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Long-Term Experiences with Fertilizers on Wheat and Maize Crops in the Pedoclimatic Conditions of the Bârlad Plateau

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ABSTRACT

A large number of long-term field experiments demonstrate that optimal application of nitrogen fertilizers to crops did not result in loss of organic matter, nor did it adversely affect soil microbial activity. Optimal use of fertilizers on agricultural crops reduces soil erosion, but repeated application of high doses of nitrogen fertilizer can lead to soil acidification, a negative trait of soil health. The main objective of this paper is to study the particular effect, interaction and complementarity of NP, NPK and organo-mineral fertilizers on the production of agricultural crops. This paper presents production data as well as references that can be used to define the scientific bases of the multi-year application of fertilizers. The experimental technique is specific to the polyfactorial character and the analytical methods used are specific and current in the field.

In this scientific paper, we present the results obtained for the cultivation of wheat and corn, during the period 2018-2023, at the "Mircea Moțoc" Perieni Research-Development Station for Combating Soil Erosion, by fertilizing with several types of organo-mineral fertilizers. The results obtained come from the long-term experiences with fertilizers with 25 variants in the NP experience, respectively 16 variants in the NPK experience and the organo-mineral experience, all being placed according to the block method with parcels subdivided into 6 repetitions. The obtained results were interpreted by analysis of variance. From the results of this long-term experience, it is concluded that the effect of long-term fertilization with NP, NPK and organo-minerals responds to the maximization of profit and the optimization of the soil-plant system and environmental protection.

Keywords: long-term fertilization, erosion, production, organic and mineral fertilizers.

INTRODUCTION

Soil is fundamental to crop production and is a natural resource that provides people with most of their food (Jităreanu et al., 2007; Ailincăi et al., 2011).

However, it is finite and fragile and requires special care and preservation so that it can be used indefinitely by future generations.

Doran and Parkin (1994) defined soil quality or health as its ability to function within ecosystem and land-use boundaries, support biological productivity, maintain environmental quality, and promote plant and animal health.

The concept of integrated mineral fertilizer and organic manure management became the mainstay of soil fertility management practices in the early 20th century as it strives to maintain/improve soil fertility and health for sustained crop productivity long-term.

Nitrogen is one of the most important essential nutrients for plants and is required by them in relatively large amounts (Alcoz et al., 1993; Barraclough et al., 2010).

Successful nitrogen management can optimize crop yields, improve profitability and minimize nitrogen losses.

Long-term agronomic experiments involving fertilizer application in different agro-ecological zones around the world can be used to generate information along these lines. In an attempt to reduce the cost of cultivation and maintain and/or improve soil health, conservation farming systems are being adopted in many parts of the world

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(Cociu, 2012). In these systems, the soil is minimally tilled and crop residues are retained in the soil to help build up organic matter, therefore the soil quality parameters are improved (Petcu et al., 2022; Burtan et al., 2023). It is necessary to establish appropriate fertilizer management strategies in such systems so that soil health is maintained or improved.

"Long-term experiences with fertilizers" took off in 1966-1967 at the initiative of acad. Cristian Hera who, in collaboration with Z. Borlan and a group of researchers, designed and placed a unique set of long-term experiences with fertilizers.

The long-term experiences with fertilizers, at SCDCES "Mircea Moțoc" Perieni, are structured and have the same objectives as the other long-term experiences in Romania, their specificity being determined by the conditions of the sloping lands subject to degradation through erosion.

The future challenge is to manage fertilizers and soil so that not only food demands are continuously met, but also that the soil remains healthy to support adequate food production with minimal environmental impact (Bucur et al., 2011; Cârlan et al., 1994).

The purpose of this work is, in addition to obtaining competitive productions, and the need to conserve the soil, that is why all the measures that lead to the reduction of the phenomenon of erosion below the admissible limits and the improvement of their fertility are used in the complex.

MATERIAL AND METHODS

Location of the research area

The long-term experiences with fertilizers and those regarding the rotation of crops and fertilizers on the production and fertility of the soil, are carried out in the perimeter of the Research and Development Station for Combating Soil Erosion "Mircea Moțoc" Perieni. Perieni Commune is located in the Tutovei Hills within the Bârladului Plateau, Vaslui County, Romania.

The experiments were located on the left and right slopes of Valea Țărnii (latitude - 46°18" and longitude - 27°37") at the altitude of 223 m, on a typical cambic chernozem, with a loamy-clay texture, with a slope of 12-13%, the exposure of the slope east, affected by moderate erosion.

Climatic aspects

The values of the meteorological elements (temperatures, precipitation) indicate the presence of a temperate-continental climate of excessive nuance, with hot, dry summers and cold winters. The data used were recorded both at the Bârlad and Perieni weather stations.

Rainfall

More than 47% of the annual volume of precipitation falls in the critical season of erosion, which explains the high values that erosion registers in the Bârlad Plateau. Also, about 18% of the annual volume of precipitation occurs when the soil is bare, freshly tilled and easily erodible. The analysis of the annual amounts of rain recorded between 1941-2023 reveals a cyclical tendency of about 40 years, in which the rainy interval alternates with the dry one, the multiannual average being 487.5 mm. Starting from 1985, the drought phenomenon was reinstated, tending to continue even today (Figure 1).

