RESEARCH REGARDING THE EVOLUTION OF SOME AGROCHEMICAL INDEXES IN LONG TERM EXPERIMENTS WITH CHEMICAL FERTILIZERS

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Abstract

Since 1968, in Romania was set up a stationary long term field experiments with fertilizers and lime in all the Agricultural Research Stations that belong to Agricultural Research and Development Institute of Fundulea.

The experiments was set up using a unitary scheme for researching the evolution of soil fertility and the influence of fertilizers and lime rates and combinations on level and quality yield of different crops.

The preluvosoil from North – West part of Romania is a medium provide with the main nutritive elements, with a weak acid reaction in the ploughing horizon.

In this paper are presented the results regarding the influence of potassium fertilizers applied on different NP background on main agrochemical indexes and on winter wheat yield and quality in long term field experiment set up in 1974 at Agricultural Research and Development Station Oradea.

Keywords: long term field experiments, potassium, soil agrochemical indexes

INTRODUCTION

In Romania acid ploughing soils are spread on 2.0 millions ha which represent 20% from total agricultural land.

The factors which have a negative influence on growing plants are: high level soil content in the H^+ and Al^{3+}, Fe^+ and Mn^+ and low level soil content in main nutrients (Lăcătuşu, 2006), low activity of microorganisms (Samuel A.D., 2009a), and stagnation of water because of unsatisfactory infiltration (Domuţa et. al., 2008).

Many researches on preluvosoil (Ciobanu and Nagy, 1986; Ciobanu, 2007 and 2008; Nemeth, 1996; Samuel A.D., 2009b) have shown the negative effect of long-term application of nitrogen, as ammonium nitrate, on soil reaction. Soil's high acidity leads to growth of mobile aluminium and manganese soil content, which can determine phytotoxicity in the first part of vegetative period, with negative influence on yield and its quality (Ciobanu, 2002).

In connection with potassium fertilizers applied in long term field experiments there are a few published research data (Hera et. al., 2007).

This paper presents the results regarding the influence of potassium fertilizers applied on different NP backgrounds in long term field experiments on main agrochemical indexes and on winter wheat yield and its quality.

MATERIAL AND METHODS

Experimental site

The research data was obtained at the Agricultural Research and Development Station Oradea, using a unique design in all research network of Research Institute Fundulea.

The investigation has been carried out beginning with the autumn of 1974 in Oradea, in a flat plain area on the third terrace of the Crisul Repede River, whose geographical coordinates are: $21^0$56' Eastern longitude, $47^0$03' Northern latitude and 136 m altitude.

The solidification rock consists of clay loam. The ground water is located at a depth of 6-8 m, the soil is a brown one with horizon disposition; the main physical and chemical characteristics are shown in table 1. The presence of clay migration, B horizon is to be noticed on the thickness of the soil profile, with high and very high values of the bulk density and compaction level and low or very low total porosity and hydraulic conductivity.

The soil reaction is acid in the ploughing A horizon, then slightly acid. The lack of $CaCO_3$ in the soil profile is underlined. The mobile Al content in the A horizon may cause poor growth of some crops (clover). The soil is well provided with mobile potassium and phosphorus. The soil humus medium content may not cause distortions to the neutronic determination of the soil moisture. (*Table 1*)

Table 1

The main properties of the preluvosoil from Oradea – Romania

Soil depth cm	Sand	Silt	Clay	OC	Humus %	Ca CO_3 %	Al mobile mg/100g soil	pH 1:2 H_2O	N Total %	P mobile ppm	Kmobile ppm
0 - 5	43,5	28,3	28,2	1,25	2.32	0.00	3.68	6,3	0.12	21.8	83.0
5 - 15	41,8	28,4	29,8	1,12	2.28	0.00	2.32	6,4	0.11	22.7	102.1
15 - 30	40,0	28,5	31,5	1,02	1.91	0.00	0.52	6,3	0.09	5.7	112.1
30 - 60	32,0	28,0	40,0	0,99	1.93	0.00	0.77	6,6	0.09	6.1	117.9
60 - 90	24,1	36,7	39,2	0,29		0.00	0.32	6,6			
90 - 150	35,1	27,3	37,6	0,17		0.00	0.59	6,5			

Field experiment with potassium fertilizers was set up in 1974 using a crop rotation: pea – winter wheat – maize – sunflower.

