Scientific Papers. Series A. Agronomy, Vol. LXVI, No. 1, 2023
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

WHEAT YIELD RESULTS UNDER THE INFLUENCE OF N, P, K FERTILIZATION AND CLIMATIC CONDITION

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Abstract

The aim of the work was to carry out a study on the influence of climatic conditions and fertilization with chemical fertilizers on wheat production in the specific conditions of Didactical Farm (SDE) of the University of Life Sciences "King Mihai I" from Timisoara (ULST). A Fundamental contribution to the increase of the yield per unit area is made by the level of N, P. K fertilization and optimal soil and climatic conditions for exploiting the productive potential of the cultivated variety. The high ecological plasticity of wheat and its constant productions means that farmers are still very interested in this crop. Growers are also interested in the crop with the highest yield per unit area. The aim of this paper is to highlight the yield results of Ciprian wheat variety, obtained in the soil and climatic conditions of SDE during 2019-2020, under the influence of nitrogen, phosphorus and potassium fertilization in order to determine the growers to choose an optimal wheat fertilization option. Wheat yield obtained was determined by nitrogen fertilizer application from the control variant as follows: N_{30}- 485gk/ha, N_{60}-584 kg/ha, N_{90}-605 kg/ha, at all four rates the differences are statistically assured as highly significant.

Key words: *cultivars, fertilization, soil and climatic conditions, yield components.*

INTRODUCTION

For more than 35% of the world's population, wheat (*Triticum aestivum* L.) is the main source of nutrition, providing more than 45% of calories and more than 40% of protein for the world's population (Imbrea, 2011, Erekul, 2012). Nutrition management is one of the approaches to improve crop yields (Sowers, 1994), Wheat depletes nutrients from the soil, so if it is not properly fertilised, soil fertility starts to decline (Arregui, 2008). Therefore, fertiliser applications are essential to maintain a positive nutrient balance by replacing nutrients that are absorbed and lost during cultivation (Blandino, 2015). However, increasing nutrient use efficiency is essential to achieve the expected yield using as little fertiliser as possible (Şmuleac, 2020). Using the right fertilizer in the right amount is one of the most important management strategies to increase fertilizer efficiency and maximize crop productivity. (Školníková, 2022) The application of mineral fertilisers in wheat increases the nitrogen, phosphorus and potassium available in the soil (Schlesinger, 1992). Optimal fertiliser dosage improves wheat yield and fertiliser use efficiency as well as reducing pollution In addition, the right combination of primary nutrients is also important to increase wheat yield and nutrient use efficiency (Harrison, 2001). In cereal crops, overall N use efficiency has been found to be 33% (Mohammed, 2013). Nutrient use efficiency decreases with increasing N dose, while increasing crop yield reported lower N use efficiency (27.1%) from a N dose of 120 kg N ha compared to a N dose of 30 kg N ha with a N use efficiency of 39.27% (2021). One of the reasons for the lower N efficiency is N losses, limiting only 50% of the applied N fertilizer available for cereals (Raun, 1999; Chen, 2008; Cameron, 2013). Apart from the individual effects of nutrients, the interaction between nutrients is also crucial for nutrient yield and efficiency. Nitrogen helps plants to use potassium, phosphorus and other nutrients efficiently. The efficiency of N and P use, as well as the productivity and quality of agricultural products could benefit from increased K fertilisation (Kozlovský, 2018).

MATERIALS AND METHODS

The wheat variety used in the research was Ciprian, a variety developed at SCDA Lovrin, recognized for its superior quality characteristics and currently grown on large areas in the western part of the country.

In the experimental field located in the SDE Timisoara, were organized every year bifactorial experiments, with the grading of experimental factors:

Factor A - P and K fertilization level, with 5 graduations: a1 - P_0K_0; a2 - $P_{40}K_0$; a3 - $P_{80}K_0$; a4 - $P_{40}K_{40}$; a5 - $P_{80}K_{80}$

Factor B - N fertilisation level, with 5 graduations: b1 - N_0; b2 - N_{30}; b3 - N_{60}; b4 - N_{90}; b5 - N_{120}.

Elements of the applied technology: - The experiment located in the Experimental Station Timisoara in the first year of the experiment the sowing of wheat was carried out on 20.10.2018 and the harvesting of the crop was carried out on 07.07.2019; in the second year of the experiment the date of sowing the crop was 19.10.2019, with the harvesting of the wheat on 29.07.2020; and in the third year of the experiment the sowing was carried out on 10.11.2020 with the harvesting on 22.07.2021. The sowing density was 550 germinable grains/m^2.

