WHEAT YIELD RESULTS UNDER THE INFLUENCE OF N, P, K FERTILIZATION AND CLIMATIC CONDITIONS OF THE 2019-2020 FROM SDE TIMIŞOARA

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***Abstract**: Increasing yields per unit area is the most important objective for increasing agricultural raw material production for the food industry. A fundamental contribution to the increase in production per unit area is made by the level of N, P and K fertilisation and optimal soil and climatic conditions for exploiting the productive potential of the cultivated variety. Nutrition management is one of the approaches to improve crop yields. Wheat depletes nutrients from the soil, so if it is not properly fertilised, soil fertility starts to decline. Therefore, fertiliser applications are essential to maintain a positive nutrient balance by replacing nutrients that are absorbed and lost during the crops.The high ecological plasticity of wheat and its constant production 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 the paper is to highlight the production results of Ciprian wheat variety obtained in the soil and climatic conditions of the Experimental Didactic Station of 2019-2020, under the influence of nitrogen, phosphorus and potassium fertilization in order to determine the growers to choose the optimal wheat fertilization option. The interaction between nitrogen, phosphorus and potassium resulted in a significant increase in yield.*

***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 the calories and more than 40% of the protein for the world's population.

According to data processed from Eurostat, in 2019, Romania ranks fourth in the area cultivated with wheat 2.163 thousand ha, after France, 4.999 thousand ha, Germany 3.087 thousand ha and Poland 2.511 thousand ha, but the yield per unit area is lower compared to the other major growing countries in Europe.

The yielding capacity of a given wheat variety, which is determined by the values of the yield component, as well as the yield quality which is determined by several indicators are important traits in making the growers to choose which variety to cultivate. (DUMBRAVĂ ET AL., 2019).

Wheat is of particular interest for the Romanian growers because it has high ecological plasticity and ensures relative constant yields.

When determining fertilizer doses and the ratio of nutrient elements, the following factors are considered: cultivated variety, genetic type of soil, precursor seed, soil moisture, climatic characteristics of the previous year, interaction between the nutrient elements. (IMBREA, 2013).

Nutrition management is one of the approaches to improve crop yields. Wheat depletes nutrients from the soil, so if it is not properly fertilised, soil fertility starts to decline. Therefore, fertiliser applications are essential to maintain a positive nutrient balance by replacing nutrients that are absorbed and lost during the crops.

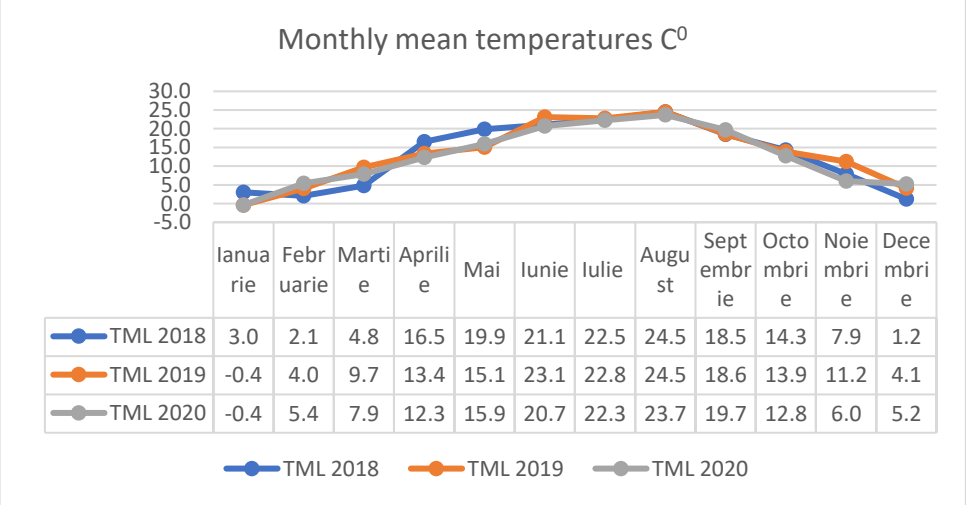
However, increasing nutrient use efficiency is essential to achieve the expected yield using as little fertiliser as possible. Using the right fertiliser in the right amount is one of the most

important management strategies for increasing fertiliser efficiency and maximising crop productivity. Application of synthetic fertilisers in wheat increases the nitrogen, phosphorus and potassium available in the soil. Optimal fertiliser dosage improves wheat yield and fertiliser use