Temperature

The average annual temperature varies between 8.0°C and 13.0°C. Analysis of monthly values from 1941-2023 reveals a multi-year average of 10.1°C (Figure 2).

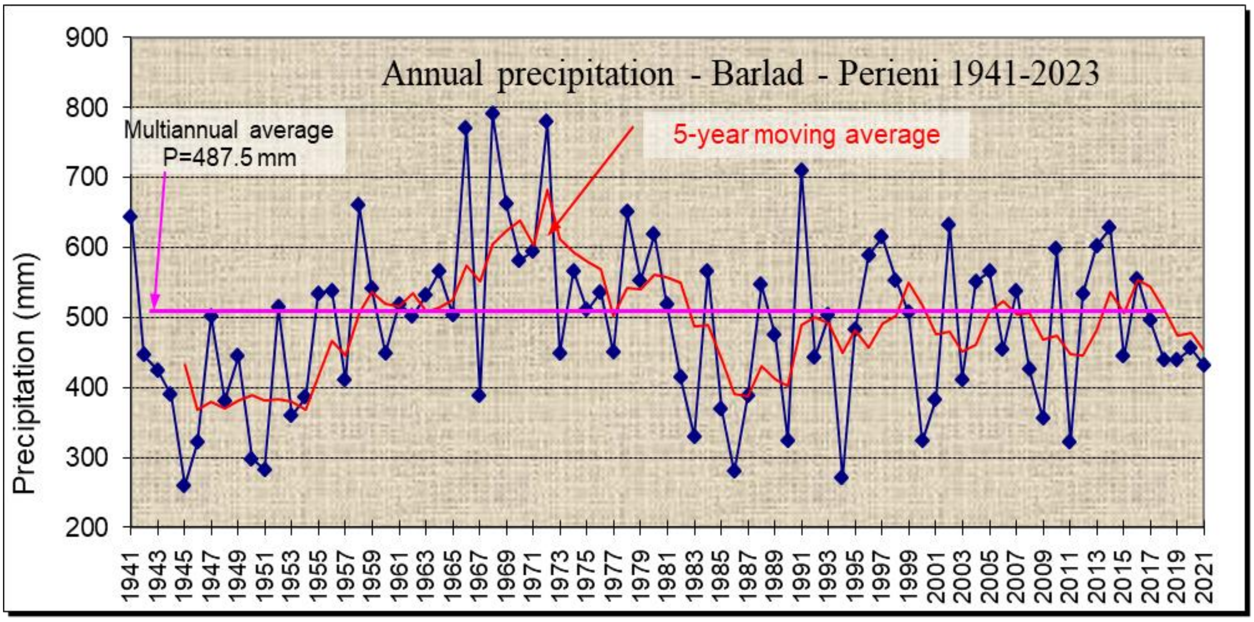

Figure 1. Distribution of multiannual average precipitation in the period 1941-2023

