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Plant available phosphorus by H3A, M3 and AL methods in Estonian soils

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Phosphorus (P) is after carbon and nitrogen the third most important nutrient element for plant growth. Most of the phosphorus needed for plant development is taken up by roots from soil. Typically the soil total phosphorus content is from 200 up to 3000 mg kg⁻¹, with an average of 1200 mg kg⁻¹. Phosphorus is present in composition of organic and inorganic (35-70%) compounds depending from the soil type. Most phosphorus containing compounds belong to groups of undissolvable and heavily dissolvable compounds. Only a small proportion of phosphorus participate in soil as easily soluble form. For development the plants can use only this minor part of soil phosphorus.

For farmers it is very important to have adequate information about the resources of plant available phosphorus in soil. Therefore, for the determination of soil plant available phosphorus content, many different methods are developed. The oldest method, which is also used nowadays in Europe is the Dyer method, developed already in 1894. Most of the methods were created in the period from 1940-s up to 1970-s. From the chemical viewpoint these methods are extraction methods, which use aqueous diluted solutions of different salts and/or acids. These methods differ also by pH of extraction solution, duration of extraction and used soil : extraction solution ratio.

In the early years of method development the main aim was to find extractant with best extraction possibilities for phosphorus extraction from soil. Due to economical reason the main aim of researches of soil analytical laboratories is to find the best extractant for simultaneous extraction of all plant macroelements (K, Mg, Ca) and also microelements (Zn, Fe, Cu, Mn, B, S) from soil with one step. Typically, in older methods the extractants were prepared from easily accessible chemicals. These chemicals are not natural components in soil and rhizosphere. Therefore the extraction process of P from soil to solution does not take place in normal rhizosphere conditions. The natural soil rhizosphere environment is imitated for P and other plant nutrient extraction in a method called H3A. This method was developed by Haney R.L and coworkers in 2006 and modified in 2017. They proposed to mimic the plant root environment by utilizing organic acids of plant root exudates to extract nutrients at ambient soil pH.

In the experiment, determination of plant available P by H3A method was investigated and

comparison was made with results obtained with Mehlich 3 and AL (Egne-Riehm-Domingo) method. In the provided experiment soil samples from Estonian agriculturally used fields by H3A; Mehlich 3 and AL methods were analyzed. For detection of P in extracts the MP-AES was used. The correlation between methods was investigated and the effect of different factors (pH, texture , organic carbon) to the correlation was also investigated.