MATERIAL AND METHOD

The research was carried out in the 2019-2020 agricultural year in an experimental field in Timisoara, a two-factor experiment was organized with the following description of the factors: factor A with 5 graduations- PK(a1 - P0K0, control variant; a2 - P40K0; a3 - P80K0; a4 - P40K40; a5 - P80K80 and factor B- nitrogen dose with graduations: b1 - N0, unfertilized control variant; b2 - N30; b3 - N60; b4 - N90; b5 - N120. The biological material cultivated was the Ciprian variety.The technology applied was specific to wheat cultivation. Production results are presented according to the fertilization level for each of the three macroelements. The obtained data were statistically processed using the analysis of variance.

From a climatic point of view, the microzone of the Didactic-Experimental Station is temperate continental moderate, falling within the moderate continental climate, at the interface between the climatic province sector with oceanic influence and the climatic province sector with sub-Mediterranean influences.

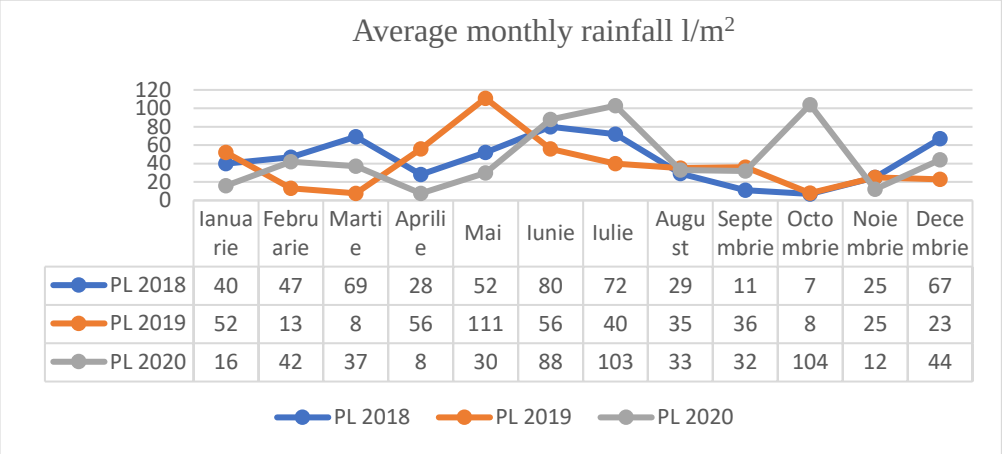


	Ianuarie	Februarie	Martie	Aprilie	Mai	Iunie	Iulie	August	Septembrie	Octombrie	Noiembrie	Decembrie
TML 2018	3.0	2.1	4.8	16.5	19.9	21.1	22.5	24.5	18.5	14.3	7.9	1.2
TML 2019	-0.4	4.0	9.7	13.4	15.1	23.1	22.8	24.5	18.6	13.9	11.2	4.1
TML 2020	-0.4	5.4	7.9	12.3	15.9	20.7	22.3	23.7	19.7	12.8	6.0	5.2

Fig. 1 Mean annual temperature 2018-2020

Source: Timișoara Meteorological Station

The figure above shows the variation of the thermal regime for Timisoara in the period 2018-2020. From Fig.1. it can be seen that, in the analyzed period, in the months of June-July, the highest values were recorded in July 2020, daily values exceeded 32-33 0C, while the monthly average in July was 25.6 0C. it should be noted that, negative monthly values were recorded in January 2019 and 2020.



	Ianuarie	Februarie	Martie	Aprilie	Mai	Iunie	Iulie	August	Septembrie	Octombrie	Noiembrie	Decembrie
PL 2018	40	47	69	28	52	80	72	29	11	7	25	67
PL 2019	52	13	8	56	111	56	40	35	36	8	25	23
PL 2020	16	42	37	8	30	88	103	33	32	104	12	44

Fig. 2 Average annual rainfall, Timișoara 2019-2020

Source: processed data from Timisoara Meteorological Station

Regarding the rainfall regime shown in Figure 2, we can say that the highest rainfall amounts were recorded in autumn 2020, about 180 l/m^2.