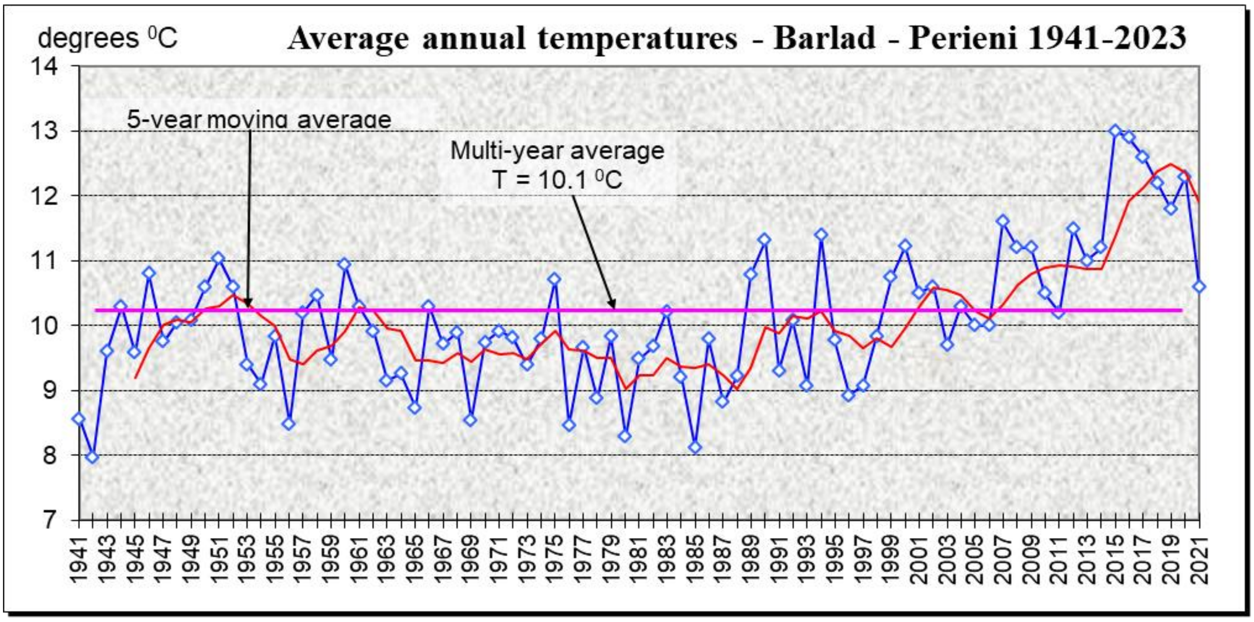

Figure 2. Distribution of multiannual mean temperatures in the period 1941-2023

The experiences have a stationary character and were executed in the rotation: wheat - corn. The polyfactorial experiment placed in the field was carried out according to the method of two-factor storied blocks, of the 6x5 type in the NP experiment, respectively 6x4 in the NPK experiment and in the NPG experiment, in six repetitions. 25 variants arranged according to the simple grid method, in six repetitions, were studied. The size of one variant is 12 m × 4 m.

Fertilizers were applied in autumn under plowing and in the spring in vegetation to wheat and to the preparation of the germinal bed to corn. Chemical fertilizers were administered annually to both crops. Manure was incorporated into the soil under basic plowing once every 5 years. Manure was used both alone and in combination with mineral fertilizers (NP), compared to mineral fertilizers used alone and unfertilized control plots.

The experience with nitrogen and phosphorus doses (NP) has the following fertilization options:

Factors A and B with 5 graduations:

$A_1 – P_0$; $B_1 – N_0$;
$A_2 – P_{40}$; $B_2 – N_{40}$;
$A_3 – P_{80}$; $B_3 – N_{80}$;
$A_4 – P_{120}$; $B_4 – N_{120}$;
$A_5 – P_{160}$; $B_5 – N_{160}$.

The experiment with doses of nitrogen, phosphorus and potassium (NPK) has the following variants:

Factors A and B with 4 graduations:

$A_1 – N_0P_0$; $B_1 – K_0$;
$A_2 – N_{100}P_0$; $B_2 – K_{50}$;
$A_3 – N_0P_{100}$; $B_3 – K_{100}$;
$A_4 – N_{100}P_{100}$; $B_4 – K_{150}$.

The experiment with doses of nitrogen, phosphorus and manure (NPG) has the following variants:

Factors A and B with 4 graduations:

$A_1 – N_0P_0$; $B_1 – G_0$;
$A_2 – N_0P_{50}$; $B_2 – G_{20}$;
$A_3 – N_{50}N_{50}$; $B_3 – G_{40}$;
$A_4 – N_{100}P_{100}$; $B_4 – G_{60}$.

RESULTS AND DISCUSSION

The present study follows the evolution over time of wheat and corn production in the period 2018-2023 at SCDCES “Mircea Moțoc” Perieni in the long-term experiences with fertilizers.

Long-term effect of NP (nitrogen-phosphorus) fertilization on wheat crop

The superiority of wheat production achieved by using nitrogen is natural, considering that nitrogen represents the “pivot of fertilization”, the decisive factor in increasing wheat yields, and phosphorus has a smaller effect (Năstasă et al., 2000; Năstasă and Filiche, 2002).

Tabel 1. Wheat production medium centralizer - NP fertilization - years 2019-2023

Agro-fund A	Agro-fund b	2019	2020	2021	2022	2023	Media	%
A1(P0)	**b1(N0)**	2366	1260	2968	942	3062	2120	100
	b2(N40)	3238	1565	2679	1241	3269	2399	113
	b3(N80)	3777	1537	3282	1324	3463	**2677**	**126**
	b4(N120)	3504	1403	3035	1348	3339	2526	119
	b5(N160)	3536	1380	3596	1256	3223	2598	123
A2(P40)	b1(N0)	2468	1254	3790	1014	2571	2219	105
	b2(N40)	2842	1523	3608	1335	3471	2556	121
	b3(N80)	4107	1459	3347	1583	3374	2774	131
	b4(N120)	4369	1459	3079	1557	3541	2801	132
	b5(N160)	4319	1383	3433	1663	3275	**2815**	**133**
A3(P80)	**b1(N0)**	2745	1408	3799	1154	2905	2402	113
	b2(N40)	4140	1521	2835	1465	3939	2780	131
	b3(N80)	4394	1755	2952	1747	3584	**2886**	**136**
	b4(N120)	4124	1480	3059	1448	3144	2651	125
	b5(N160)	4859	1380	2983	1541	3302	2813	133
A4(P120)	b1(N0)	3558	1377	3027	1004	2755	2344	111
	b2(N40)	3411	1726	3325	1485	3701	2730	129
	b3(N80)	3784	1674	3391	1843	3574	2853	135
	b4(N120)	4875	1505	3366	1632	3337	**2943**	**139**
	b5(N160)	4265	1433	2730	1681	3319	2686	127
A5(P160)	**b1(N0)**	2615	1271	3239	1174	3675	2395	113
	b2(N40)	3232	1595	2933	1669	3914	2668	126
	b3(N80)	3967	1469	2710	1699	3269	2623	124
	b4(N120)	4325	1407	3197	1561	3593	**2817**	**133**
	b5(N160)	4412	1298	2977	1492	3462	2728	129

In the case of the cultivation of wheat after corn, the priority role of nitrogen is significantly recorded, with production increases of 600-700 kg/ha, so with levels of production and differences predominantly higher than those due to phosphorus, but it is also obvious the complementary contribution of phosphorus which supports the efficiency of the N doses applied, even progressively with a better utilization of it in accordance with the applied doses. The production differences due to the increase in N doses (0-160 kg) are 300-400 kg/ha and with the increase in P doses (0-160 kg) the production differences are 600-700 kg/ha (Table 1).

