Professional paper

Popularization of soil fertility control among landusers

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Abstract

Institute for soil – Osijek has started a project „Soil fertility control on family farms"in 2003 with Faculty of agriculture Osijek and Osijek – Baranja County. Main goals of this project was that land users get soil analysis and fertilizations recommendations for low prices, also increasing popularization of soil fertility control through soil chemical analysis among land users and establishing the information system of the soil features. For over 10 years it has taken about 17400 of soil samples and covered about 108000 ha of arable land. Interest for this project increased each year; crop producers get chemical analysis and fertilizations recommendations at low prices (they paid 20% of total price and rest is cover with budget of Osijek - Baranja County) and savings in costs of mineral fertilizers with positive effects on their management inputs. Project involved arable land with different types of crops and farmers with different management of soil cultivation. This project has retained in its basic concept until today and these activities are being conducted on the basis of contracts with other counties as well.

Key words: soil fertility control, soil chemical analysis, soil degradation

Introduction

Soil testing has been an accepted agricultural management practice for decades. Interpretations and fertility recommendations based on soil analyses and the information obtained with soil samples on cropping systems, tillage practices, soil types, manure use, and other parameters have contributed to the increased efficiency of agricultural production (Sims et al., 2000).

Soil fertility is defined as the ability of a soil to provide the conditions required for plant growth. It is a result of the physical, chemical and biological processes that act together to provide nutrients, water, aeration and stability to the plant, as well as freedom from any substances that may inhibit growth. (Stockdale et al., 2002).

Soil fertility management is described under 3 headings: (1) appropriate crop husbandry practices to maintain and/or improve the condition of the soil; (2) organic fertilizers and inorganic fertilizers that can be applied to achieve quicker results but at a higher cost; and (3) an explanation of scientific terms that are often used in texts about soil science to help those who want to read more about soils (Scholl, 1998). Establishing the information system of the soil features from database that was formed we get multiply useful for the user (fertilization recommendation for a specific culture) and for local self-government and a county when planning the production and considering the possibilities of agricultural production. By connecting the data on the way of soil usage and chemical analysis results with coordinates of sampling spots, the Institute of soil creates GIS data base enabling spatial interpretation of all data of analyzed land plots.

Material and methods

Average soil samples for soil analysis are taken by probe. Average soil sample makes 25 subsamples took at random locations throughout one field or area. For areas in which field crops are grown, samples were collected at the same depth that the field is plowed (0-30cm) because this is the zone in which lime and fertilizer have been incorporated. Soil sampling sites are located with Global positioning system (GPS) and all data are in GIS database.

Soil analysis was with emphasis on amount of phosphorus, potassium, percentage of organic matter and soil reaction in top layer (0-30 cm). The AL-method - extraction with ammonium-lactate was used for determination of available phosphorus (Test method: Determination of ammonium lactate extractable phosphorus express as P_2O_5-spectrophotometric determination-In house method) and potassium (Test method: Determination of ammonium lactate extractable potassium express as K_2O –-flamefotometric determination-In house method).

The percentage of organic matter (%) was determined spectrometricaly using bichromate method (Test method: Determination of humus bysulfochromic oxidation spectrophotometric determination – In house method) and the results were classified according to Gracanin (Skoric, 1992). Soil reaction, pH was determined according to HRN ISO10390:2005).

Results and discusion

Perhaps the most important property of soil as related to plant nutrition is its hydrogen ion activity, or pH (the term "reaction" is also used, especially in older literature). Soil reaction is intimately associated with most soil-plant relations. Consequently, the determination of pH has become almost a routine matter in soil studies relating directly or indirectly to plant nutrition. Knowledge of soil acidity is useful in evaluating soils because pH exerts a very strong effect on the solubility and availability of many nutrient elements (Thomas, 1967).

Over a 37% of soil samples from this project had pH strongly acid, 18% moderately acid and rest of the soil samples had neutral to slightly alkane (Figure 1). From this data we can see different between western, which is largely strongly acid and moderately acid, and eastern part of named county which is most neutral to slightly alkane.

