INFLUENCE OF NITROGEN RATES APPLICATION IN DIFFERENT PHOSPHATIC POTENTIAL LEVEL ON MAIZE YIELD AND IT'S CHEMICAL COMPOSITION IN PRELUVOSOIL CONDITIONS FROM NORTH-WESTERN PART OF ROMANIA

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Abstract

The paper presents research results obtained in stationary experiments, carried out at Development Agricultural Research Station Oradea, regarding the influence of nitrogen and phosphorus fertilizers, on yield and soil fertility evolution.

The research results obtained in long term experiments bring scientific arguments regarding necessity of rational application of nitrogen as a function of soil phosphatic potential in preluvosoil conditions.

The kernel yield maize and it's chemical composition are strong influenced by the N rates level and by the level of phosphatic potential. The N total (%) and protein content of maize kernel are proportional increasing, with increasing of N rates until 150 kg N /ha.

Because of secondary soil acidification like a consequence of systematically N application, appear nutritive unbalance which limit the yield level obtained. In these soil conditions for increasing of fertility potential is necessary cyclic lime application and for technical plants (inside of crop rotation is necessary potassium and microelements.

Key words: phosphatic potential, nitrogen rate, nutritive unbalance, protein content.

INTRODUCTION

The synthesis of research results obtained in long term experiments set up in network research of National Agricultural Research and Development Institute Fundulea presented in scientific papers by Hera et al. (1984), Ciobanu, Toncea (1984), Dorneanu et al. (1998), has shown that long term fertilizers application strong influenced, but different, the main agrochemical indexes and this are reflected in the level and quality of yield.

The long term NP fertilizers application in the preluvosoil conditions determine in the case of some rates and combinations appears of nutrition unbalance of progressive decreasing of soil reaction and of increasing of mobile aluminium and manganese soil content which starting the molybdenum deficiency, factor which lead to phytotoxicity phenomenon (Ciobanu, 2007).

This paper has proposal to present the long term nitrogen and phosphorus application on maize yield and it's chemical composition in preluvosoil conditions from Oradea.

MATERIALS AND METHODS

The research data was obtained at Agricultural Research and Development Station Oradea and represent the results from long term field experiments set up in 1974 after the same design in the whole research network belong National Agricultural Research and Development Institute Fundulea.

The experimental factors were:

- Phosphorus: 0, 40, 80, 120, 160 kg P_2O_5/ha (rates annual applied which lead after 38 years to phosphorus potential levels) - 56 ppm, 70 ppm, 112 ppm, 150 ppm, 164 ppm
- Nitrogen: 0, 50, 100, 150, 200 kg N/ha (in the case of maize)

The fertilizers utilized was ammonium nitrate and concentrate superphosphate.

The crop rotation was: bean – winter wheat – sunflower – maize – wheat.

The long term experiments were set up on the preluvosoil with follow chemical properties:

- acid reaction in A horizon, the weak acid in the rest of profile
- medium provided with humus, N, P and K
- the mobile aluminium content in A horizon may cause severe damage for some crops
- the phosphorus potential values was determined in 2012's autumn.

RESULTS AND DISCUSSION

In the paper is presented the yield results obtained in 1974 – 2012 period in long term yield experiments regarding the effect of different phosphorus level potential on maize yield and chemical composition in the year of 2012.

Analyzing the influence of N x P interaction on yield in 1974 – 2012 period, we can see that the yield level obtained is different as a function of phosphorus potential determined and by the nitrogen rates applied (Fig. 1).

If in the first stationary application period of chemical fertilizers the effect obtained are very positive in the case of fertility indicators evolution and of yield level obtained and later was registered yield stagnation and even an increasing of yield because of unbalanced nutrition created in some variants.

The appears of phytotoxicity is due the nitrogen accumulation in plants because of molybdenum deficiency determined by the increasing of soil acidity.

This phytotoxicity effect manifested in the first vegetation stage is the principal cause of yield stagnation in the case of high rates nitrogen application.