The factors researched were the potassium and NP rates applied:

a. potassium rate : K_0, K_{40}, K_{80}, K_{120}
b. NP rates: N_0P_0; $N_{80}P_{40}$; $N_{80}P_{80}$; $N_{160}P_{80}$. (N was apllied like ammonium nitrate, in spring, P was aplied like superphosphate and K like KCl in autumn).

The crop rotation used in the field experiments was sunflower - wheat - corn - wheat. In the field experiment the influence of fertilizers applied on wheat kernels yield was determined and a statistical interpretation of the yield differences obtained between different treatements was made.

Sampling and analytical method

Soil samples from top soil (0-20cm) were collected from each experiment plot, in august 2008, after wheat harvesting.

All samples were taken to the laboratory and used for routine soil chemical analysis, pH was determined in water suspension.

RESULTS AND DISCUSSION

Influence of potassium application on preluvosoil reaction

Data presented in Fig. 1 show that in the case of all NP backgrounds application of potassium fertilizers determine decreasing of pH values. Even the main factor of pH decreasing is nitrogen application, is obvious negative effect on reaction values of potassium application. Decreasing of pH values is depending by potassium rate applied and by the level of NP background used.

In the case of N_0P_0 background the pH values are decreasing from 6.1 to 5.5 and in the case of $N_{200}P_{80}$ background the pH values are decreasing from 5.1 to 4.4.

The high rates of potassium fertilizers lead to pH values modification and this can increase the maximum yield level in the case of some crops sensitivity at soil reaction.

Influence of potassium fertilizers on preluvosoil humus (%) content

The application of potassium fertilizers on different NP backgrounds had a differentiate influence on humus level content depending on K rates used and NP backgrounds.

It's obviously that the highest values of soil humus content were determined in $N_{100}P_{80}$ backgrounds in the variants fertilized with K_{40} and K_{80}. In this variants were registered the highest level of yield and a high quantity of roots and remaining plants which determined the increasing of soil humus content (Fig. 2).

It is noticed that in the variants fertilized with higher rates of K (K_{120}), it was registered a lower level of humus content because of the negative effect of lower Ph values on this agrochemical indexes.

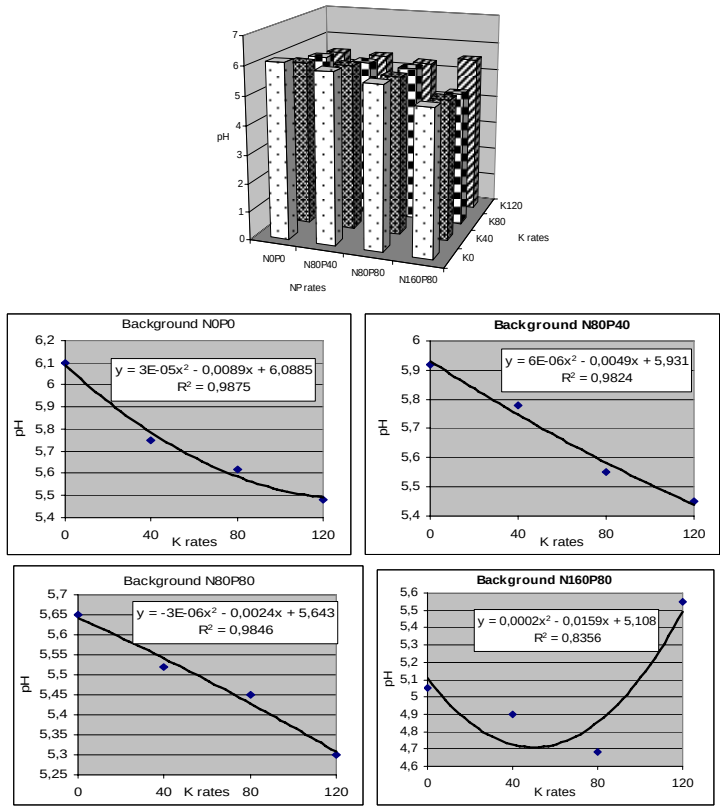

Fig. 1. The influence of the KxNP fertilizers applied in long term field experiments on the reaction of the preluvosoil from Oradea

