Література

1. Агрохімічні методи дослідження ґрунтів. –Київ, 2003.-390 с.
2. Федорец Н. Г., Медведева Н. В. Методика исследования почв урбанизированных территорий. Петрозаводск: Карельский научный центр РАН, 2009. 84 с.
3. Силкин К. Ю. Геоинформационная система Golden Software Surfer 8. – В., Изд-во ВГУ, 2008.- 66 с.

***Bilyera N.** , Candidate of Science, senior lecturer*
***Gorodniy M.**, Doctor of Science, professor*
***Dudka O.,** postgraduate student*
National University of Life and Environmental Sciences of Ukraine,
Kyiv, Ukraine

EVALUATION OF PHOSPHORUS AND POTASSIUM SOIL STATUS UNDER SPRING BARLEY IN LONG-TERM FIELD EXPERIMENT

Phosphorus is an essential for all living organisms. In crop plants adequately supplied it usually makes up to between 0.2 -0.5 % ofthe dry weight and is a constituent of important cellular molecular components including the nucleic acids, phospholipids, and ATP and other energy transferring compounds. Phosphorus thus plays a role in an array of physiological processes including energy generation, nucleic acid synthesis, photosynthesis, respiration, membrane synthesis and stability, enzyme activation/inactivation, redox reactions, signaling, carbohydrate metabolism and nitrogen (N) fixation [1].

Potassium also plays a major role in various physiological and biochemical processes. Most of potassium, unlike other macronutrients, is dissolved in plant sap [2]. Potassium is important for strong stem development and lodging resistance, promotes starch accumulation and plays an important role in carbohydrate metabolism.

Numerous numbers of long-term experiments have been conducted and it was established that long term application of mineral fertilizers improves soil quality, reduces N mineralization from soil and leads to reduction in P sorption [3] and decreasing of pH (H2O), pH (KCl), EC and organic matter. The availability of fertilizer P was obviously increased by long-term applying fertilizer P together with manure, compared with applying fertilizer P alone [4], but available P was increased in the treatments that received only chemical fertilizers, and thus, P accumulation might be a gradual saturation of the P-sorption capacity [5].

Therefore such experiments shoud be conducted at all soil types to evaluate crop responses to P and K application and find right fertilization rates.

Site characteristics. The trials were carried out at the long-term experimental field of the Agrochemistry and Crop Quality Department of the National University of Life and Environmental Sciences of Ukraine, Kiev during the years 2006-2008.

The local climate can be defined as temperate with annual rainfall of about 562 mm (273 mm of it falls during the vegetation period) and a mean annual air temperature of 7.5°C with mean temperature during the vegetation period of 12.4°C. The soil is a meadow-chernozemic calcareous loam. pH_{H2O} was 8.1, SOM content by Turin is 4.22 %, mobile phosphorus and exchangeable potassium by Machigin (extraction by 1%-$(NH_4)_2CO_3$) was 27.1 and 155 mg/kg respectively.

Treatments and design. Organic (farmyard manure) and mineral fertilizers (ammonium nitrate, ordinary superphosphate and potassium chloride) were applied systematically over the last 50 years. The treatments were without fertilizers (control), Farmyard manure (FYM) (mean annual rate 12 t/ha; FYM + P (mean annual rate 81 kg/ha); FYM + PK (mean annual rate 166 kg/ha); FYM + 1 NPK (mean annual rate 239 kg/ha); FYM + 1,5 NPK (mean annual rate 358 kg/ha);NPK (mean annual rate 239 kg/ha).

The experiment is systematic block with three replicates. Plot size was 175 m^2. Crop management was handled according to standard farm practices.

Sampling and analyses. The soil was collected from the top layer (0-25 cm) and subsoil (25-50 cm) in the 10th field under spring barley. The soil was air dried, grinded and sieved. Mobile P and exchangeable K were extracted with 1% NH_4CO_3 and measured colorimetrically by Machigin method. Analysis of variance has been performed by using Agrostat and Excel MS.

