

SEASONAL DYNAMIC OF PHOSPHORUS AND POTASSIUM ON CALCAREOUS CHERNOZEM SOIL

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Introductions

Results from a long-term field experiments can give useful information for nowadays plant nutrition practice, as well as the future ones. In a long-term experiment (Nagyhőrcsök experimental station of RISSAC) the fertilizer treatments (NPK application rates) were chosen to build up different fertility levels, i.e. nutrient supplying categories and later on to investigate the changes in overall nutrient-supplying categories (weak, moderate, adequate, excessive) by the main nutrients and their combinations, which nutrient supplying categories can be found in Hungarian agricultural soils.

From the point of view of soil fertility the one of most important things are the sustainability – and enhancement – of nutrient supplying capacity of soil, and the experiments, which can serve enough data for the agricultural practice (Győri, 1984). As follow there are the phosphorus and potassium changing and moving in the soils. Several scientific studies engage in the favourable or unfavourable effects of NPK fertilizers. In consequence of the extreme weather (also nowadays, not just in the future – climate change), the nutrient supplying capacity of soil will be appreciated (Németh, 1996), because the fertilizing can increase the yield, much more than the water regime of soils (Ruzsányi, 1996). After all getting acquainted with the nutrient demand of cultivated plants (Kádár, 2004, 2005a, 2005b; Márton, 2004), the agricultural cultivation can be more economical and environmental friendly.

Methods

In 1973 a long-term NPK fertilization experiment was set up on the Nagyhőrcsök experimental station of RISSAC (Kádár et al. 2004). There is calcareous loam chernozem soil on the experimental site, which is supplied by nitrogen in medium, phosphorous in poor and potassium in medium quantity (Németh, 1996). The NPK fertilization experiment was set up with 4 levels of supply for each nutrient, which involved 4N X 4P X 4K, so 64 treatments in 2 replications on a total of 128 plots. Annual N rates of 0, 100, 200 and 300 kg/ha were distributed in the form of calcium ammonium nitrate. The K and P levels were adjusted by the addition of 0, 1000, 2000 and 3000 kg/ha P_2O_5 and K_2O applied in the form of super phosphate and potassium salt, which are repeated in every 5-10 years in order to refill (Kádár-Földesi, 2002; Kádár-Németh, 2004).

The seasonal dynamic of NPK nutrient elements were followed from March to November in 2003. In the seasonal dynamics investigation, only the $N_0P_0K_0$, $N_1P_1K_1$, $N_2P_2K_2$ and $N_3P_3K_3$ treatments were used. Two parallel average samples (composed from 12–12 sub-samples) were collected 19 times between March and November from three layers (0–20, 20–40 and 40–60 cm, respectively) per plot.

Every nutrient concentration was determined in the air-dry samples. To enable the study of the nutrient regime of the soil and the related biological factors, in 2003 these measurements were just part of an examination series that included the determination of NO_3-N , NH_4-N and total-N contents, ammonium-lactate soluble AL- P_2O_5 and AL- K_2O contents, soil moisture (by two methods), CO_2 emission in situ, microbiological biomass, specific enzyme activity, arbuscular mycorrhizal colonization etc. In this long-term experiment was a seasonal dynamic examination with the same methods in 1983 by Németh (1996).

Results and discussion

The seasonal dynamic of the AL-P₂O₅ concentration can be seen on the *Figure 1*. The seasonal fluctuation of AL-P₂O₅ was slight in each treatment. The highest treatment (N₃P₃K₃) has a small fluctuation. Fertilizer application had significant effect on the AL-P₂O₅ content of the 0–60 cm layer, no seasonal fluctuation was observed.

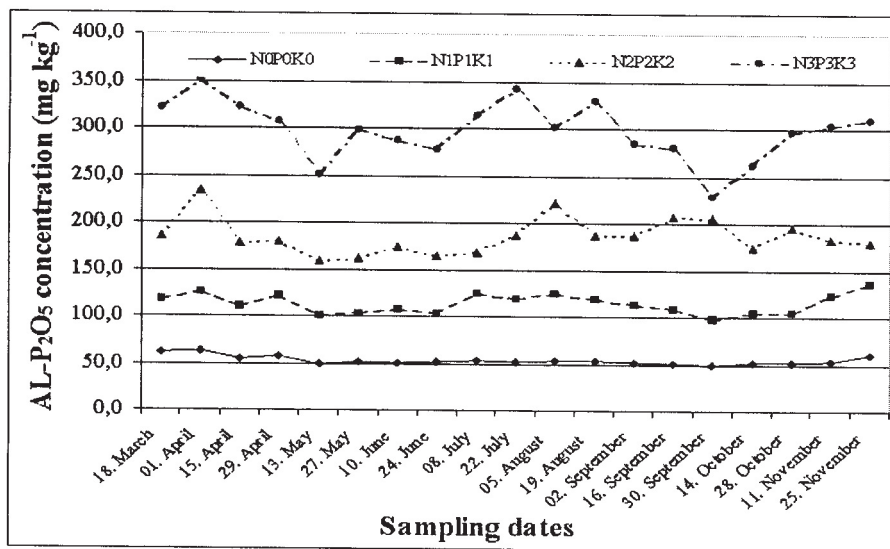


Figure 1. The seasonal dynamic of the AL-P₂O₅ concentration (mg kg⁻¹), calcareous loam chernozem, Nagyhörcsök, Mezőföld, 2003

