SOIL SAMPLING WITH NEW SOIL SAMPLING PROBE

Milan MESIC – Igor BOGUNOVIC – Aleksandra JURISIC – Darija BILANDZIJA – Ivana SESTAK

Department of General Agronomy, Faculty of Agriculture, University of Zagreb, Svetosimunska c. 25, 10 000 Zagreb, Croatia, mmesic@agr.hr

Abstract: Conventional soil sampling usually considers sample weight of 2 kg per 4-5 ha area, which means that representative sample in relation to soil mass up to 30 cm depth, is presented through the ratio 1:10,000,000. In order to increase the volume of sampled soil and thus to increase the accuracy of sampling, we have designed new circular soil probe apparatus that can take 16 soil samples in one run (PCT/HR2011/000021 Rotary Soil Sampling Assembly). Samples are distributed in a 50 cm radius from the center of the probe. After sampling all 16 samples are mixed and homogenized in one composite sample, which is used for chemical soil analyses. We have tested new soil sampling probe at the field of 84 ha. Sampling was performed with grid sampling at intersections in a grid of 50 x 50 m. Results of soil pH and plant available phosphorus are based on 330 soil samples and they provide sound basis for recommendations for variable liming and phosphorus fertilization rates. Results were processed with ordinary kriging.

Keywords: Precise soil sampling, circular soil probe apparatus, grid sampling

Introduction

After construction of new soil sampling probe that was developed as a patent of University of Zagreb (PCT/HR2011/000021 Rotary Soil Sampling Assembly), we have tested new probe at production field used for arable farming in NW Croatia. The goal of work was to get clear information about variability of soil pH and plant available P_2O_5 content in soil. Based on spatial distribution of soil acidity and plant available phosphorus content we can apply variable liming and phosphorus fertilization rates. According to Robert (2002) precision agriculture will be a significant component of the agricultural system of the future because it offers a variety of potential benefits in profitability, productivity, sustainability, crop quality, food safety, environmental protection, on-farm quality of life, and rural economic development. Precision phosphorus management requires knowledge about links between phosphorus fertilization, crop yield, accumulation of soil phosphorus reserves, and phosphorus loading into waterways adjacent to agricultural land (Iho and Laukkanen, 2012). According to Nanni et al. (2011) for P, K and V%, a finer sampling resolution than the one using 1 sample ha^{-1} is required, while for OM and clay coarser resolutions of one sample every two and three hectares, respectively, may be acceptable.

Materials and methods

Soil sampling was performed in a period from 23 – 26 July 2012, after harvest of winter wheat. Soil samples were taken with newly designed soil sampling probe at the field located in NW Croatia near Hrastovac. Sampling was performed with grid sampling in a grid of 50 x 50 m, at grid intersections. File size is 84 ha and total number of samples is 330. The location of a sampled field and scheme of sampling and are presented on *figures 1* and *2*. Precise location of sampling at grid intersection was set up Trimble GeoExplorer GeoXH 6000 with accuracy +- 10 cm.

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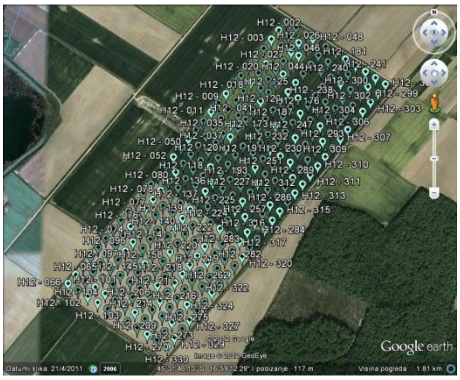

Figure 1. Location of sampled field

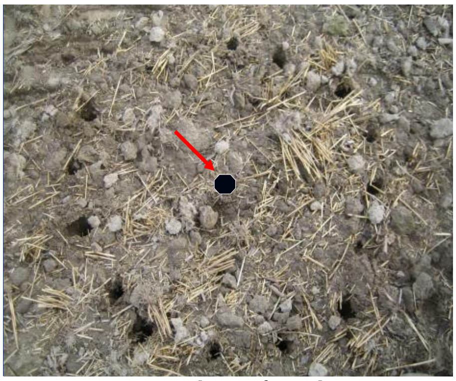

Figure 2. Scheme of sampling

Soil pH was measured in 1M KCl (HRN ISO 10390:2004) and phosphorus content was determined with AL method.

Results and discussion

Results of soil analyses for pH and available P_2O_5 are presented in *figures 3, 4, 5* and *6*.

