7K_{50}$ + Siapton 2 l/ha	522	10.8	29.4	1.29	40
T_3 $N_0P_7K_0$ + Siapton 3 l/ha	395	10.4	28.6	1.23	39

Table 2. Wheat grain yield – кg/ha

Variants	2019		2020		Mean	
	kg/ha	%	kg/ha	%	kg/ha	%
T_0 –non- fertilized	4300	100,0	3200	100.0	3750	100.0
$T_1N_{180}P_{140}K_{100}$	7500	174.4	4950	154.6	6230	166.1
T_2 $N_{90}P_7K_{50}$ + Siapton 2 l/ha	6550	152.3	4400	137.5	5480	146.1
T_3 $N_0P_7K_0$ + Siapton 3 l/ha	4820	112.0	3680	115.0	4250	113.3
GD 5.0%	2,247 кg/ha		4.018 кg/ha			
1.0%	5.556 кg/ha		6.556 кg/ha			
0.1%	8.672 кg/ha		7.680 кg/ha			

tion of the nitrogen and potassium norm and reduction of the phosphorus norm by half plus leaf-applied Siapton in a dose of 3l/ha (T_3), the grain yields of wheat are reduced to a greater extent, as the difference between the high and this fertilization rate is in the range of 40 - 62%. The application of the same norm has increased the yield compared to the unfertilized control in the amount of 12.0 - 15.0%. The obtained differences in yields between the four options and compared to the control are of high statistical significance. The results we obtained were different from those of Samodova (2008 and 2019), in relation to the influence of the fertilization on the changes in structural elements and wheat yield in the conditions of South Bulgaria. This was most likely caused by different climate and soil conditions of the region and the applied different norms of fertilization with which were conducted these field experiments.

CONCLUSIONS

The best indicators of the elements of the yield in wheat are obtained with mineral fertilization with $N_{180}P_{140}K_{100}$ kg/ha. By reducing the fertilizer rate by half plus foliar fertilization with Siapton as well as fertilization only with phosphorus fertilizer at P_2O_5 rate - 70 kg/ha + Siapton, the indicators of the structural elements of the yield are significantly reduced, which also affects the yield. When fertilizing with $N_{180}P_{140}K_{100}$ kg/ha, the grain yield from wheat increases by 66.1% compared to the unfertilized control. The reduction of the norm by half and feeding with Siapton – 2 l/ha, the yields compared to the control increased by 45.1%. Fertilization only with P_2O_5 - 70 kg/ha plus Siapton – 3 l/ha with complete elimination of the nitrogen and potassium norm increases the yield by 13.3% compared to the variant without fertilization.

REFERENCES

Almaliev M., Kostadinova, S. & Panayotova, G. (2014). Energy efficiency of systems with nitrogen and phosphorus fertilization in hard wheat. Proceedings, pp. 226-235.

Almaliev, M., Panayotova, G. & Kostadinova S. (2014). Uptake and utilization efficiency of nitrogen and phosphorus in durum wheat. Agrosym 2014“, ISBN: 978-99955-751-9-9 http://www.agrosym.rs.ba, Book of Proceedings, Original scientific paper 10.7251/AGSY 1404118A, pp. 118-122.

Arduini, I., Masoni, A., Ercoli, L. & Mariotti M. (2006). Grain yield, and dry matter and nitrogen accumulation and remobilization in durum wheat as affected by variety and seeding rate. *European Journal of Agronomy, 25,* pp. 309–318.

Davidkov E. & Tosheva, E. (2005). Fertilization influence on different sowing dates and application of growth regulators and fungicides on the nitrogen uptake by wheat plants grown on carbonate chernozem. *Agricultural Sciences*, 7, pp. 76-80.

Dochev, V., Atanasov, A., Dyakova, G., Mincheva, R., Stoyanova, S. & Tanova, K. (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), 27329-27331.

Dochev, V., Atanasov, A., Dyakova, G., Mincheva, R. & Stoyanova, S. (2016, b). Effects of Aminobest and Biobest Organic Fertilizers on the Technological Qualities of Winter Common Wheat (Triticum aestivum L.). *Ecologica,* 84, 833-836.

Dochev, V. & Atanasov, A. (2013). Investigation Productivity of Some Winter Wheat (Triticum aestivum L.) Varieties, Grownunder Conditions of Organic and Conventional Agriculture. In: International Scientific

Conference "Impact of Climate Change on the Environment and the Economy", 70, pp. 230-233.

Gerdzhikova, M. (2015). Influence of Various Predecessors and Nitrogen Fertilization Rates On Yield Structure Characteristics of Common Wheat (Triticum Aestivum). *Science & Technologies*, 6, pp. 162-173.

Kostadinova S., Panayotova, G. & Almaliev, M. (2013). Nutrient uptake of durum wheat at elevated temperature, "XVIII Savetovanje o Biotehnologiji", Agronomski fakultet, Cacak, god. *Zbornik radova, 18*(20), 141-145.

Koteva, V. & Marcheva, M. (2012). Wheat productivity (Miryana variety) cultivated with reduced mineral fertilization. Bulgarian Journal of Soil Science, Agrochemistry and Ecology 3, 55-6.

Panayotova, G., Kostadinova, S. & Almaliev, M. (2012). Effect of different fertilizing rates on the yield and grain quality of durum wheat, 16th International Eco-Conference® on 7th SAFE FOOD, Novi Sad, Book of Proceedings, 183-191.

Panayotova, G., Kostadinova, S., & Almaliev, M. (2013). Agronomic efficiency of fertilization at durum wheat under contrast climate conditions. In *Book of Proceedings of Fourth International Scientific Symposium" Agrosym* (Vol. 2013, pp. 114-118).

Panayotova, G., Almaliev. M. & Kostadinova, S. (2017) Nitrogen uptake and expense in durum wheat depending on genotype and nitrogen fertilization. International Scientific Journal *"Agricultural Science and Technology", 9*(1), 26-34.

Prystupa, P., Savin, R. & Slafer, G. (2004). Grain number and its relationship with dry matter, N and P in the spikes at heading in response to N×P fertilization in barley. Field Crops Research, 90(2-3), 245-254.

Samodova, A. (2008). Study on the influence of fertilization on the yield from hard and soft wheat in the conditions of Pazardzhik. Scientific conference with international participation / Scientific papers, III(II), 195-199.

Samodova, A. (2019). Grain yield and yield elements in soft winter wheat cultivated in the conditions of the Pazardzhik region. Field Crops Studies, XII (4), 33-40.

Samodova, A. (2020). Influence of the period of sowing and the period of fertilizing on the elements of yield of durum wheat in the region of Pazardzhik, Bulgarian Journal of Crop Science, 57(5), 3-7.

Yordanova, N. (2020). Effect of nitrogen fertilization on the productivity and quality of wheat varieties. Knowledge International Journal, 41 (4), 751 – 757.