Long-term effect of NP (nitrogen-phosphorus) fertilization on maize crop

Maize is one of the most important crops worldwide and in Romania it holds a top position among cultivated cereals (Năstasă et al., 1999). Usually if we analyze the surface of total cultivated cereals in Romania, maize area overcomes 50% (Dragomir et al., 2022).

In the context of the influence of years, the yield differences due to nitrogen application are unanimously superior, having the highest statistical significance, with a wide range of yield differences from 350-573 kg grains/ha. Therefore, nitrogen, as in other crops, is the determining element of production and the pivot of fertilization (Neamțu, 1985). And in the case of increases due to the application of N, they tend to decrease with the increase of the applied dose (Popa et al., 1984).

In the corn crop, in 2022, production was affected by the low volume of precipitation, registering only 295.4 mm/year.

The reciprocity of nitrogen-phosphorus interaction works in achieving the productive effects of fertilization with superior statistical significance essentially due to nitrogen doses over those of phosphorus, obviously understanding that a higher level of phosphorus coverage significantly potentiates the effect of applying nitrogen doses (Constantinescu et al., 2023). It is clearly highlighted that the increase and continuity of phosphate fertilization, in soils initially deficient in P, as the supply of this element improves, supports and increases the level of corn production, ensures the effect of potentiating the results of nitrogen fertilization (Table 2).

Table 2. Centralizer average corn production - NP fertilization - years 2018-2023

Agro-fund A	Agro-fund b	2018	2019	2020	2021	2023	Average	%
A1(P0)	**b1(N0)**	1596	3137	2262	7014	2165	3235	100
	b2(N40)	1701	4001	2716	7110	1931	3492	108
	b3(N80)	1945	4089	2897	7448	2662	**3808**	**118**
	b4(N120)	1928	4251	2897	7587	1895	3712	115
	b5(N160)	1902	4130	2811	7434	2473	3750	**116**
A2(P40)	b1(N0)	1859	3130	2572	6437	1878	3175	**98**
	b2(N40)	1704	3896	2641	7606	1348	3439	**106**
	b3(N80)	1913	4335	2912	7269	1645	3615	**112**
	b4(N120)	2050	4332	2994	7489	1639	3701	**114**
	b5(N160)	2055	4360	3052	7642	1829	**3788**	**117**
A3(P80)	**b1(N0)**	1404	3030	2102	6598	2353	3097	**96**
	b2(N40)	1937	4106	2928	7359	2180	3702	**114**
	b3(N80)	1942	4354	2989	6971	2314	**3714**	**115**
	b4(N120)	1910	4399	3019	6852	2368	3710	**115**
	b5(N160)	1915	4217	2923	6820	2369	3649	**113**
A4(P120)	b1(N0)	1571	2961	2202	6217	2260	3042	**94**
	b2(N40)	1596	3321	2425	6400	2088	3166	**98**
	b3(N80)	1836	4214	2781	6935	1866	3526	**109**
	b4(N120)	1911	4318	2932	7071	2206	3687	**114**
	b5(N160)	1783	3986	2765	7003	2327	3573	**110**
A5(P160)	**b1(N0)**	1512	3222	2309	6910	2050	3200	**99**
	b2(N40)	1573	3149	2353	6894	2017	3197	**99**
	b3(N80)	1775	4188	2793	6546	2033	3467	**107**
	b4(N120)	1808	4075	2803	6902	2233	**3564**	**110**
	b5(N160)	1796	4183	2811	6493	1744	3405	**105**

The increase in production obtained compared to the non-fertilized control, 2943 kg/ha (139%), demonstrates the significant effect of nitrogen and phosphorus fertilization on wheat production (2019-2023).

The productions achieved in the corn culture, compared to the level of the experimental control, represent 99-118% of its level with almost minimal increases, in many situations of fertilization the differences have minimal significance (Figure 3).

