Soil reaction (pH) and status of mobile phosphorus and potassium in Sava valley area of Bosnia and Herzegovina

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Abstract
Acid soils in Bosnia and Herzegovina occupy 2256272 ha or 44.12% of total soils area of the country and prevail district cambisols (28.73%), luvisols (6.90%) and pseudogleys (4.64%). Soil pH and plant available phosphorus (P) and potassium (K) status were analysed in 478 soil samples covering 663 ha taken in five municipalities of Sava valley (Samac, Pelagicevo, Modrica, Srbac and Gradiska). About 55% samples were with pH in KCl below 5, while adequate mobile P and K (AL-method) supplies were found in third part of samples only. Liming and the higher P and K fertilization of majority soils of the region could be useful for increases soil fertility.

INTRODUCTION
Excessive soil acidity on agricultural land of Bosnia and Herzegovina (BIH) as an agricultural limiting factor impacts crops production (Komljenovic et al., 2006, 2010, 2013; Markovic et al., 2006; Komljenovic and Markovic, 2008). Resulovic et al. (2008) estimated that acid soils in BIH occupying 2256272 ha or 44.12% of total soils area of the country and prevailing district cambisols (28.73%), luvisols (6.90%) and pseudogley (4.64%). Aim of the study was testing soil pH and plant available phosphorus (P) and potassium (K) status in part of Sava valley area in the entity Republic of Srpska (RS), BIH.

MATERIAL AND METHODS
General description of the area
The area covering five municipalities situated in the Bosnian part of Sava river valley in RS of BIH as follows: Samac (184 km²), Pelagicevo (178 km²), Modrica (363 km²), Srbac (453 km²) and Gradiska (762 km²). According the statistical data (SYB, 2013) this area covering 1 940 km² and participating with 7.8% in territory and 13.4% in arable lands contribution of RS. These municipalities contains 78427 ha of arable lands and gardens or 13.4% in level of RS. Main field crops are maize and winter wheat (SYB, 2013). The analysed area is part of the Peri-Pannonian region of BIH. Climate of the region is characterised by moderately cold winters and warm summers (Saric et al., 1997). Excessive drought periods as result of recent climatic changes (Kovacevic et al., 2013) have considerable impact on nutrient mobilization to field crops.

Collection of the data and chemical analysis
Total 478 soil samples covering 663 ha were taken by the auger to 30 cm of depth during 2006 with aim of testing main agrochemical properties. Determination of plant available P was made by AL-method (Egner et al., 1960) at the Faculty of Agriculture, University of Banja Luka. Interpretation of the data was made according Vukadinovic and Loncaric (1998) by criterion as follows: for P (mg P₂O₅ 100 g⁻¹) = very low (<5.0), low (5.1-12.0), good (12.1-20.0), high (20.1-30.0) and very high (>30.0); for K (mg K₂O 100 g⁻¹) = very low (<12.0), low (12.1-19.0), good (19.1-30.0), high (30.1-40.0) and very high (>40.0).

RESULTS AND DISCUSSION
About 55% samples were with pH in KCl below 5, while adequate mobile P and K supplies were found in third part of samples only (Table 1). Interaction of soil acidity and low supplies with P and K and unfavorable physical properties could be reasons of low yields of maize and wheat. The lowest yields of maize (3.6 t ha⁻¹) and wheat (2.7 t ha⁻¹) in Srbac municipality could be in connection with the something higher share of P and K deficient and acid soils (Table 1). Growth retardation and chlorosis of maize were found on acid hydromorphic soils of Gradiska municipality. Excessive aluminum and iron, as well as the lower P concentrations are in close connection with this type of disorders (Table 2). Liming and ameliorative fertilization, particularly with P fertilizers, could be recommended for improvement of soil properties. Markovic et al. (2008) applied dolomite up to 20 t ha⁻¹ on the acid hydromorphic soil of Gradiska municipality. Maize was grown three years on the experiment and yield was increased average for 48%. Komljenovic et al. (2010) applied increasing rates of P fertilizers up to 1750 kg P₂O₅ ha⁻¹ on soil of Gradiska municipality. Phosphorus fertilization resulted mainly by considerable yield increase of maize in level 17 %. Yield increases were achieved mainly by application of the P in the level of 750 kg P₂O₅ ha⁻¹.
Table 1. Ranges of soil pH and mobile (AL-method) phosphorus and potassium

<table>
<thead>
<tr>
<th>Soil properties in the municipality Samac (a), Pelagicevo (b), Modrica (c), Srbac (d) and Gradiska (e): number of samples (N) and area covered by sampling (ha)</th>
<th>Soil pH ranges (pH in H₂O)</th>
<th>Soil KCl ranges (mg K₂O 100 g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH H₂O</td>
<td>Number of soil samples (N)</td>
<td>Σ N</td>
</tr>
<tr>
<td>&lt; 4.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.0 - 5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5.0 - 6</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>6.0 - 7</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>7.0 - 8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 8.0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*very low (<5.0), low (5.1-12), good (12.1-20), high (20.1-30) and very high (>30)*

Table 2. Properties of maize at early growth stage on P-deficient soils (Kovacevic et al., 1988)

<p>| Top of maize at 6-9 leaves stage on PIK «Mladen Stojanovic» Nova Topola (municipality Gradiska): dry matter yield (DMY), plant height (PH) and P, Fe and Al status (on DM basis) – averages of four samples | Chlorotic (majority of plants) maize | Normal (at the same plot) maize |</p>
<table>
<thead>
<tr>
<th>Sample</th>
<th>g plant⁻¹</th>
<th>cm</th>
<th>%</th>
<th>mg kg⁻¹</th>
<th>g plant⁻¹</th>
<th>cm</th>
<th>%</th>
<th>mg kg⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMY</td>
<td>PH</td>
<td>P</td>
<td>Fe</td>
<td>Al</td>
<td>DMY</td>
<td>PH</td>
<td>P</td>
<td>Fe</td>
</tr>
<tr>
<td>1-4</td>
<td>2.78</td>
<td>23</td>
<td>0.29</td>
<td>3470</td>
<td>3817</td>
<td>18.84</td>
<td>72</td>
<td>0.46</td>
</tr>
</tbody>
</table>

REFERENCES