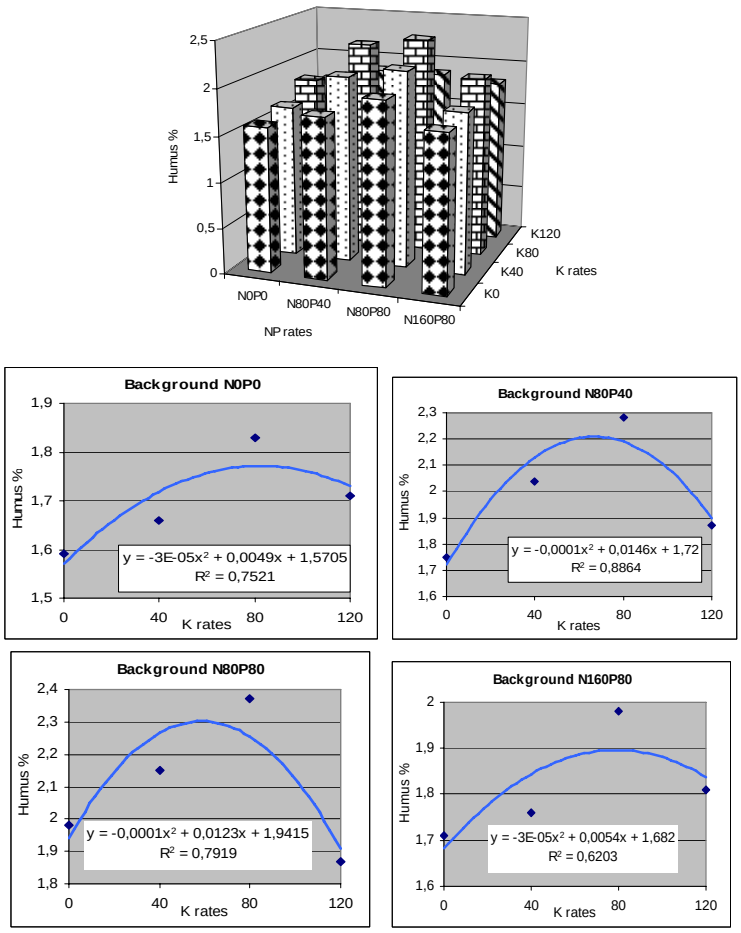

Fig. 2. The influence of the KxNP fertilizers applied in long term field experiments on humus (%) content on the preluvosoil from Oradea

Influence of potassium fertilizers on mobile phosphorus content

The main mobile phosphorus content depends on P and N rates used, the higher level of P was determined in the case of $N_{100}P_{80}$ background. The increasing of N rates to N_{200} (in the case of N_{200} background) determined a decreasing of soil mobile phosphorus level content because of increasing of soil acidity and mobile aluminum content which immobilized a part of phosphorus fertilizers in an inaccessible forms.

In the case of $N_{100}P_{40}$ and $N_{100}P_{80}$ backgrounds it is noticed a slow positive influence of potassium fertilizers used on soil mobile phosphorus content and registered an increase of 20-22 ppm in the case of K_{40} and K_{80} rates used (Fig. 3).