The level of yield and the nitrogen rate which determine yield stagnation is a function of phosphorus background utilized.

In the case of unfertilized background during 30 years, the phosphatic potential is 56 ppm and the yield maize level is 53 q/ha in the variants fertilized with 120 kg N/ha. The increasing N rates after this level determine a progressive decreasing of maize yield.

In the case of background annual fertilized with 80 kg P_2O_5/ha the phosphatic potential is 70 ppm and the yield level is stagnation at 63 q/ha when 150 kg N/ha was applied. In the case of background annual fertilized with 160 kg P_2O_5/ha the phosphatic potential is 164 ppm and the maximum yield level, 68 q/ha was obtained applying 200 kg N/ha.

This research data has shown that in the case of unfertilized background with phosphorus or than fertilized with small phosphorus rates (40 kg P_2O_5/ha) the maximum yield level is not higher 60 q/ha and this level is obtained with N rates smaller than 150 kg N/ha.

The higher yield level (65 – 68 q/ha) can be obtained only in the case of high potential phosphatic level (between 112 – 164 ppm). These levels can be obtained through annual P rates applied bigger than 80 kg P_2O_5/ha and N rates higher than 150 kg/ha.

The smaller maize yield level obtained in the preluvosoil conditions even in the case of increasing of P and K rates is due the soil acidity increasing with the all implications which came from cations antagonism and decreasing of microbiological life of soil.

The N total (%) maize kernels content is taken values between 1,3% and 2,3% in function of phosphatic potential and of N rates applied (Fig. 2).

The smaller value of N content was realized in the case of variants unfertilized with P. in the case of control unfertilized with P (56 ppm) and N, the N total % kernel content value is under 1,3%.

Nitrogen application in the lack of phosphorus determine the N total % maize yield content in increasing with increasing of N rates to 120 kg N/ha (1,8%) and after this level the values of this indicator is decreasing.

In the case of different phosphatic potential level the values of N total% kernels content are around 1,5% increasing concomitant with N rates.

The maximum N total % kernels content (2,3%) was obtained when phosphatic potential is taking values between 112 – 164 ppm, which is realized through annual fertilization with 80 kg P_2O_5/h and 120 kg N/ha.

Increasing of N rate at 200 kg N/ha lead to a decreasing of N total kernels content from 2,3% to 2,0%.

When phosphatic potential is 164 ppm (in the case of variant annual fertilized with 160 kg P_2O_5/ha) the values of N total % content are smaller than in the case when phosphatic potential has lower level, the values ranging between 1,45% and 1,85%, because of higher yield level in this variants.

