THE EFFECT OF NITROGEN AND PHOSPHORUS FERTILIZERS ON THE MAIZE YIELD UNDER THE CLIMATE AND SOIL CONDITIONS FROM LOVRIN IN THE PERIOD 2016-2019

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Abstract. *The increase, improvement and stability of agricultural production and therefore of food security in all agricultural areas (tropical, subtropical, temperate, etc.), is achieved by cultivating certain plants, creating optimal vegetation conditions for them through well-defined elements of technology, starting from the fundamental idea that man must cooperate with the environment, to consciously become a protector of it. Given these considerations and starting from the fact that there are relations of a varied and complex reciprocity between the properties of the soil and the main cultivated species, this paper presents, based on studies conducted during three experimentation years, within the theme "**Research on pedoclimatic and anthropogenic factors that condition land productivity from the Low Plain of Banat**" and carried out during doctoral school, several aspects regarding the physical-geographical characteristics illustrated by the maize yields on a typical Chernozem soil, slightly gleyic, epicalcaric, medium clay loam/medium clay loam from the research field in Lovrin. Given these aspects regarding the existence of risks due to various manifestations of natural factors or irrational human interventions, in this paper the authors try to transfer descriptive theoretical activities to analytical activities that provide practical solutions for the use of nitrogen and phosphorus fertilizers on the maize crop. The importance of the research topic derives from the fact that the soil/land properties are differentiated in the territory, due to the variation of pedogenesis factors and conditions, as well as to the fact that in the plant production system the productive potential of the soil is combined with the applied human labour, integrated by plants in the biomass production.*

Keywords*: fertilizers, harvest, maize, soil, climate*

INTRODUCTION

There are complex and reciprocal relationships that can be established between the main properties of the soil and the cultivated species. Thus, soil properties can exert a decisive influence in terms of root system development, mineral nutrition, ensuring the aerohydric and thermal regime necessary for the development of the main physiological processes, while plants and phytocenoses, in their turn, act both directly and indirectly on the state of soil fertility.

In order to determine the complex relationships that are established between the different properties of the soil, a series of researches were carried out, both in Romania and around the world, which found several causalities in relation to their differentiated contribution on land productivity (Berbecel et al., 1979, Borcean et al., 1992, 1996, 2006, David et al., 2003, 2018, Matei et al., 2014, Niță et al., 2018, Pîrșan et al., 2006, Roman et al., 2011, Rogobete et al., 1997, Teaci, 1980, Țărău et al., 2018). Between these properties and the geomorphological-hydrological ones there are interrelations that determine the level of yields up to the limit given by the "climate-envelope", characteristic of different pedoclimatic areas (Teaci 1980).

Taking these considerations into account, based on the research conducted during the doctoral school, we present here some aspects regarding the influence of nitrogen and phosphorus fertilizers on the maize production, under the specific natural conditions from the Low Plain of Banat and the features of the area as elements that define the current and potential level of yields.

MATERIAL AND METHOD

The researches regarding the ecopedological conditions were conducted in accordance with the "Methodology of Elaboration of Pedological Studies" (vol I, II, III) elaborated by ICPA Bucharest in 1987, completed with specific elements from the Romanian Soil Taxonomy System (SRTS-2003/2012), as well as other updated normative acts (MADR Order 278/2011).

The analyzes and other determinations were performed in the ***physico-chemical analysis laboratory "O.S.P.A-U.S.A.M.V.B.T"***, *Faculty of Agriculture, BUASVM Timişoara*, at 1**19, Calea Aradului, accredited by RENAR** according to STAS SR EN ISO/CEI 17025, through the **accreditation certificate no. LI 1001/2013**.

The experiments were placed on a typical Chernozem soil, slightly gleyic, epicalcaric, medium clay loam/medium clay loam in the area of Lovrin, dominant within the *Galaţca Plain (Pesac-Lovrin-Teremia)* and with a large area in the Low Plain of Banat.