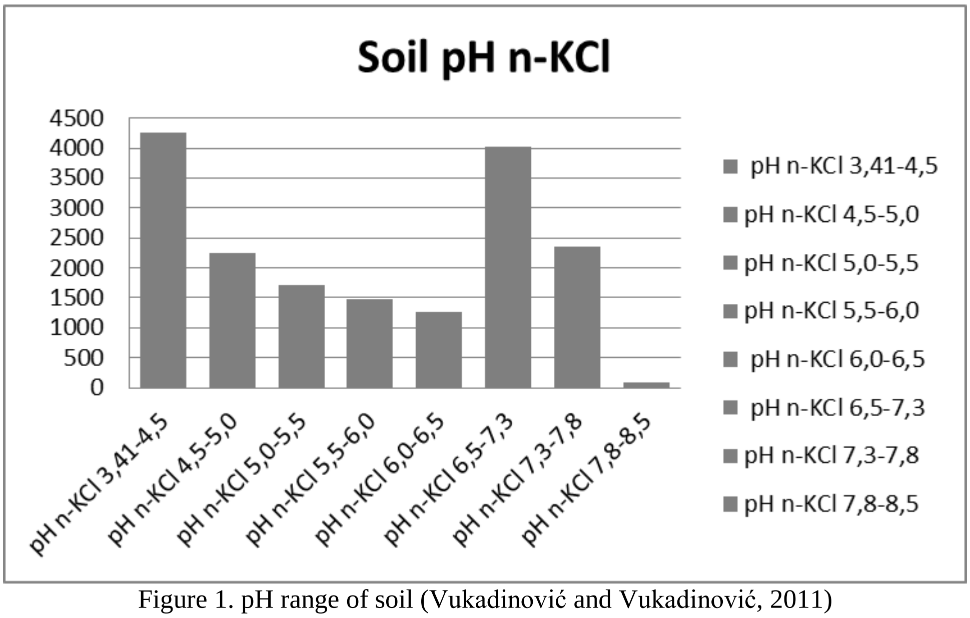

Figure 1. pH range of soil (Vukadinović and Vukadinović, 2011)

Phosphorus (P) is an essential element classified as a macronutrient because of the relatively large amounts of P required by plants (Figure 2). Phosphorus is one of the three nutrients generally added to soils in fertilizers. One of the main roles of P in living organisms is in the transfer of energy (Busman, 2009).

15% of soil samples had low values of available phosphorus less than 10 mg /100g of soil, 41% of soil samples had between 11 and 20 mg/100g of available phosphorus, 44% of samples had over 20 mg /100g of available phosphorus

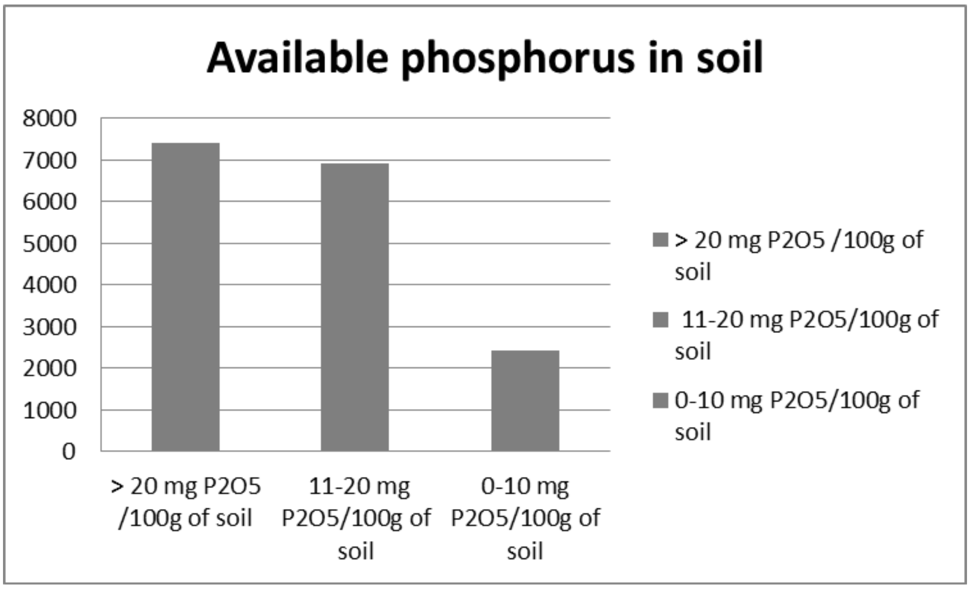

Figure 2. Soil phosphorus availability (Skoric, 1992)

Potassium is one of the principle plant nutrients underpinning crop yield production and quality determination (Figure 3). While involved in many physiological processes, potassium's impact on water relations, photosynthesis, assimilate transport and enzyme activation can have direct consequences on crop productivity. Potassium deficiency can lead to a reduction in both the number of leaves produced and the size of individual leaves (Pettigrew, 2008).

Available potassium situation is a little bit better. Only 4% of samples had less than 10mg/100g, 31% of samples had 11 to 20mg/100g of soil, 64% samples had over 20 mg/100g.