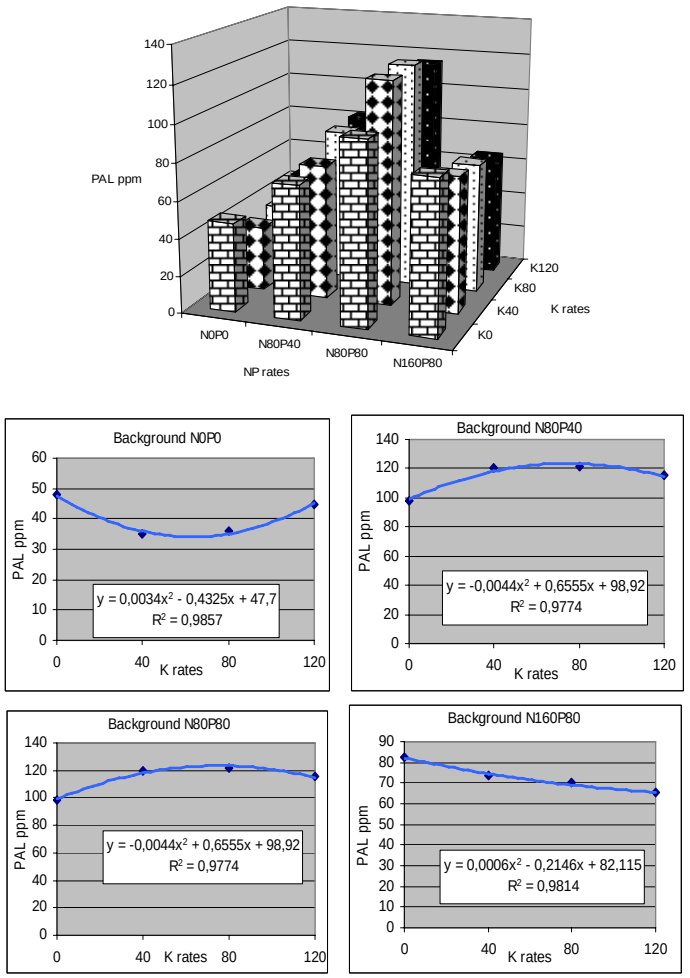

Fig. 3. The influence of the KxNP fertilizers applied in long term field experiments on mobile phosphorus content on the preluvosoil from Oradea

The influence of potassium fertilizers on preluvosoil mobile potassium content

The higher rates of N and P fertilizers applied in absence of K application, determined the increase of mobile potassium content because of supplementary export of K^+ cations and a higher level of yields.

In all of the NP backgrounds which used the application of K fertilizers, determined a decrease of mobile potassium content proportional to rates applied.

Obviously a decreased of mobile potassium content (80- 110 ppm) was registered on N_0P_0 and $N_{160}P_{40}$ backgrounds and in the $N_{100}P_{40}$ and $N_{200}P_{80}$ backgrounds was registered a decrease by 60-80 ppm (Fig. 4).

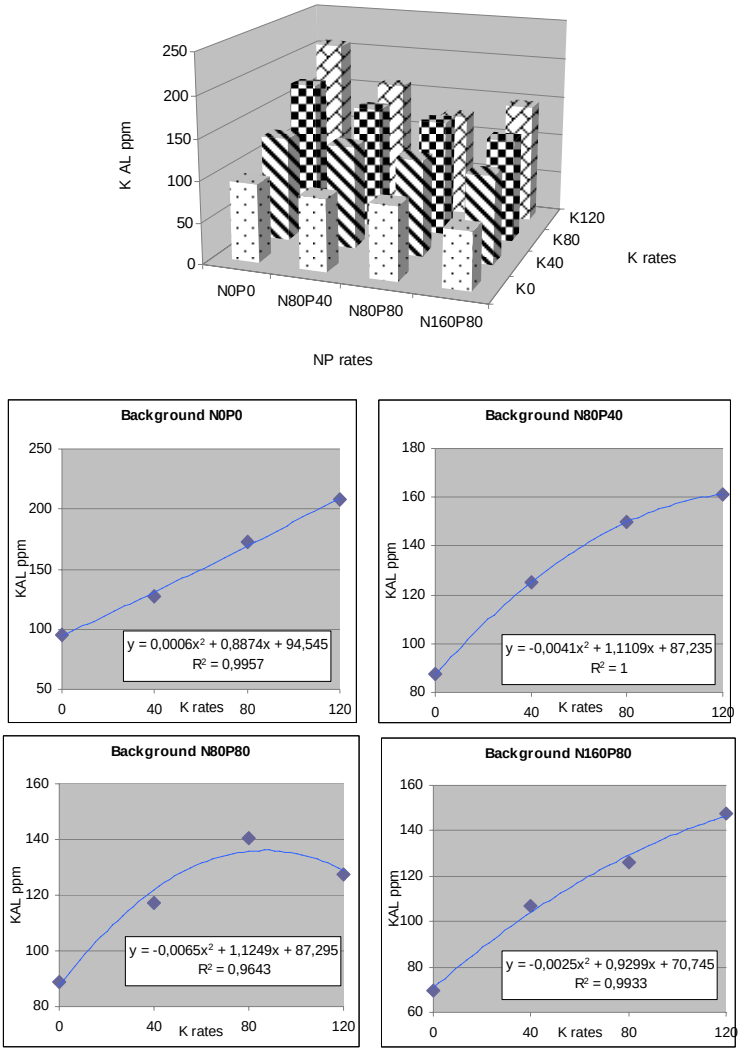

Fig. 4. The influence of the KxNP fertilizers applied in long term field experiments on the mobile potassium content of the preluvosoil from Oradea