The field research was started in the fall of 2016 (4.10.2016) when phosphorus fertilizers (triple superphosphate 46%) were administered for the 4 supply levels (P_{40}, P_{80}, P_{120}, P_{160}).

The experiments were bifactorial of type 5 x 5 with the plots subdivided in 4 repetitions (100 plots), the experimental factors being (table 1):

Table 1

Doses of nitrogen and phosphorus fertilizers

Maize	
Factor A	**Factor B**
Nitrogen	**Phosphorus**
a_1- 0 kg/ha	b_1- 0 kg/ha
a_2– 50 kg/ha	b_2 – 40 kg/ha
a_3– 100 kg/ha	b_3 – 80 kg/ha
a_4– 150 kg/ha	b_4 – 120 kg/ha
a_5– 200 kg/ha	b_5 – 160 kg/ha

Nitrogen fertilizers were applied in fractions: 50% when sowing and 50% on the second plowing, aspects that are found along with other elements in the technical data box.

The precursor plant was the autumn wheat.

The research material used in the experimental years was the P303-Pioneer hybrid.

Technological elements, with some small exceptions (date of sowing, fertilizer administration, harvesting, etc.) are the same.

In order to achieve the proposed objectives, observations and measurements were made, both in the experimental field and in laboratory analyzes.

The processing and interpretation of these experimental results was done by statistical analysis of variants, developed by Fischer in 1923, described and explained by Săulescu N. A. and Săulescu N. N., 1967, the statistical calculation being performed using a computer (PC).

RESULTS AND DISCUSSIONS

Field research was started in the autumn of 2016 when phosphorus fertilizers (superphosphate 46%) were administered for the 5 supply levels (P_0, P_{40}, P_{80}, P_{120}, P_{160}), and continued in the spring of 2017 with the establishment of the maize crop, and then in the agricultural year 2017-2018, respectively 2018-2019.

The experiments were placed on a typical Chernozem soil, slightly glayic, epicalcaric, medium clay loam/medium clay loam, dominant within the *Galaţca Plain (Pesac-Lovrin-Teremia)* and representative for a large area in the Low Plain of Banat, being part of the Mureş Plain located south of its current course.

From the morphogenetic study of the soil profile and from the research of the sheets with analytical measurements (table 2) results that it presents the following micromorphological characteristics, namely the microstructure of the Am horizon is predominantly spongy generated by an intense fauna (earthworms, mesofauna) and biological (roots) activity.

The morphological and micromorphological properties of the soil indicate a developmental stage characteristic of soils from the cernisols class, having the profile of the type Ap-Atp-Am-AC - Cca.

Among the chemical properties that influence the composition and way of life of ecosystems and that have a significant role on soil fertility the more important are: reaction, calcium carbonate content, humus content, nutrient supply, etc.

The reaction of the soil (ind. 63, M.E.S.P.-1987) has some specific features, pH values oscillating within the norms, for the parent materials in the area, indicating a slightly alkaline reaction (7.3-8.4) in the range of 20-100 cm, respectively moderately alkaline (8.5-9.0) between 100 -130 cm and strongly alkaline (9.1-9.4) between 130-200 cm.

Lower pH values in the processed layer (pH = 6.60 slightly acidic) indicate a slight debasification.

Table 2

Physico-mechanical, hydro-physical and chemical characteristics of the typical Chernozem, slightly gleyic, epicalcaric medium clay-loam/medium clay-loam from Lovrin