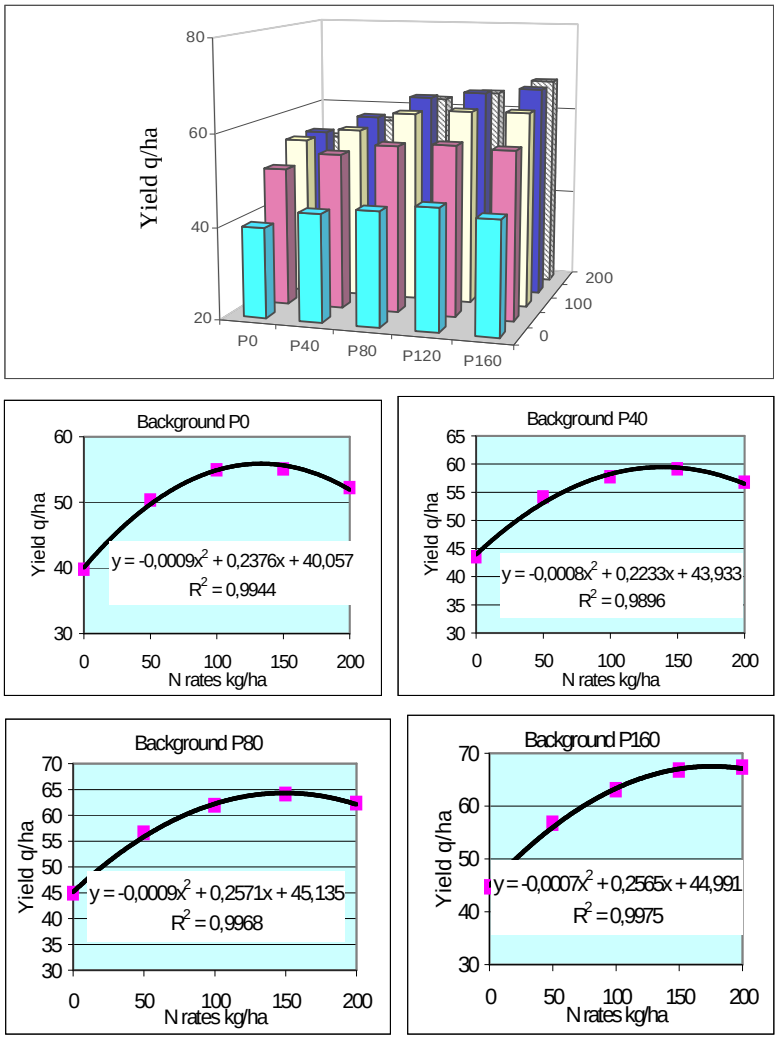

Fig. 1. The influence of NP fertilizers on maize yield in preluvosoil conditions from Oradea (1974 - 2012)

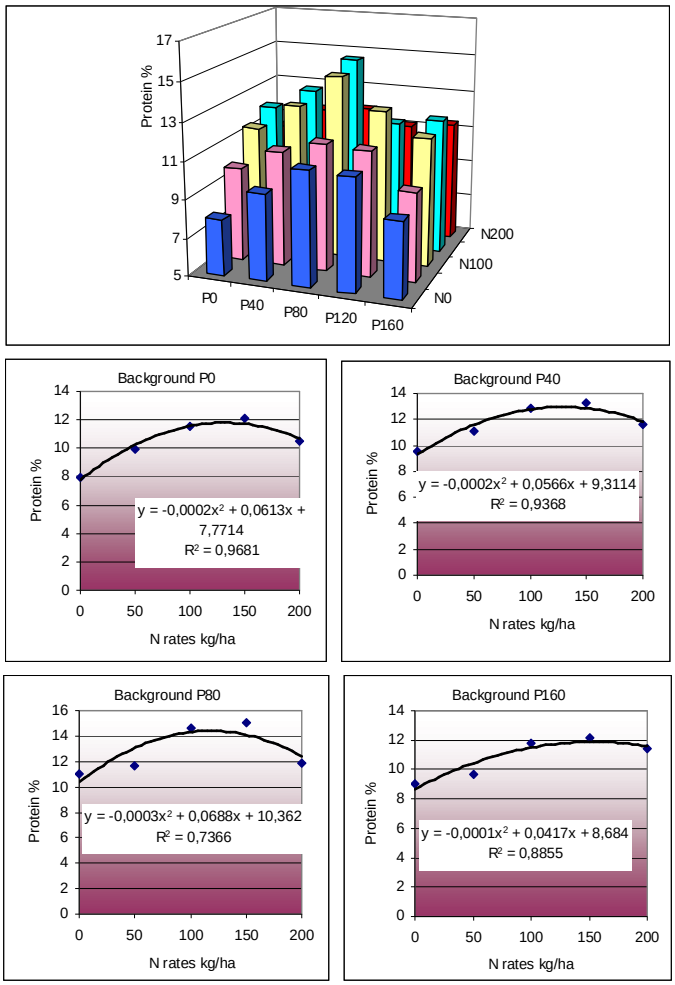

Fig. 2. The influence of NP fertilizers on protein maize content (%) in preluvosoil conditions from Oradea (1974 - 2012)

The protein yield content is direct correlated with N total% content and is influenced by the P background and by the N rates level.