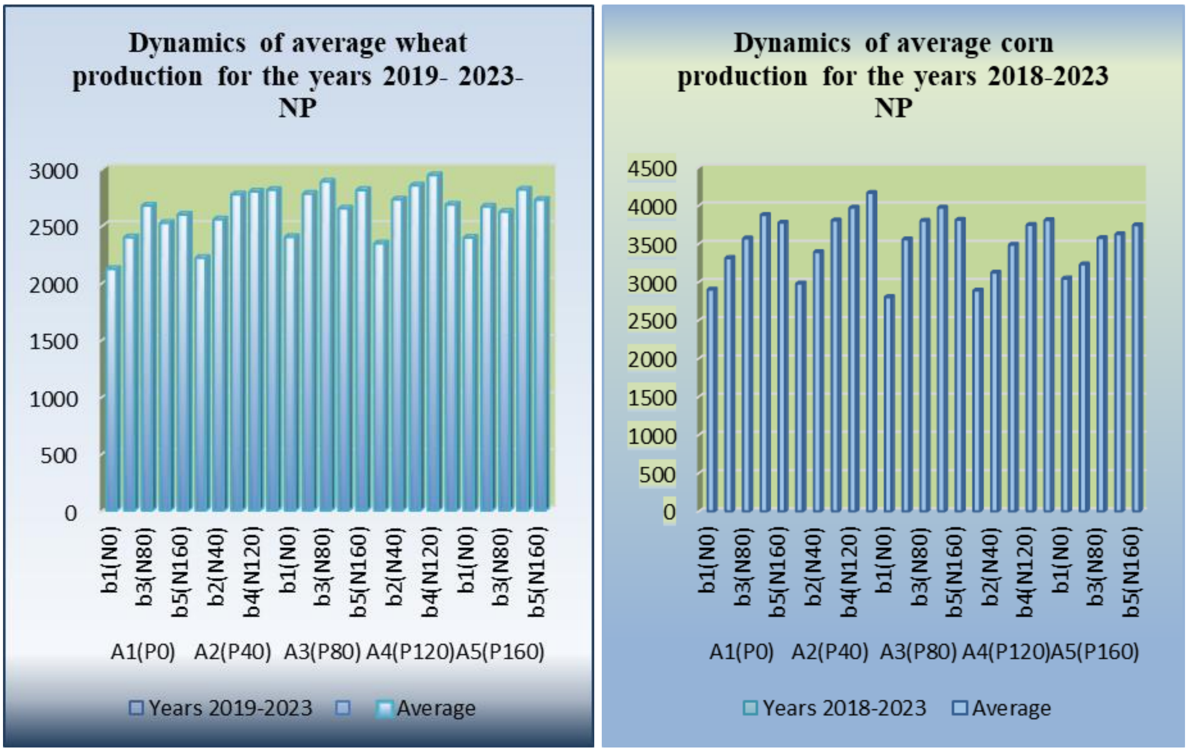

Figure 3. Production dynamics of wheat (2019-2023) and corn (2018-2023) NP fertilization

Long-term effect of NPK (nitrogen-phosphorus-potassium) fertilization on wheat crop

Merca et al. (2021) states that most crops have, in the context of NPK, the highest specific consumptions of K, more than N and much more than P, with the exception of legumes and some fodder crops and grasses from the spontaneous flora where N consumption prevails.

Grain cereals respond to the basic application (NPK) of the presence and potassium, with balanced growth, healthy plants, resistant to breakage and good quality (including ripening). They have consumption equal to that of N and higher than P (Merca et al., 2021).

Applied together, nitrogen and phosphorus through the effect of complementarity and mutual support, phosphorus potentiating the action of nitrogen, increases in the productions obtained are noted, but at increased doses, a slight reduction is noted (Nistor and Nistor, 1979).

In the long-term experience with NPK fertilization, the 2023 wheat crop was a disaster and the processed data are from the years 2018-2022.

According to the data in Table 3, the difference in production recorded for the variant fertilized with N100P100K150 is very significant, being 53% higher than the non-fertilized variant.

Table 3. Wheat production medium centralizer - NPK fertilization - years 2018-2022

Agro-fund A	Agro-fund b	2018	2019	2020	2021	2022	Average	%
A1(N0P0)	b1(K0)	853	2057	1141	3556	1110	1743	100
	b2(K50)	891	2043	1258	3591	1021	1761	101
	b3(K100)	929	2034	1118	3506	1083	1734	99
	b4(K150)	862	2024	1211	3537	1286	**1784**	**102**
A2(N100P0)	**b1(K0)**	1205	1963	1484	3114	1515	1856	108
	b2(K50)	1354	1933	1609	3359	1460	1943	111
	b3(K100)	1319	2800	1592	3202	1479	**2078**	**119**
	b4(K150)	1293	2261	1813	3231	1435	2007	115
A3(N0P100)	b1(K0)	973	3661	1277	3996	1143	2210	127
	b2(K50)	902	3448	1459	3854	1212	2175	125
	b3(K100)	954	3844	1246	3527	1221	2158	124
	b4(K150)	939	4019	1399	4029	1137	**2305**	**132**
A4(N100P100)	**b1(K0)**	**1329**	**4418**	**2073**	**3269**	**2055**	2629	152
	b2(K50)	**1414**	**4316**	**2034**	**3380**	**2032**	2635	151
	b3(K100)	**1436**	**3252**	**1997**	**3070**	**1965**	2344	134
	b4(K150)	**1358**	**4319**	**1856**	**3388**	**2382**	**2660**	**153**

The long-term effect of NPK (nitrogen-phosphorus-potassium) fertilization on maize crop

Maize is a crop with efficiency in the application of NPK (basic) and with support for the phase application (including localized) of some varieties with N and complexes in whose efficiency the presence of potassium is essential (Merca et al., 2021).