HORIZONS	UM	Ap	Atp	Amk	ACk	Cca	$Ccag_1$	$Ccag_2$-ac	$Ccag_3$ ac
Depths	cm	20	38	56	75	100	130	150	200
Interval for U%	cm	0-10	-25	-50	+75	-100	-125		
Gross sand (2.0 – 0.2 mm)	%	2.9	2.2	2.2	1.6	1.3	1.6	1.2	0.6
Fine sand (0.2 – 0.02)	%	30.7	33.7	33.8	33.1	37.6	28.9	28.2	28.6
Dust (I + II) (0.02-0.002 mm)	%	31.1	30.8	28.3	29.8	30.8	31.8	35.4	38.3
Colloidal clay (under 0.002)	%	35.3	33.3	35.8	35.5	30.3	37.7	35.2	32.5
Physical clay (dust II +colloidal clay)	%	54.6	54.3	48.3	48.8	44.3	41.1	41.3	
TEXTURE		TT	TT	TT	TT	LL	TT	TP	TP
Specific density (Ds)	g/cm^3	2.43	2.44	2.47	2.49	2.52	2.55		
Apparent density (Da)	g/cm^3	1.35	1.44	1.21	1.18	1.19	1.46		
Total porosity (Pt)	%	45.00	40.00	51.00	52.00	52.00	42.00		
Aeration porosity (Pa)	%	10.69	-3.57	20.88	22.03	24.87	-9.72		
Compaction ratio (Cr)	%	13.31	18.69	-0.32	-4.12	-1.67	16.49		
Hygroscopicity coefficient (HC)	%	8.79	8.50	8.48	8.33	7.17	6.73		
Wilting coefficient (WC)	%	13.18	12.75	12.72	12.50	10.76	10.10		
Field capacity (FC)	%	25.90	25.30	24.90	25.40	22.80	22.11		
Total capacity (TC)	%	33.83	27.77	42.14	44.06	43.69	28.76		
Useful water capacity (UC)	%	12.75	12.55	12.18	12.90	12.04	12.01		
pH in water		6.60	7.28	7.95	8.05	8.40	8.90	9.32	9.30
Carbonates ($CaCO_3$)	%	-	0.47	4.06	9.80	18.60	21.50	20.20	19.60
Humus	%	3.55	3.35	3.30	2.70	1.05			
Nitrogen indicator (IN)		3.07	3.35	3.30	2.70	1.50			
Humus reserve (50)	to/ha	90,45	86,63	47,92	225,00				
Mobile P	ppm	75.7	50.5	38.7	8.7	7.0			
Mobile K	ppm	205	160	160	132	115			
T	me/100g				24.4	23.5	15.2	20.2	25.7
Na	me/100g					0.21	1.10	1.37	1.32
Na% T	%					0.90	5.14	7.68	6.84
Salts	mg/100g				74.3	88.8	145.9	148.5	159.1
Degree of saturation in bases (V)	%	80.6	100	100	100	100	100	100	100

The calcium carbonate content (ind. 61, MESP-1987) has low values (<1%) in the range of 20-38 cm, after which it gradually increases to depth reaching the maximum value (21.50%) in the carbonate-accumulative horizon (Ccag1 = 100-130cm).

The degree of saturation in bases (ind.69, M.E.S.P.-1987) is a very important indicator for characterizing soils with specific values for each type of soil, in the case of the researched profile its values place the soil in the class of soils saturated in bases.

The *humus content* (*ind.70*, M.E.S.P.-1987), namely in the organic matter by its constitutive characteristics and by its dynamics in the soil and at its surface, represents one of the fundamental features that defines the fertility state of soils.

The humus content of the researched profile shows medium values between 0-20 cm, small on the interval 20-56cm and very small between 56-100cm.

The extension on a large thickness of the humus within the soil profile determines a humus reserve in the first 50 cm (ind. 144, M.E.S.P.-1987), very large, namely 225.00 t / ha.

As the quality of humus depends primarily on the reaction state, namely the saturation of the soil in bases, a so-called nitrogen index (IN) has been developed in the form of the product between the humus content and the saturation in bases, both expressed in percentages.

This indicator could be used directly in research, namely in determining the influence of the essential chemical properties of the soil regarding the food supply and the reaction state of the soil.

The value of the nitrogen index (ind 142, MESP-1987) of 3.07 in the processed layer Ap (0-20 cm), as well as in the underlying horizons (Atp = 3.35 Am = 3.30) indicates a state of nitrogen supply medium to good.

The content of soil in P_2O_5 and K_2O, as the main nutrient macro-elements, determines together with its other properties its potential and real level of fertility, at a certain moment.