RESULTS AND DISCUSSIONS

The nitrogen, phosphorus and potassium from chemical fertilizers, each macro-element, but especially through interaction, contribute to the production per unit area. (MARINESCU, 1984).

The results presented in Table 1. show the influence of N, P and K fertilizers on crop levels in the first year of experimentation. Data processed by analysis of variance shows significance for F-test have the following values: ns p>0.05; * p≤0.05 ; ** p≤0.01;*** p≤0.001; P și K: p< 0.001; N: p< 0.001; interaction PK*N: p< 0.05.

Influence of N, P and K fertilizers on wheat yield (kg/ha) in 2019

Table 1

Significance of N,P and K fertilizer application differences on wheat yield (kg/ha), 2019

Source of variation	SSP [SP]	Degrees of freedom	Weighted sum of squares [s^2]	Test F		semnification
				value	p	
PK	4.436474E+06	4	1.109118E+06	25.75	0.000000	***
N	5.066616E+06	4	1.266654E+06	29.41	0.000000	***
PK*N	1.473010E+06	16	9.206314E+04	2.14	0.014786	*
Error	3.230015E+06	75	4.306686E+04			
Total	14206114.99					

Table 1 shows that, compared to the unfertilised control a1-P0K0, the following yield increases were obtained: by applying the P40K0 dose, the yield increase is significant, with a yield decrease of 151 kg/ha, the wheat yield obtained with the P40K0 dose is lower than the yield obtained with the unfertilised control - P0K0 by 151 kg/ha. (ORMAN, 1980)

At the P80K0 dose level the wheat yield obtained is insignificant, while the two fertilisation levels P40K40 and P80K80 show a very significant increase.

Wheat yield obtained was 4939 kg/ha and 5141 kg/ha, at the two dose levels P40K40 and P80K80 both exceeding the control with a very significant increase: 6% and 10% respectively. The difference in yield was 459 kg/ha and 258 kg/ha respectively compared to the unfertilised variant, differences that were statistically assured as highly significant. (ANDREI, 1995).

Table 2

Influence of phosphorus and potassium fertilization on wheat yield (kg/ha) obtained in 2019

Variant	**Yield**		**Dif.**	**Semnif**
	kg/ha	**%**	**kg/ha**	
V1 – control (unfertilised)P0K0	**4682**	**100**	**mt**	
V2 – fertilised cu P40K0	4531	96.8	-151	0
V3 – fertilised cu P80K0	4773	101.9	91	ns
V4 – fertilised cu P40K40	5141	109.8	459	***
V5 – fertilised cu P80K80	4939	105.5	258	***
DL 5% = 131 kg ; DL 1% = 171 ; DL 0.1% = 225				

From the data presented in table 2 we note that, compared to the N0 control, very significant yield increases were obtained regardless of the nitrogen dose applied. Yield gains varied between 436 - 605 kg/ha.

Each nitrogen dose outperforms the control with gains ranging from 10% - 14%.

Table 3

Influence of nitrogen fertilization on wheat yield (kg/ha) in 2019

Varianta	**Yield**		**Dif.**	**Semnif**
	kg/ha	%		
V1 – control (unfertilized) – N0	4378	100.0	mt	
V2 – fertilized with N30	4814	110.0	436	***
V3 – fertilized with N60	4938	112.8	561	***
V4 – fertilized with N90	4983	113.8	605	***
V5 – fertilized with N120	4952	113.1	574	***
DL 5% = 131 kg ; DL 1% = 171 ; DL 0.1% = 225				

Compared to the non-fertilized **P_0K0N0** variant, on the P0K0 variant, a statistically significant yield increase was obtained, and with the application of N30 -369 kg/ha, the rest of the increases are very significant, exceeding the control with values ranging from 540 at the N60 dose level to 712 kg/ha with the application of N90.

By increasing the phosphorus dose at P40 and by increasing the nitrogen dose at N30, no statistically assured yield increases were obtained. There were also two distinctly significant increases at N60 - 444 kg/ha, N90 - 410 kg/ha and one highly significant increase at the N120 dose level -543 kg/ha.

On the **P80K0** variant, on the unfertilized variant the yield is statistically not assured, the rest of the yields are assured as highly significant, with values ranging from 596 kg/ha-N30 to 763 kg/ha -N120. (MIHOC, 1980)

At the nitrogen dose level, on the **P40K40** variant, very significant yield increases were obtained exceeding the control with values ranging from 557 to 1177 kg/ha, as follows: N0 - 557 kg/ha; N30 -874 kg/ha; N60 -1177 kg/ha; N90 -918 kg/ha; N120 -1054 kg/ha.