CONCLUSIONS

1. Long term field experiments are important tools for examining the soil fertility and its influence on the yield level
2. The main agrochemical indexes depends on the fertilizers' type and on the rates fertilizers level applied
3. The nitrogen and the potassium fertilizers influenced the soil reaction in an unfavorable way: the pH values decreased with 0.2 – 1.05 units when N was applied and with 0.13 – 0.62 units when K was applied, as a function of rate and background used
4. Because of secondary soil acidification, a consequence of systematically N and K application in preluvosoil conditions, the nutritive unbalance appears which can limit the yield level obtained

5. The mobile potassium content of the preluvosoil has average values between 85.4 – 161.1 ppm if K rates is applied and are increasing from 0 to 120 K_2O kg/ha in function with the NP background
6. In this soil conditions, for an increasing fertility potential is necessary cyclic lime applications
7. The applications of potassium fertilizers on different NP backgrounds had a differentiated influence on humus level content, depending on K rates used and NP backgrounds
8. The mobile phosphorus content of preluvosoil has average values between 35.0 – 70.2 ppm if P rates applied are increasing from 0 to 80 P_2O_5 kg/ha in function with the nitrogen background. Potassium application in rates of K_{40} – K_{80} determine a increasing of phosphorus mobile content with 20 – 22 ppm

REFERENCES

1. Ciobanu, Gh., M., Nagy, 1986, Evitarea dezechilibrului de nutriție la grâul cultivat pe solurile brune luvice, prin aplicarea rațională a îngrășămintelor cu azot. Prod. veget. cereale și pl. tehn., 2, 12-18.
2. Ciobanu, Gh., 2002, Metode agrochimice de analiză, interpretare și îmbunătățire a fertilității solului, Editura Universității din Oradea.
3. Ciobanu, Gh., 2007, Agrochimia îngrășămintelor, Editura Universității din Oradea.
4. Ciobanu, Gh., C., Ciobanu, A., Vuşcan, C., Cosma, Gh., Tirpe, 2008, Research regarding the unbalanced nutrition appearce in long term field experiments with chemical fertilizers. Editura Agroprint Timişoara, (ISSN 1221-5279), Analele USAMV Timişoara, Lucrări Ştiinţifice Facultatea de Agricultură, vol 40 (1), (Scientific Papers Faculty of Agriculture), pp. 31-37.
5. Domuța, C., V., Bara, Gh., Ciobanu, Gh., Bandici, M., Şandor, A.D., Samuel, C., Ciobanu, N.C., Sabău, C., Bara, L., Bara, I., Borza, Cr., Domuța, R., Brejea, M., Gîtea, A., Vuşcan, 2008, Crop rotation influence on soil properties in the long term trial from Oradea, "Natural resources and sustainable development" of the Faculty of Agriculture University of Debrecen (the 6-th International Scientific Symposium), Journal of Aricultural Sciences, Debrecen 03-05 oct., pp. 84-88, ISSN 1588-8363.
6. Hera, Cr., Gh., Ciobanu, Cornelia, Ciobanu, C., Domuța, A., Vuşcan., Gh., Sarca, 2007, Influence of chemical fertilizers manure and lime applied in long term field experiments on pH-value of preluvosoil from north west part of Romania, Joint International Conference on Long term Experiments, Agricultural Research on Natural Researches, Debrecen Nyrlugos, pp. 12-20.
7. Lăcătuşu, R., 2006, Agrochimie, Editura Terra Nostra Iaşi.
8. Nemeth, T., 1996, Enviroment friendly fertilizer recommendation for sustainable agriculture. In: Enviromental Pollution, ed. B. Nath et ALL ECRP, Queen Marz and Westfield, College, London, 99-105.
9. Samuel, Alina, Dora, 2009a, Influence of long term fertilization on soil enzyme activities. Analele Universității din Oradea, Fascicula Biologie, Tom.XVI, pp.113-116.
10. Samuel, Alina, Dora, 2009b, Long term fertilization effects on enzymatic activities in a preluvosoil. Analele Universității din Oradea, Fascicula protecția Mediului, vol. XIV, pp.325-331.