In the corn crop, in 2022, production was affected by the low volume of precipitation, registering only 295.4 mm/year.

Potassium applied to the corn crop influences yield differences that increase with increasing doses. According to the data in table 4, regarding the doses of potassium, on the effect of nitrogen and phosphorus on grain production in the corn crop, only by applying N100P100K150 was there a yield difference of 651 kg, statistically assured as very significantly superior followed by N100P100K100 (614 kg) and N100P0K100 (606 kg) both with significantly higher statistical assurance (Table 4).

Table 4. Centralizer average corn production - NPK fertilization - years 2018-2023

Agro-fund A	Agro-fund b	2018	2019	2020	2021	2023	Average	%
A1(N0P0)	b1(K0)	1390	1196	1174	2909	1522	1638	100
	b2(K50)	1532	909	1191	3179	1560	1674	102
	b3(K100)	1599	1105	1313	3069	1546	**1726**	**105**
	b4(K150)	1208	987	1056	2729	1312	1458	89
A2(N100P0)	**b1(K0)**	1340	2448	1611	3897	1447	2149	131
	b2(K50)	1382	2357	1559	4048	1384	2146	131
	b3(K100)	1512	2454	1677	4100	1480	**2244**	**137**
	b4(K150)	1393	2564	1642	3751	1531	2176	133
A3(N0P100)	b1(K0)	1738	1160	1296	3848	1522	1913	117
	b2(K50)	1622	1121	1268	3220	1410	1728	105
	b3(K100)	1981	1143	1329	3254	1638	**1869**	**114**
	b4(K150)	1510	1218	1231	3532	1518	1802	110
A4(N100P100)	**b1(K0)**	**1763**	**2164**	**1617**	**3884**	**1564**	2199	134
	b2(K50)	**1560**	**2057**	**1464**	**3385**	**1451**	1983	121
	b3(K100)	**1789**	**2271**	**1628**	**3833**	**1738**	2252	137
	b4(K150)	**1910**	**2212**	**1704**	**3867**	**1755**	**2289**	**140**

The highest production increases, in the wheat crop, due to the influence of potassium on the effect of nitrogen and phosphorus doses, were 53% (2660 kg/ha at N100P100K150) higher than the variants to which potassium was not applied. Compared to the variants not fertilized with potassium, the production differences were statistically significantly higher when applying K150/N0P0 and distinctly higher when applying N80P40 and N160P80 doses.

The influence of the doses of potassium on the effects of those of nitrogen and phosphorus was less, statistically ensured production differences being recorded when applying the doses of N100P100K50 of 892 kg/ha significantly higher and N100P100K150 of 917 kg/ha distinctly significantly higher than the unfertilized control.

At the maize crop, the influence of potassium determined the achievement of very significantly higher production differences than the control by applying N100P100K100 (Figure 4).