By increasing only the dose of **P80K80**, an insignificant yield increase was obtained, the rest of the very significant increases are determined by the nitrogen input which determines increases ranging from 614 kg/ha at the dose level of N120 to 1016 kg/ha at N30.

Note that the maximum yield increase of 1177 kg/ha, compared to the non-fertilized control **P0K0N0**, is obtained with the combination **P40K40N60**

Table 4

Wheat yield results (kg/ha) under fertilizer interaction with P, K and N in 2019

Factor A- N dose	**Factor B - P and K doses**														
	a1-P0K0			**a2-P40K0**			**a3-P80K0**			**a4-P40K40**			**a5-P80K80**		
	Yield	Dif.	Semnf	Yield	Dif.	Semnf	Yield	Dif.	Semnf	Yield	Dif.	Semnf	Yield	Dif.	Semnf
b1 – N0	**4225**	**mt**		4266	42	ns	4212	-13	ns	4782	557	***	4404	179	ns
b2 – N30	4594	369	*	4317	92	ns	4820	596	***	5099	874	***	5241	1016	***
b3 – N60	4764	540	***	4669	444	**	4870	645	***	5401	1177	***	4987	763	***
b4 – N90	4936	712	***	4635	410	**	4973	748	***	5143	918	***	5227	1002	***
b5 – N120	4888	664	***	4768	543	***	4987	763	***	5279	1054	***	4839	614	***
	DL 5% = 292 kg DL 1% = 388 DL 0.1% = 503														

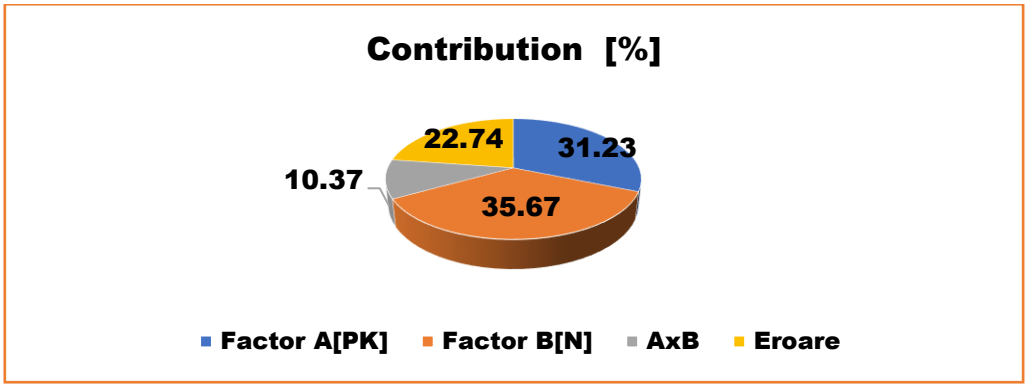


Fig 3. Contribution of P, K and N fertilizer factors and macro-elements interaction

Nitrogen fertilizers contributed 35.7% to wheat yield, phosphorus and potassium fertilizers 31.2% and the interaction of experimental factors of the three macro-elements 10.37%.

CONCLUSIONS

The yield potential of a particular wheat variety is determined by the level of fertilization, a very important technological link that leads wheat growers to choose the optimal fertilization option. (BAGHINSCHI, 1979)

From the analysis of the experimental factors, we can draw the following conclusions:

- application of nitrogen fertilizer doses, N60N90 and N120, resulted in very significant yield increases ranging from 540-712kg/ha, on a variant not fertilized with phosphorus and potassium.
- on P40K0 variant, only at the N120 dose level a very significant difference was recorded, at the other two doses of N60-N90, the differences were statistically assured as distinctly significant.

- by doubling the phosphorus dose P80K0, we obtain very significant yield differences in all variants where nitrogen fertilizers were also applied.
-variants with the highest yield increases statistically assured as very significant are obtained on the P4K40 variant at all four nitrogen doses, also by doubling the doses of phosphorus and potassium also determine very significant yield differences.

The interaction between nitrogen, phosphorus and potassium resulted in a significant increase in yield.

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