Regarding the phosphorus content (ind.72, MESP-1987) of the researched profile, it shows values that indicate a very high content (over 72 ppm) in the processed layer Ap (0-20cm), high (37-72 ppm), between 20-56 cm, after which a sudden decrease can be observed, at a very low content.

The potassium content (ind. 73, MESP-1987) is found in the soil in quantities that indicate a high content (201-300 ppm) in the processed layer Ap (0-20cm), medium (131-200 ppm) between 20-75 cm , after which it decreases to a small content.

Data recorded at Lovrin Station were used to **characterize the climatic conditions** specific to the agricultural years **in the period 2016-2019**.

The climate is temperate continental with Mediterranean influences, the average multiannual temperature being 10.9ºC (table 3) and the average multiannual precipitation is 521.4 mm (table 4) at the LOVRIN Meteorological Station.

Table 3

Average monthly, annual (2016-2019)
and multiannual temperatures in the period 1946-2019 (mm)

Agricultural year	monthly												Annual
	IX	**X**	**XI**	**XII**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
16-17	18.8	11.6	6.2	3.1	-5.3	3.2	9.4	10.9	16.9	22.1	28.9	24.1	12.5
17-18	17.7	12.5	6.5	2.9	5.3	0.8	3,6	16,5	19,9	21,9	22.3	24.7	12.8
18-19	18.3	15.1	7.8	1,0	-0.4	4.6	9	13.4	15.1	22.3	21.6	23.9	12.7
normal	**17.9**	**11.3**	**5.4**	**1.5**	**-1.2**	**0.8**	**5.5**	**11.0**	**16.6**	**19.7**	**21.6**	**21.7**	**10.9**

Deviations

Agricultural year	monthly												Annual
	IX	**X**	**XI**	**XII**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
16-17	+2	-0.4	+1	+1.7	-4.1	+2.4	+4.2	+0.2	+0.3	+2.3	+6.7	+2.4	+1.6
17-18	+0.9	+1.4	+1	+1.9	+6.4	0	-1.6	+5.8	+3.6	+2.1	+0.1	+3	+2.1
18-19	+1.5	+3.9	+2.3	-0.1	+0.7	+3.8	+3.7	+2.7	-1.2	+2.5	-0.6	+2.2	+1.8

Table 4

Average monthly, annual (2016-2019)
and multiannual rainfall in the period 1946-2017 (mm)

Agricultural year	monthly												Annual
	IX	**X**	**XI**	**XII**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
16--17	48,0	112,0	37,0	3,0	20,0	25,0	30,0	54,0	29,0	40,0	30,0	22.5	450.5
17-18	34.0	32.0	35.0	16.0	53.0	58.0	86,0	40,0	50,0	152,0	85.0	58.0	698.0
18-19	29,0	10,0	21,0	41,0	58,0	15,0	15,0	34,0	92,0	88,0	55,0	18,0	476.0
normal	42.7	40.6	48.2	40.1	32,0	29.4	32.6	42.9	56.8	67.8	55.8	32.5	521.4

Deviations

Agricultural year	monthly												Annual
	IX	**X**	**XI**	**XII**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
16-17	+5.3	+71.4	-11.2	-37.1	-12.0	-4.4	-2.6	+11.1	-27.8	-27.8	-25.8	-10.0	-70.9
17-18	-8.6	-10.5	-13.0	-23.7	+21.0	+28.6	+53,4	-2,9	-6,8	+84,2	+29.2	+25.5	+176.6
18-19	-13,7	-30,6	-27,2	+0,9	+26,0	-14,4	-17,6	- 8,9	+35,2	+20,2	-0,8	-14,5	-45,4

From the presented data, it results that in terms of temperatures there was an increase in temperature by 1.6ºC in the agricultural year 2016-2017, 2.1ºC in the agricultural year 2017-2018 and 1.8ºC in the agricultural year 2018-2019, and in terms of rainfall it can be seen that compared to the multiannual average there was a deficit of 70.9 mm in the agricultural year 2016-2017, 45.4 mm in the agricultural year 2018-2019 and a surplus of rainfall in the agricultural year 2016-2017 (the more pronounced surplus 84.2 mm being recorded in June).