While in case of AL-K₂O there was not significant effect by the treatments (*Figure 2*). Only the highest treatment is separated from the others in significantly. The seasonal fluctuation of AL-K₂O was even slight in each treatment. Follow the AL-P₂O₅ and AL-K₂O concentrations in the soil profile, that can be seen in the 0-20 cm layer treatments had significant effect, while in the 40-60 cm layer the different is light (*Table 1*).

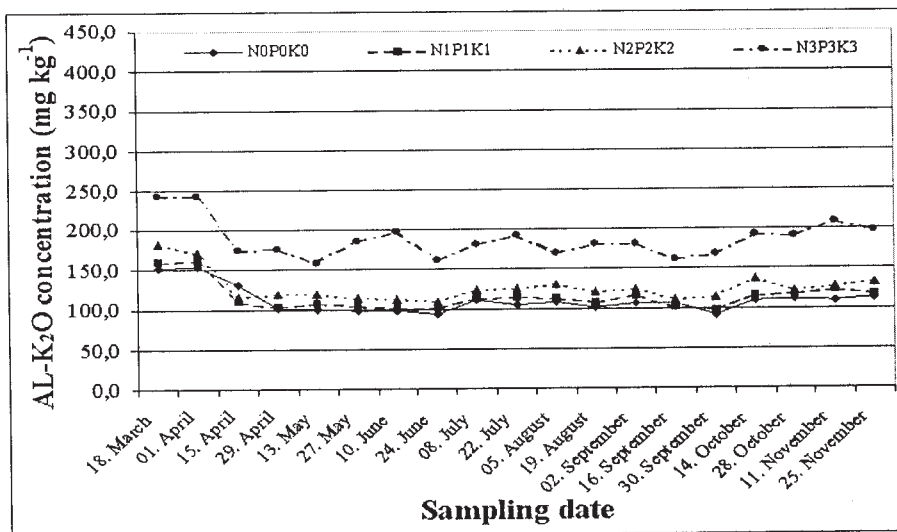


Figure 2. The seasonal dynamic of the AL-K₂O concentration (mg kg⁻¹), calcareous loam chernozem, Nagyhorcsök, Mezőföld, 2003

Table 1. The AL-P₂O₅ and AL-K₂O concentration (mg kg⁻¹) in the three different soil layers per the treatments, calcareous loam chernozem, Nagyhorcsök, Mezőföld, 2003

treatment	soil layer (cm)			mean
	0-20	20-40	40-60	
AL-P ₂ O ₅ (mg kg ⁻¹)				
N ₀ P ₀ K ₀	78,8	50,0	32,6	53,8
N ₁ P ₁ K ₁	213,8	95,8	34,8	114,8
N ₂ P ₂ K ₂	407,2	117,9	33,9	186,3
N ₃ P ₃ K ₃	632,6	206,3	55,7	298,2
LSD ₅ %		23,2		13,4
mean	333,1	117,5	39,3	
AL-K ₂ O (mg kg ⁻¹)				
N ₀ P ₀ K ₀	141,6	109,1	82,4	111,1
N ₁ P ₁ K ₁	148,7	119,9	78,5	115,7
N ₂ P ₂ K ₂	178,3	131,3	73,1	127,6
N ₃ P ₃ K ₃	270,4	208,8	84,4	187,9
LSD ₅ %		9,4		5,4
mean	184,8	142,3	79,6	

Conclusions

In case of AL-P₂O₅ and AL-K₂O there were not characteristic seasonal fluctuation, what can be explained by these two macro nutrients are non-mobile, or rather compared to Nitrogen forms (NO₃-N). Fertilizer application had significant effect on the AL-P₂O₅ content, while by AL-K₂O content only the highest treatment is separated from the others in significantly. In case of AL-K₂O it can be supposed that the highest fertilizer dose (N₃P₃K₃) was too much for the grass (overdose), in this way a significant after-effect can be detected. The AL-P₂O₅ has the most lasting after-effect, and in this case the fertilizer application had significant effect on the AL-P₂O₅ content of the 0–60 cm layer.

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