In the first year in the wheat crop, an application of the systemic herbicide Pallas 250 g/ha + adjuvant 0.5 l/ha and a second herbicide application with Priaxor at a rate of 250 ml/ha was carried out during the vegetation, at the appearance of the first internode in wheat and in the rosette phase of weeds. Herbicides were applied when the air temperature was between 8-10°C.

In the 2020 and 2021 crops, one application of Gramitrel herbicide, 1 l/ha and one application of Trinity herbicide (2 l/ha) were made in vegetation, at weed rosette stage and at first internode emergence in both microzones studied.

Insecticides used for disease and pest control were: Catapult, at tillering stage (0.6 ml/ha); Krima (100 g/ha) and Twist Plus (1 l/ha), at bud stage and Cyperguard (0.6 ml/ha) at the emergence of spikelet.

For the processing and interpretation of the experimental results, the following programs were used: for analysis of variance - statistics [ANOVA], MSTATC; for correlations and regressions - statistics - Regressions and Graphs; procedures with formulas on factor contribution and DLs - in EXCEL; Cluster Analysis.

RESULTS AND DISCUSSIONS

Nitrogen fertilization has determined very significant increases, compared to the control variant, with the exception of the dose of N_{30} where a distinctly significant increase is obtained, as shown in Table 1.

Doses N_{30} - N_{120} exceed the control by 8% to 13%. The difference in production between the productions obtained at these doses compared to the N_0 control are between 378-688 kg/ha, differences statistically assured as distinct and very significant. The influence of fertilization with phosphorus and potassium on the wheat production obtained, the average of the years 2019-2021 is presented in Table 2. Compared to the unfertilized control P_0K_0 [a1], insignificant increases were obtained, except for the dose of P40K0 where a difference is obtained very significant, this difference is negative 397 kg/ha, i.e., the production obtained at the dose $P_{40}K_0$ compared to the control dose P_0K_0 is lower by 387 kg. Negative differences were obtained at all doses of P and K.

The production analysis carried out at the 5 doses of PK [factor A] which highlights the fact that it is between 4900 kg/ha obtained by applying the dose of $P_{40}K_0$ and approx. 5300 kg/ha obtained at the other 4 doses at P_0K_0, $P_{80}K_0$, $P_{40}K_{40}$ and $P_{80}K_{80}$. (Figure 1).

Table 1. Influence of nitrogen fertilization on wheat production, average years 2019-2021

Factor N	Yield		Diff	Signif.
	Kg/ha	%		
N_0	4811	100	mt	
N_{30}	5189	107.9	378	**
N_{60}	5498	114.3	688	***
N_{90}	5418	112.6	607	***
N_{120}	5264	109.4	453	***

DL 5% = 221 kg DL 1% = 293 DL 0.1% = 380

The production increases up to the dose of N_{60}, after which it decreases, as we can see from Figure 2. The lowest production is obtained with the unfertilized variant N_0 - 4800 kg/ha, and the highest with N_{60} -5500 kg/ha. So, there is a non-linear relationship between N and production.

Table 2. Influence of phosphorus and potassium fertilization on wheat production, average years 2019-2021

Factor P,K	Yield		Diff	Signif.
	Kg/ha	%		
P_0K_0	5316	100	mt	
$P_{40}K_0$	4929	92.7	-387	000
$P_{80}K_0$	5317	100.0	1	
$P_{40}K_{40}$	5315	100.0	-1	
$P_{80}K_{80}$	5304	99.8	-12	

DL 5% = 221 kg DL 1% = 293 DL 0.1% = 380

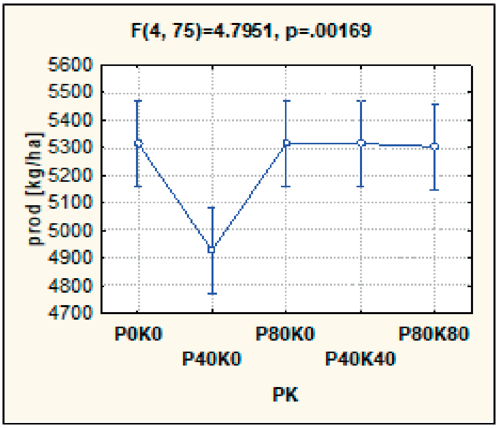

Figure 1. Variation of production under the influence of P and K fertilization (average years 2019-2021)

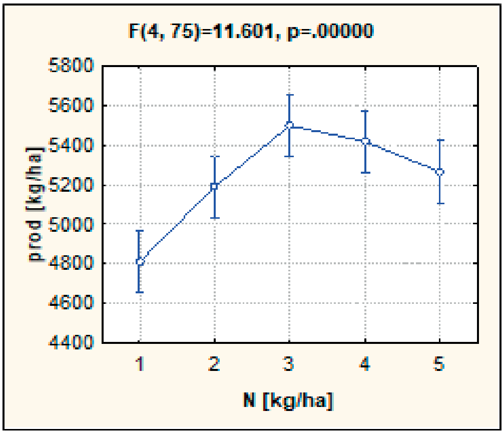

Figure 2. Variation of production under the influence of N fertilization (average years 2019-2021)