In order to evaluate the impact of meteorological conditions on land productivity, the recorded data were compared with the significance of precipitation amounts (reference limits in relation to agricultural requirements, table 5), using data from the Timiş County Agroclimatic Resources (Berbecel, 1979).

Table 5

Significance of precipitation amounts
(reference limits in relation to agricultural requirements)

Period	Significance of precipitation amounts				
	Very dry	Dry	Satisfactory	Optimal	Surplus
September-October	Under 40	41-60	61-80	81-150	Over 150
November-March	Under 100	101-150	151-200	201-300	Over 300
April	Under 20	21-30	31-40	41-70	Over 70
May-July	Under 100	101-150	151-200	201-300	Over 300
Annual	Under 350	351-450	451-600	601-700	Over 700

Table 6

Significance of precipitation amounts in relation to agricultural requirements
in the period 2016-2017

Characteristic periods										
Agricultural year	IX-X	Significance	XI-III	Significance	IV	Significance	V-VII	Significance	Annual	Significance
16-17	160,0	surplus	115,0	dry	54,0	satisfactory	99,0	very dry	450,5	dry
17-18	66,0	satisfactory	248,0	optimal	40,0	very dry	180.4	satisfactory	698.0	optimal
18-19	39.0	very dry	150.0	dry	34,0	satisfactory	253.0	optimal	476,0	satisfactory
normala	83,3	optimal	182,3	satisfactory	42,9	optimal	180,4	satisfactory	521,4	satisfactory

From the analysis of the data regarding the pluviometric regime, from the agricultural year 2016-2017, it results that as a whole it was a dry year (table 6), the quantities of water from precipitations registering surplus values in the period September-October (table 6). In the rest of the months, values were registered below the multiannual averages, and the agricultural year 2017-2018 as a whole was a year in which the precipitation quantities registered optimal values, while the agricultural year 2018-2019 as a whole is characterized by satisfactory values.

The multiannual rainfall values of 521.4 mm frame the researched area within the limit of satisfactory values. In September-October the precipitations register optimal values, being followed by November-March with satisfactory values. In April, optimal values are registered, and in May-July the values are satisfactory.

Regarding the level of registered yields, they presented different values in the mentioned period, as it results from the presented data (table 7-9).

Table 7

The effect of nitrogen and phosphorus fertilizers
on maize (hybrid P303-Pioneer) on a typical Chernozem soil in the agricultural year 2016-2017

Variant	Average yield kg/ha	Difference kg/ha	%	Significance
N_0 P_0	**4809**	-	100	
N_{50} P_0	5255	445	109	
N_{100} P_0	5772	963	120	***
N_{150} P_0	5868	1059	122	***
N_{200} P_0	5937	1128	123	***
N_0 P_{40}	4960	150	103	
N_{50} P_{40}	**5790**	981	120	***
N_{100} P_{40}	5857	1048	122	***
N_{150} P_{40}	6213	1403	129	***
N_{200} P_{40}	6315	1506	131	***
N_0 P_{80}	4978	169	104	
N_{50} P_{80}	5480	671	114	*
N_{100} P_{80}	6293	1484	131	***
N_{150} P_{80}	6590	1781	137	***
N_{200} P_{80}	**6652**	1842	138	***
N_0 P_{120}	4912	103	102	
N_{50} P_{120}	5845	1036	122	***
N_{100} P_{120}	6375	1565	133	***
N_{150} P_{120}	6506	1697	135	***
N_{200} P_{120}	6535	1726	136	***
N_0 P_{160}	4585	-224	95	
N_{50} P_{160}	5882	1073	122	***
N_{100} P_{160}	6202	1393	129	***
N_{150} P_{160}	6399	1590	133	***
N_{200} P_{160}	6550	1740	136	***

		AxB	BxA
DL	5%	253,6	256,1
	1%	337,2	342,7
	0.1%	438,7	450,6

In the **agricultural year 2016-2017** the yield was between 4809 and 6652 kg/ha (table 7), at the control variant (unfertilized N_0 P_0) obtaining a production of 4809 kg/ha. The maximum yield was achieved at the variant $N_{200\ 80,}$ namely 6652 kg/ha.