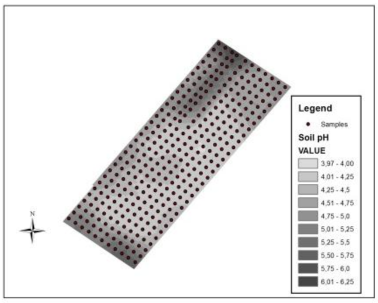

Figure 3. Spatial distribution of soil pH

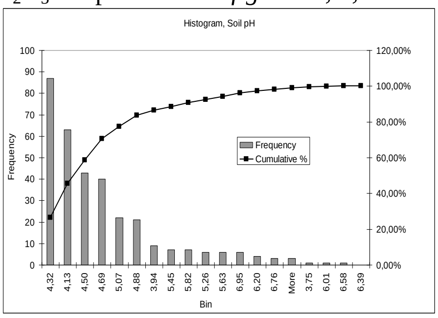

Figure 4. Cumulative histogram, soil pH

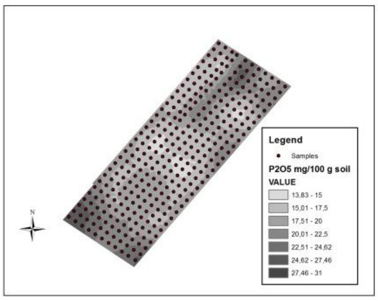

Figure 5. Spatial distribution of P_2O_5

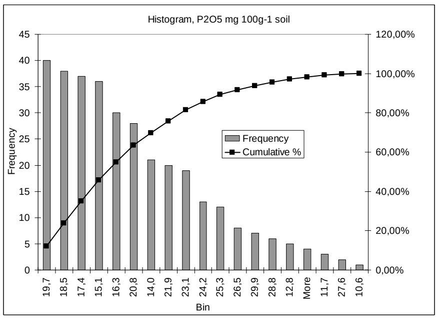

Figure 6. Cumulative histogram, P_2O_5

It is evident that almost 60% of the studied field is very acid with pH value lower than 4.5. In addition to that 30% of the field is acid, with pH varying from 4.5 to 5.5. Regarding P_2O_5 content 10% of the field has moderate level of supply, 55% has good supply, while 25% is rich, and 10% is very rich in phosphorus. Descriptive statistics for soil pH and P_2O_5 content is presented in *table 1*. Average pH value is 4.56 with variation from 3.75 to 7.15. Average content of P_2O_5 is 18.91 mg $100g^{-1}$ varying from 10.58 to 31.03 mg $100g^{-1}$. Coefficient of variation for pH is 14.29 % and 22.06 % for P_2O_5 content.

Table 1. Descriptive statistics for soil pH and P_2O_5 content

Soil property	pH	P_2O_5 mg $100g^{-1}$
Mean	4.56	18.91
Standard Error	0.0359	0.2297
Median	4.33	18.23
Mode	4.20	18.60
Standard Deviation	0.65	4.17
Sample Variance	0.42	17.41
Range	3.39	20.45
Minimum	3.75	10.58
Maximum	7.14	31.03
Sum	1503.74	6240.23
Count	330	330
Confidence Level(95,0%)	0.0705	0.4518
CV	14.29 %	22.06 %

Correlation between soil pH and P_2O_5 content is weak and positive, r = 0.31*** (fig. 6).

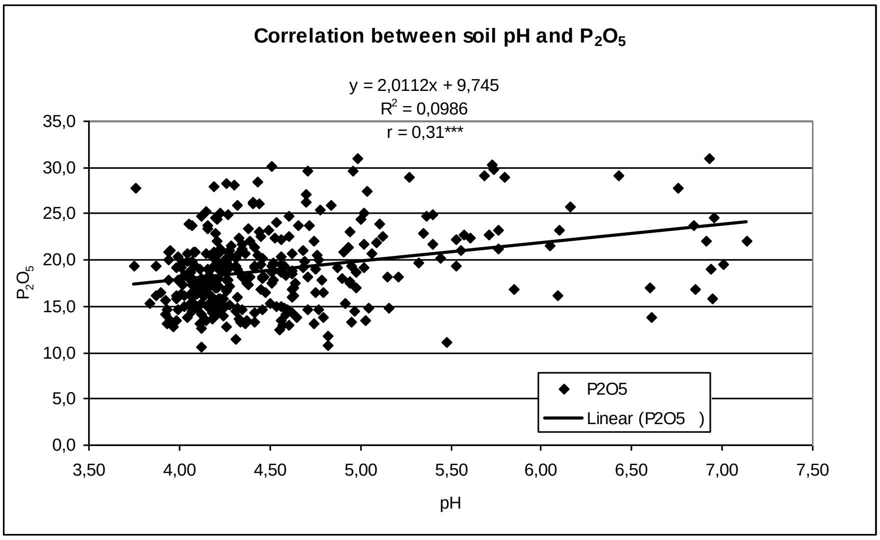

Figure 6. Correlation between soil pH and soil P_2O_5

Availability of phosphorus in soil is greatest at pH range of 5.5 to 7.0. Positive influence of liming and increase of soil pH to plant available phosphorus content in soil was noted by other authors – Rastija et al. (2008), Rastija et al. (2010). Zhang et al. (2004) and Rahman et al. (2002) elaborated influence of liming on phosphorus availability in acid soils, stressing that a moderate pH increase leads to greater phosphorus availability, while too high doses can lead to its decreasing. According to Kovacevic et al. (2007) moderate supplies of soil with phosphorus (P) and potassium (K), alone or in their combination, are limiting factors of field crop yields, especially maize and soybeans under condition of continental part of Croatia. With the information about spatial distribution of soil pH and soil phosphorus supply we can adjust liming and fertilization rates.

Conclusions

Newly constructed soil sampling probe is efficient, work is fast and soil samples are taken in a way that sampling can be repeated in a future with relatively small error of sampling. Results can be used for variable liming and fertilization rates and recommendations can influence the unification of spatially distributed soil fertility parameters.

Acknowledgements

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