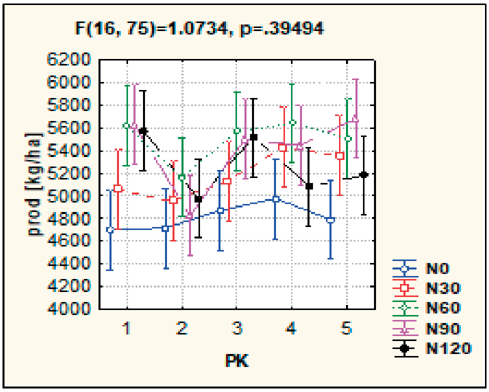

Figure 3. Variation of production by interaction of fertilization with P, K (average years 2019-2021)

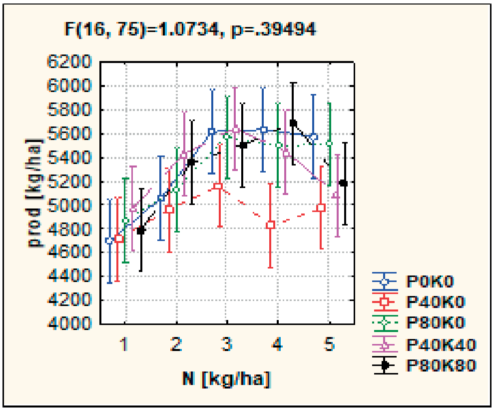

Figure 4. Variation of production by interaction of fertilization with N (average years 2019-2021)

Factor A[PK] contributes to the achievement of production in a proportion of 12.2%, factor B[N] with 29.4%, and the interaction AxB with 10.9%. (Figure 5).

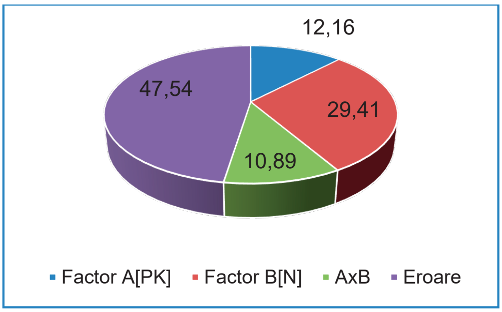

Figure 5. Contribution of P, K and N fertilisation and macroelement interaction (average years 2019-2021)

The influence of phosphorus and potassium fertilizers on protein content in the 2019-2021 cycle, in the experimental field at SDE Timişoara, presented in Table 3, shows us that, compared to the unfertilized control variant a1[P_0K_0], the following increases were obtained:

- insignificant, at the $P_{40}K_0$ dose level
- significant at the dose of $P_{80}K_0$
- distinctly significant on the agrofund of $P_{40}K_{40}$
- the highest value was statistically assured as highly significant at the dose of $P_{80}K_{80}$.

In conclusion, the increases varied between 0.2 and 0.7%. The results presented in Table 4, regarding the influence of nitrogen fertilizers on the average protein content (%) of the years 2019-2021, show us that, compared to the control b1[N_0], very significant increases were obtained regardless of the nitrogen dose applied. Spores have values between 2-5.3%.

Table 3. Influence of phosphorus and potassium fertilizers on protein content (%) average years, 2019-2021

Factor P, K	Protein	Diff	Signif.
P_0K_0	13.12	mt	
$P_{40}K_0$	13.32	0.19	ns
$P_{80}K_0$	13.58	0.46	*
$P_{40}K_{40}$	13.67	0.54	**
$P_{80}K_{80}$	13.80	0.67	***

DL 5% = 0.38 DL 1% = 0.51 DL 0.1% = 0.66

Table 4. Influence of nitrogen fertilizers on protein content (%), average years, 2019-2021

Factor N	Protein	Diff	Signif.
N_0	10.34	mt	
N_{30}	12.38	2.04	***
N_{60}	14.03	3.69	***
N_{90}	15.10	4.76	***
N_{120}	15.63	5.29	***

DL 5% = 0.38 DL 1% = 0.51 DL 0.1% = 0.66

The analysis of the protein content achieved at the 5 doses of PK [factor A] highlights the fact that it is between 13.1-13.8%. (Figure 6). Protein content increases with PK dose, increases are small from dose to dose.