The unilateral phosphorus fertilization determined a yield between 4960 and 4916 kg/ha. Nitrogen applied alone brought yields between 5255 and 5937 kg/ha.

The joint application of nitrogen and phosphorus fertilizers led to yields of 5790 and 6652 kg/ha, recording yield increases between 981 and 1842 kg/ha.

Compared to the **control N_0P_0**, very significant increases were obtained in almost all cultivated variants, except for the N_{50} P_{80} variant in which a significant increase was registered, and in the variants $N_{50}P_0$, N_0 P_{40}, N_0 P_{80}, N_0 P_{120}, N_0 P_{160} the registered increases were not statistically ensured.

In the **agricultural year 2017-2018**, at the control variant (unfertilized N_0 P_0) a yield of 9137 kg/ha was obtained (table 8).

Table 8

The effect of nitrogen and phosphorus fertilizers
on maize (P303 - Pioneer) on a typical Chernozem soil in the agricultural year 2017-2018

Variant	Average yield kg/ha	Difference kg/ha	%	Significance
N_0 P_0	**9137**	-	100	
N_{50} P_0	12250	3113	134	***
N_{100} P_0	12399	3262	136	***
N_{150} P_0	12587	3451	138	***
N_{200} P_0	12061	2925	132	***
N_0 P_{40}	***8655***	- 481	95	
N_{50} P_{40}	10133	996	111	
N_{100} P_{40}	10659	1523	117	*
N_{150} P_{40}	11917	2781	130	***
N_{200} P_{40}	11788	2652	129	***
N_0 P_{80}	9642	506	106	
N_{50} P_{80}	11664	2528	128	***
N_{100} P_{80}	12304	3167	135	***
N_{150} P_{80}	12576	3439	138	***
N_{200} P_{80}	**13209**	4072	145	***
N_0 P_{120}	***9317***	181	102	
N_{50} P_{120}	10683	1547	117	*
N_{100} P_{120}	10808	1671	118	*
N_{150} P_{120}	11723	2587	128	***
N_{200} P_{120}	11758	2622	129	***
N_0 P_{160}	8591	-546	94	
N_{50} P_{160}	10672	1536	117	*
N_{100} P_{160}	11112	1975	122	**
N_{150} P_{160}	12338	3202	135	***
N_{200} P_{160}	11742	2605	129	***

	AxB	BxA
DL 5%	1420	1480
1%	1901	1968
0.1%	2500	2560

The maximum yield was obtained at variant $N_{200}P_{80,}$ namely 13209 kg/ha.

The unilateral phosphorus fertilization determined the production of yields between 8655 and 9317 kg/ha (P_{40}-P_{120}). When the nitrogen was applied alone, the yields were 12250 and 12587 kg/ha (N50-N150).

The joint application of nitrogen and phosphorus fertilizers resulted in yields of 10133 (N_{50} P_{40}) and 13209 kg/ha, recording yield increases between 996 and 4072 kg/ha.

Compared to the **control N_0P_0**, very significant increases were obtained in almost all variants (in 14 of the 25 variants). The exception was variant N_{100} P_{160} in which a distinctive significant and significant increase was registered in variants N_{100} P_{40}, N_{50} P_{120}, N_{100} P_{120}, N_{50} P_{160}, while in variants N_0P_0, N_{50} P_{40}, N_0 P_{80}, N_0 P_{120}, N_0 P_{160} the increases registered were not provided statistically (situation similar to that of the agricultural year 2016-2017).

In the **agricultural year 2018-2019** for the control variant (unfertilized N_0 P_0) a yield of 7825 kg/ha was obtained (table 9).