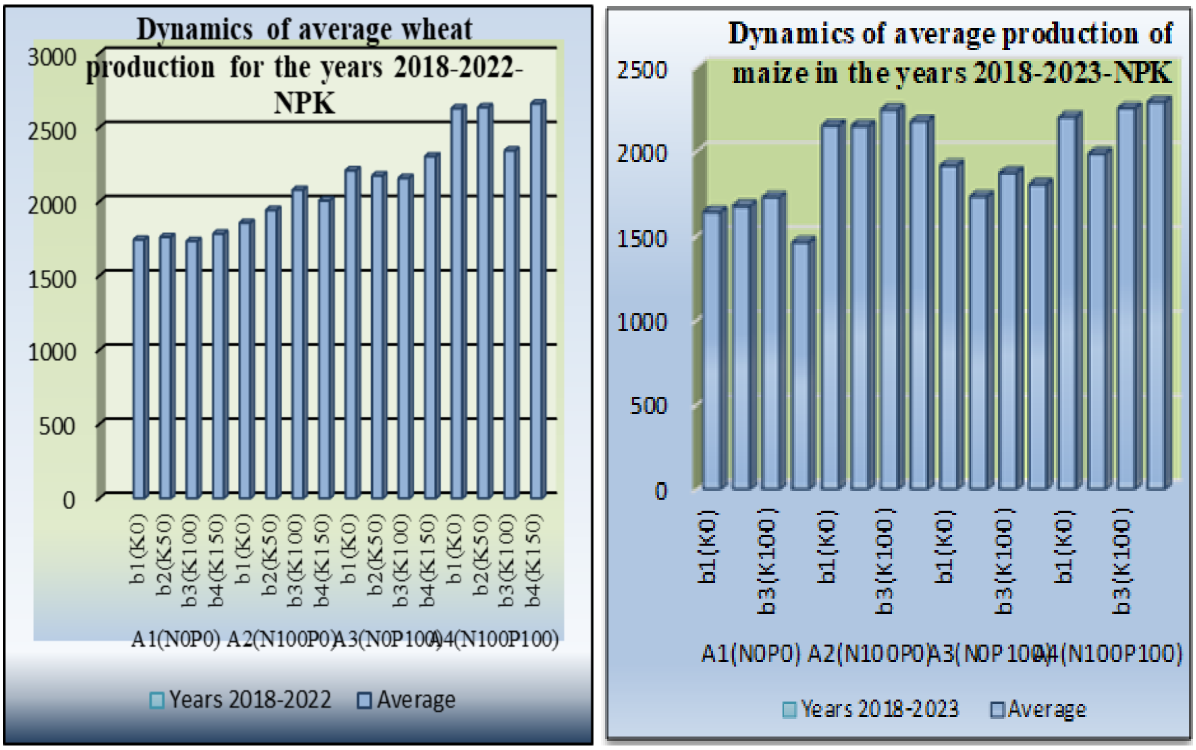

Figure 4. Dynamics of wheat and corn production for the years 2018-2023 - fertilization with NPK

The long-term effect of NPG (nitrogen-phosphorus-manure) fertilization on wheat crop

The effect of manure fertilization is maintained for up to 3-5 years and through its slow action, a significant amount of nutrients needed during the entire vegetation period is ensured (Bilsborrow et al., 2013). The application of manure simultaneously with mineral fertilizers ensures both the immediate needs of nutrients in the soil and the needs in the longer term (Moțoc, 1975).

In the long-term experience with NPG fertilization, the wheat crop of 2023 was calamity and the data processed are from the years 2018-2022.

Table 5. Average wheat production centralizer - NPG fertilization - years 2018-2022

Agro-fund A	Agro-fund b	2018	2019	2020	2021	2022	Average	%
A1(N0P0)	**b1(G0)**	1406	1922	1292	2979	2539	2028	100
	b2(G20)	1484	1870	1323	3828	3350	2371	117
	b3(G40)	1507	1957	1503	3803	3193	2393	118
	b4(G60)	1779	2119	1563	3743	3504	**2542**	**125**
A2(N0P50)	**b1(G0)**	1428	1928	1388	3817	3110	2334	115
	b2(G20)	1588	1795	1328	3968	3130	2362	116
	b3(G40)	1785	2449	1404	4229	3219	**2617**	**129**
	b4(G60)	1706	1969	1342	4343	3452	2562	126
A3(N50P50)	**b1(G0)**	2390	3143	1432	4277	3393	2927	144
	b2(G20)	2602	3174	1424	4215	3293	**2942**	**145**
	b3(G40)	2591	3332	1507	3849	2989	2853	141
	b4(G60)	2581	3326	1253	3914	3065	2828	139
A4(N100P100)	**b1(G0)**	3393	3746	1362	4198	3680	3276	162
	b2(G20)	3372	3868	1250	4327	3587	**3281**	**162**
	b3(G40)	3430	3335	1310	3974	3367	3083	152
	b4(G60)	3577	3546	1295	3889	3327	3127	**154**

According to the data in Table 5, in the experimental years, the production increases recorded in the wheat crop fluctuate, the most considerable increases are found in the case of the N100P100G20 variant, where a production increase of 1253 kg/ha was recorded.

The long-term effect of fertilization with organo-mineral fertilizers on maize crop

In the corn crop, in 2022, production was affected by the low volume of precipitation, registering only 295.4 mm/year.

Table 6. Centralizer average corn production - NPG fertilization - years 2018-2023

Agro-fund A	Agro-fund b	2018	2019	2020	2021	2023	Average	%
A1(N0P0)	**b1(G0)**	1707	1233	1415	4579	2523	2291	100
	b2(G20)	1861	1711	1616	4461	2463	**2423**	**106**
	b3(G40)	2003	1656	1700	4144	2548	2410	105
	b4(G60)	1564	1175	1307	4407	2347	2160	94
A2(N0P50)	**b1(G0)**	1701	1347	1434	5057	2268	2362	103
	b2(G20)	1761	1279	1448	5540	2180	**2442**	**107**
	b3(G40)	1819	1234	1489	4890	1910	2268	99
	b4(G60)	1726	1248	1432	5069	2134	2322	101
A3(N50P50)	**b1(G0)**	2095	2070	1859	4474	2081	2516	110
	b2(G20)	2167	1989	1883	4304	2232	**2515**	**110**
	b3(G40)	2106	1948	1840	4194	1995	2416	105
	b4(G60)	1819	1684	1591	4333	2142	2314	101
A4(N100P100)	**b1(G0)**	**2230**	**2554**	**2056**	**4833**	2231	2781	121
	b2(G20)	**2050**	**2066**	**1833**	**4865**	2296	2622	114
	b3(G40)	**2162**	**2395**	**1975**	**4973**	2121	2725	119
	b4(G60)	**2229**	**2598**	**2067**	**5253**	2183	**2866**	**125**

Due to the supply of nutrients and the improvement of organic matter in the soil, following the application of manure, a decrease in the need for nitrogen fertilizers is obtained (Table 6).