Today international net totally includes 620 long term experiments, and 15 of them are situated in Ukraine [6]. Our long-term experiment is among of them and results obtained there is valuable for understanding loss or improvement of soil fertility after long term organic and mineral fertilizers application in Forest-Steppe of Ukraine.

Our research showed that systematically fertilizers application in crop rotation over 50 years promotes soil fertility improvement, as well as leads to better crops growth and development. Application of FYM+1,5 NPK was resulted in highest mobile Machigin P at tillering in topsoil (138 mg/kg) and subsoil (104 mg/kg), that is respectively 4,4 and 4,2 times higher those in control. There was significant increasing in Machigin P in soil in treatment with N-fertilizers application if compared to application only P or PK fertilizers. This might be due to acidifying of soil solution after N fertilizers application. Over the last 50 years of fertilizers application both processes can occur: decreasing of soil fertility in control and increasing – in treatments with fertilizers application, especially when combining organic and mineral.

Long-term organic and mineral fertilizers application in crop rotation promotes increasing exchangeable Machigin K in soil. We have found that long term application of FYM+1,5 NPK in crop rotation was resulted in additional 77% of Machigin K in topsoil and 82% of Machigin K in subsoil, if compared to treatment without fertilization. It can be explained by several processes: 1) losses of soil

Machigin K due to soil chemical degradation in control; 2) increasing of soil Machigin K as a result of accumulation in soil after long term application of organic and mineral fertilizers.

Whereas the crop yield of spring barley in FYM+1,5 NPK treatment was 2,1 times higher than in control, the difference in Machigin K between tillering and harvesting in control (28,5mg/kg) and FYM+1,5 NPK (56,0 mg/kg) was predictable due to removing this element with harvest.

Difference in mobile Machigin P between the beginning and the end of vegetation period in control (11,7 mg/kg) was 4.8 times lower than inFYM+1,5 NPK (55,7 mg/kg). It was caused not only by removing with harvest, but also by P retrogradation (altering) processes in meadow-chernozemic calcareous soil and P leaching in treatment with very high P Machigin content. Therefore the amount of applied mineral P can be reduced to avoid leaching and retrogradation losses and to increase its agronomical effectiveness.

At the beginning of vegetation there was significant increasing of mobile P and exchangeable K in top soil on 107 and 73 mg/kg respectively after systematic 50-years application of FYM and 1,5 NPK. After harvesting the difference in P and K content between the most fertile plots and control (without fertilizers) was less due to high removal with much higher yields of crops, and for P also due to leaching and P retrogradation. To use P fertilizers more effective and avoid losses their management should be revised.

References

1. Vance C. P., C. Uhde-Stone and D. L. Allan (2003). Phosphorus acquisition and use: critical adaptations by plants for securing a nonrenewable resource. New Phytologist, 157: 423-447.

2. Igras J. and V. Danyte (2007). Potassium concentartion in tissue water as an indicator of crop potassium require. Proceedings of international conference “Plant nutrition and its prospects” held at 5-6 September 2007: 47-50.

3. Rizand A., R.H. Marrs, M.W. Gough and T.C.E. Wells (1989). Long-term effects of various conservation management treatments on selected soil properties of chalk Grassland. Biological Conservation, 49 (2):105-112.

4. Liu, J. and F. Zhang (2000). Dynamics of soil P pool in a long-term fertilizing experiment of wheat-maize rotation. II. Dynamics of soil Olsen-P and inorganic P. Ying Yong Sheng Tai Xue Bao, 11 (3):365-368.

5. Park M., O. Singvilay, W. Shin, E. Kim, J. Chung and T. Sa (2004). Effects of long-term compost and fertilizer application on soil phosphorus status under paddy cropping system. Communications in soil science and plant analysis, 35 (11&12): 1635–1644.

6. MIneev, V.G., V.G. Sychev and V.A. Romanenkov (2006). About improving of management and metrological issues of geographical webs of fertilizers trials. Agrochimiya, 2:78–85 [in Russian].