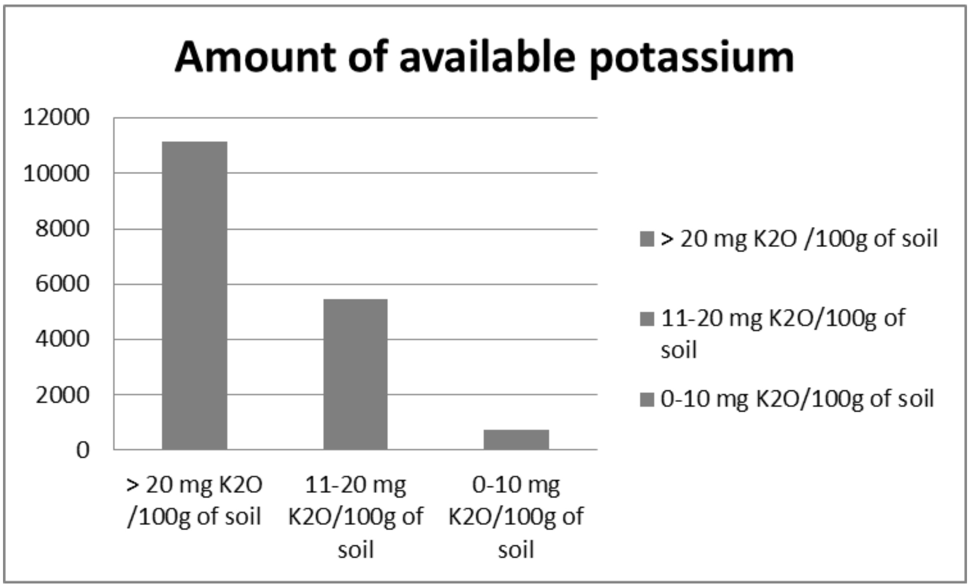

Figure 3. Soil potassium availability (Skoric, 1992)

There is more reason for unevenness in availability of phosphorus and potassium. The factors can be relate to pH of soil (soil acidity can affect P-sorption), soil mineral type, temperature or it could be because of excessive use of mineral fertilizers.

Land using and management practices can affect dramatically on losses of humus and decreases of soil organic matter also very little or no application of manure. (Skoric, 1992; Bot, 2005). Various types of human activity decrease soil organic matter contents and biological activity (Seput et. al., 2006). For 90% surfaces that have been sampled had humus content between 1 and 3 percent. The maintenance of soil organic matter levels and the optimization of nutrient cycling are essential to the sustained productivity of agricultural systems (Bot, 2005).

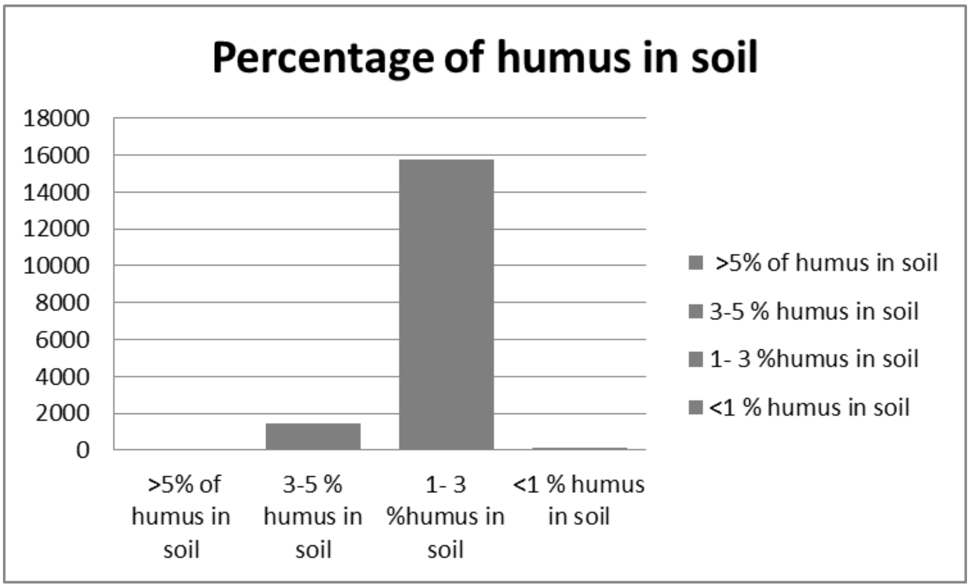

Figure 4. Humus content in agricultural soils (Skoric, 1992)

Conclusion

Main goals of this project was that land users get soil analysis and fertilizations recommendations for low prices, also increase popularization of soil fertility control through soil chemical analysis among land users and establishing the information system of the soil features. After 10 years of doing this project is still going and the farmers are well satisfied. They get chemical analysis and fertilizations recommendations at low prices (they paid 20% of total price and rest is cover with budget of Osijek – baranja County) and savings in costs of mineral fertilizers with positive effects on their management inputs. Also they learned importances of different chemical properties of a soil interact in complex ways that determine its potential fitness or capacity to produce healthy and nutritious crops.

In scientific way what we have noticed that are increased amount of available potassium is closely linked with intensive fertilization. Low values of available phosphorus can be linked with strong acidity of more than half soil samples. Also results for content of soil humus is a very disturbing, 90% surfaces has humus content between 1 and 3 percent, average 1,7%. Therefore, low soil organic matter has influence on soil compatibility, friability, and soil water-holding capacity while aggregated soil organic matter has major implications for the functioning of soil in regulating air and water infiltration, conserving nutrients, and influencing soil permeability and edibility.

Results and data that we got from this project serve us and to crop producers, farmers to get early warning indicators of soil degradation and how they relate to the sustainability of agricultural systems.

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