Table 9

The effect of nitrogen and phosphorus fertilizers
on maize (P303 - Pioneer) on a typical Chernozem soil in the agricultural year 2018-2019

Variant	Average yield kg/ha	Difference kg/ha	%	Significance
N_0 P_0	***7825***	-	100	-
N_{50} P_0	9450	1625	121	*
N_{100} P_0	10325	2500	132	**
N_{150} P_0	11900	4075	152	***
N_{200} P_0	13075	5250	167	***
N_0 P_{40}	***7975***	150	102	-
N_{50} P_{40}	**9125**	1300	117	-
N_{100} P_{40}	10275	2450	131	**
N_{150} P_{40}	12475	4650	159	***
N_{200} P_{40}	12300	4475	157	***
N_0 P_{80}	9075	1250	116	-
N_{50} P_{80}	10525	2700	135	***
N_{100} P_{80}	11150	3325	143	***
N_{150} P_{80}	12675	4850	162	***
N_{200} P_{80}	**12950**	5125	166	***
N_0 P_{120}	8875	1050	113	-
N_{50} P_{120}	**9575**	1750	122	*
N_{100} P_{120}	10925	3100	140	***
N_{150} P_{120}	12650	4825	162	***
N_{200} P_{120}	12775	4950	163	***
N_0 P_{160}	9450	1625	121	*
N_{50} P_{160}	9475	1650	121	*
N_{100} P_{160}	11025	3200	141	***
N_{150} P_{160}	12300	4475	157	***
N_{200} P_{160}	12775	4950	163	***

	AxB	BxA
DL 5%	1422	1470
1%	1891	1980
0.1%	2460	2631

The unilateral phosphorus fertilization determined yields of 7975 and 9575 kg/ha (N_0 P_{40} – N_0 P_{120}). Unilaterally applied nitrogen achieved yields between 9450 and 13075 kg/ha (N_{50}-N_{200}).

The combined application of nitrogen and phosphorus fertilizers resulted in yields of 9125 (N_{50} P_{40}) and 12950 kg/ha (N200P80), with yield increases between 1300 and 5125 kg/ha.

Compared to the **control N_0P_0**, very significant increases were obtained in almost all variants (in 14 of the 25 variants), except for the variants N_{100} P_0, N_{100} P_{40} in which there was a distinctive significant and significant increase in the variants N_0 P_{160}, N_{50} P_{160} while for the variants N_0 P_{40}, N_{50} P_{40} N_0 P_{80}, N_0 P_{120} the registered increases were not statistically ensured (situation similar to that of the agricultural year 2016-2017, respectively 2017-2018).

CONCLUSIONS

The area where the research and the experiments were carried out is part of the Mureş-Bega Interfluvium, part of the Mureş Plain.

The origin of the plain is attributed to the great Pleistocene Delta of the Mureş, which flowed here towards the Pannonian Lake at the beginning of the Quaternary.

The macroclimatic features of the researched area are determined by its geographical position, which is specific to a certain circulation of air masses of various types.

The plain from the Mureş-Bega interfluvium lies at the interference of the air masses with oceanic nuances of western origin, and of those with continental aspect of eastern origin, suffering in addition the invasion of warm southern air masses that cross the Mediterranean Sea.

The climate is temperate continental with Mediterranean influences. The average multiannual temperature is 10.9°C, and the average multiannual rainfall is 521.4 mm.

Regarding the rainfall in the periosd 2016-2019, it can be seen that compared to the multiannual average there was a deficit of 70.9 mm in the agricultural year 2016-2017, while the rainfall recorded in the agricultural year 2017-2018 exceeded the multiannual average by 176 mm.

Climatic conditions influenced the level of yields recorded for **maize** (control variant N_0 P_0) from **4809 kg/ha** in the first year, to **9137 kg/ha** in the following year.

The agricultural year 2018-2019 as a whole is characterized by satisfactory values of precipitation, with a deficit of 45.4 mm compared to the multiannual average, fact illustrated by the level of yields of 7825 kg/ha (control variant N_0 P_0).

The lowest level of all experimental years was in the agricultural year 2016-2017.

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