The analysis of the protein content achieved at the 5 doses of N [factor A] (Figure 7), highlights the fact that it is between 10.3-15.6 percent. The protein content increases with the increase of the applied nitrogen dose. The highest percentage of protein [15.6] is obtained at N_{120}.

Protein content increases with nitrogen dose regardless of PK dose [b]. The highest values of the protein content are obtained at N_{90} and N_{120} regardless of PK [a], and the lowest at N0. (Figure 8).

Analysis of results regarding the influence of the interaction of AxB factors [PK x N], on protein content, 2019-2021 (Figure 9).

Factor A - fertilizers with P and K contribute to the protein content by 1.45%, factor B by N doses by 91.1%, and the AxB interaction by 1%.

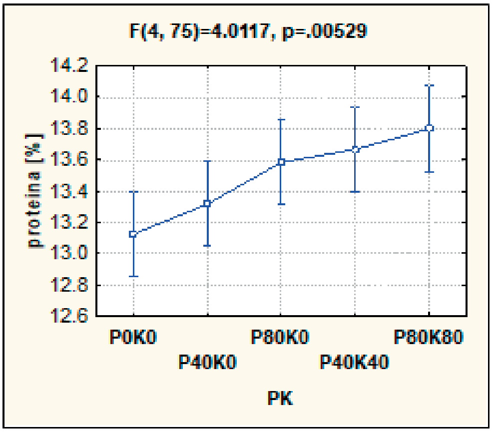

Figure 6. Variation in protein content [Factor A] 2019-2021

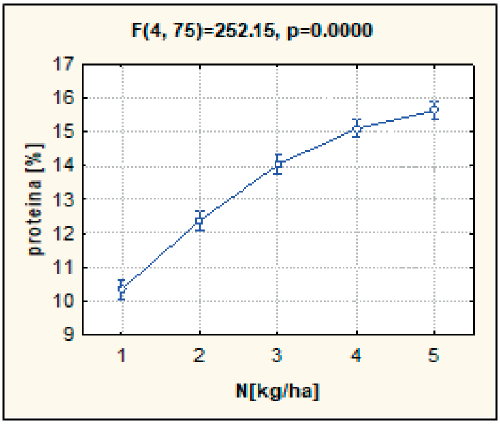

Figure 7. Variation in protein content [Factor B] 2019-2021

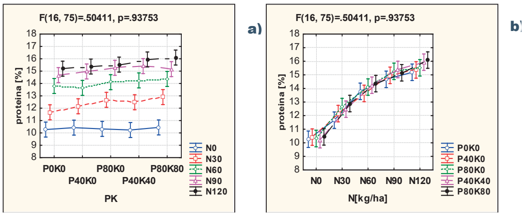

Figure 8. Variation in protein content [Factor AxB] 2019-2021

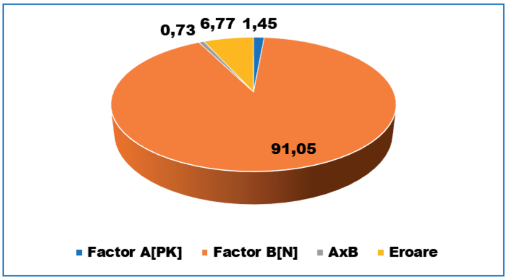

Figure 9. Contribution of factors A[PK], B[N] and interaction AxB 2019-2021

CONCLUSIONS

The research results demonstrated the favorability of the microzone (SDE Timişoara) for wheat cultivation and also the suitability of the Ciprian variety for cultivation in this area.

Chemical fertilizers have contributed to obtaining production increments, Thus, on cambic chernozem from SDE Timişoara, fertilizers with P and K contribute to the achievement of production in a proportion of 8.7% and those with N contribute with 13%.

The highest wheat production of 5680 kg is obtained on the $P_{80}K_{80}N_{90}$ farm, followed by the $P_{40}K_{40}N_{60}$ farm, with 5640 kg, $P_0K_0N_{90}$, with 5634 kg and $P_{80}K_0N_{60}$, with a production of 5570 kg/ha.

The production analysis carried out at the 5 doses of PK highlights the fact that it is between 4900 kg/ha obtained by applying the dose of $P_{40}K_0$ and approx. 5300 kg/ha obtained at the other 4 doses, i.e. at P_0K_0, $P_{80}K_0$, $P_{40}K_{40}$ and $P_{80}K_{80}$. The protein content obtained under the conditions of the Timişoara microzone, at the 5 P and K doses, was between 13.12% obtained at P_0K_0 and 13.80% obtained at $P_{80}K_0$ and $P_{80}K_{80}$. The analysis reflects the variation of the protein content, obtained at the 5 N doses, in the Timişoara microzone, between 10.34% (N_0) and 15.63% (N_{120}).

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