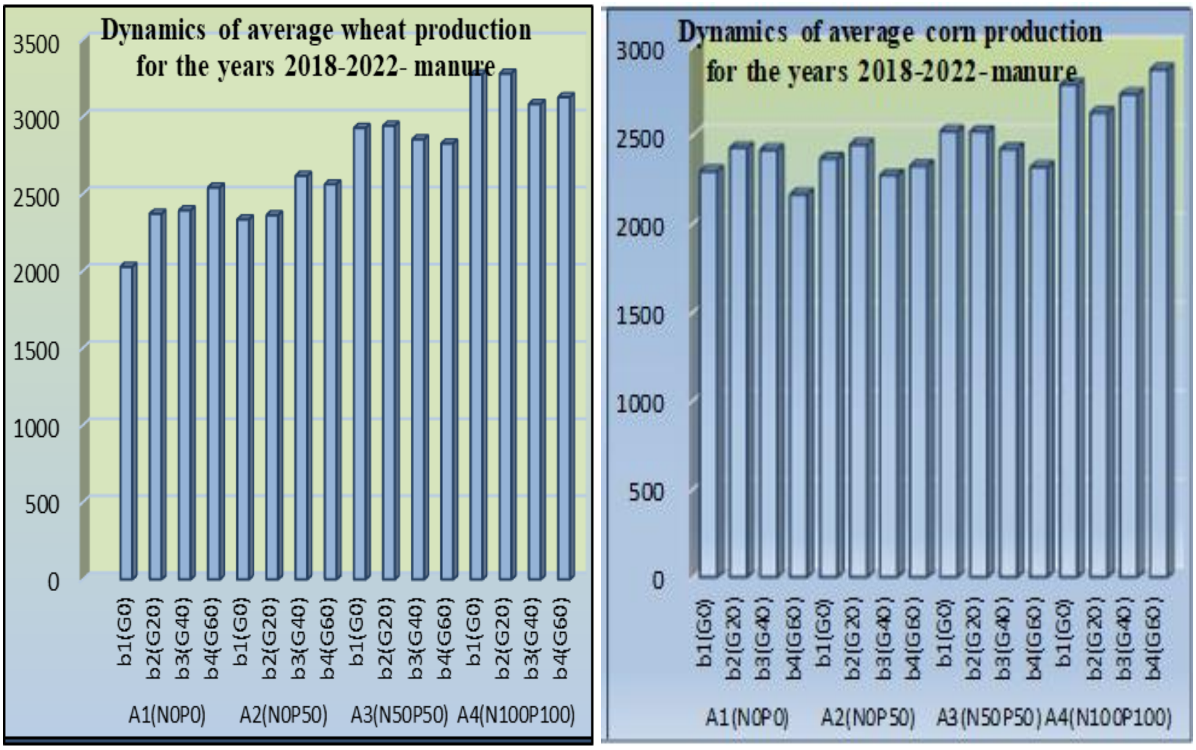

Figure 5. Dynamics of wheat and corn production for the years 2018-2023 - organic fertilization

In the five experimental years, the wheat crop obtained superior production differences compared to the unfertilized variant between 914 (N50P50G20) - 1253 (N100P100G20) kg/ha. The highest increase in production was obtained in the fertilization variant in which the dose of manure was 20 tons/ha, which is 1253 kg/ha significantly higher than the manure.

In corn, higher yields were obtained when a dose of 60 t/ha of manure was applied, and in the variants where the manure was applied in combination with mineral fertilizers, significantly higher yields were obtained with 500-600 kg/ha compared to of witness (Figure 5).

CONCLUSIONS

The results obtained highlight the fact that the combined use of both fertilizer and manure has been shown to be superior in terms of crop productivity, soil health and economic profitability.

The type and rate of fertilization have a strong influence on wheat and maize, yield components and quality characteristics of yields. However, as other authors have found, crop growth, yield and quality traits are mainly dependent on environmental conditions. In fact, significant second- and third-order interactions were found, confirming the year-to-year variations for wheat and maize production. This variability may be due to changes in the amount and distribution of precipitation over the growing seasons.

The influence of climatic conditions (temperature and precipitation) on the production of wheat and corn in years with drought in autumn or excessive amounts of precipitation in spring-summer, is manifested by large variations and limitations in the level of harvests.

Analyzing the results on the production of the two crops, from the last 5 years, it can be stated that the best productions are obtained with the N100P100G20 variants, but even so, most productions have fluctuated annually due to climate changes, the lack of precipitation during the growing season, as well as other factors.

Application of nitrogen, phosphorus and manure in wheat cultivation after maize (2-year rotation) yield increases of 900-1200 kg/ha.

Regarding the evolution of soil fertility under the impact of fertilization, it is useful to focus on the „sustainability" of the conditions - that is, high productions with the maintenance of the balance of the soil-plant system and the favorable evolution of soil productivity and fertility.

These results are corroborated by previous reports of other long-term experiments where the occurrence of multi-nutrient deficiencies led to a decrease in yield over time, and the provision of different nutrients in adequate amounts helped to achieve yield stability.

Thus, our study indicates that the integrated use of organic matter and fertilizers can support higher crop productivity.

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