Is noticed that the maximum protein level content is 14,3% and is registered in the case of background fertilized with 80 kg P_2O_5/ha (phosphatic potential, 112 ppm) and 120 kg N/ha.

CONCLUSIONS

- The research results obtained in long term field experiments from Oradea has brought scientific arguments for a rational fertilization with N and P.
- Nitrogen fertilizers applications on different P backgrounds determine progressive increasing of maize yield when the N rate level is under 100 kg/ha.

- The increasing of N rates after these level is decreasing the yield especially in the case of smaller P backgrounds.
- The N total% maize kernels content is increasing proportional with increasing of N rate to 150 kg/ha. The rates higher than 200 kg N/ha determine a severe decreasing of N total %, content especially in the case of backgrounds fertilized with small P rates.
- The maximum protein (%) kernels content was obtained in the case of backgrounds fertilized with 80 kg P_2O_5/ha.

REFERENCES

1. Bica A., Curilă M., Curilă S., 2011, About a numerical method of succesive interpolations for two point boundary value problems with deviating argument, Applied Mathematics and Computation, vol. 217, Issue: 19, pages 7772-7789, ISSN 0096-3003
2. Bica A., Curilă M., Curilă S., 2010, Approximating the Solution of Second Order Differential Equation with Retarded Argument, Journal of Computational Analysis and Applications, Volume: 12, Page(s):37 – 47, ISSN 1521-1398
3. Bica A., Curilă M., Curilă S., 2006, Optimal Piecewise Smooth Interpolation of Experimental Data, ICCCC 2006, International Journal of Computers, Communications & Control, pg. 74-79, ISSN 1841-9836
4. Brejea R., 2010, Ştiinţa solului – îndrumător de lucrări practice, Editura Universităţii din Oradea.
5. Brejea R., 2011, Practicum de pedologie, Editura Universităţii din Oradea.
6. Ciobanu Gh., 2003, Metode agrochimice de analiză, interpretare şi îmbunătăţire a fertilităţii solului. Editura Universităţii din Oradea.
7. Ciobanu Gh., 2007, Agrochimia îngrăşămintelor. Editura Universităţii din Oradea
8. Ciobanu Gh., Domuţa C., 2003, Cercetări agricole în Crişana. Editura Universităţii din Oradea.
9. Ciobanu Gh., Domuta C. et al., 2004, Tehnologia culturii porumbului in nord-vestul Romaniei. Editura Universitatii din Oradea
10. Davidescu D., Velicica Davidescu et al., 1976, Azotul în agricultură. Editura Academiei Bucureşti
11. Domuţa C., 2006, Agrotehnica diferenţiată. Editura Universitatii din Oradea
12. Hera Cr., Borlan Z. et al., 1980, Asigurarea azotului necesar culturilor agricole. Editura Ceres, Bucureşti
13. Hera Cr., Elliade Gh., Ghinea L., Popescu Ana**,** 1984, Asigurarea azotului necesar culturilor agricole. Ed. Ceres Bucureşti.
14. Hera Cr., Tianu M., Eliade G., Tianu A., 1989, Participarea azotului din sol şi din îngrăşăminte asupra formării producţiei. Analele ICCPT Fundulea, Vol. LVII, 127–140.
15. Lixandru Gh. et al., 1990, Agrochimie. Ministerul Învăţământului Bucureşti
16. Olson, R.A., 1978, The indispensable role of nitrogen in agricultural production, Sacramento, California.
17. Rusu M. et al., 2005, Tratat de Agrochimie. Editura Ceres Bucureşti.
18. Tunney H., 1980, Agricultural waste as fertilizers, Academic Press, New York.
19. Vintilă I., Borlan Z., Răuţă C., Daniliuc D., Tignaş L., 1984, Situaţia agrochimică a solurilor din România. Prezent şi viitor, d. Ceres, Bucureşti.