Micronutrients in selected food crops in Muguga, Kenya
Nguli Magdalene1,2, A. Galgalle1,2, M. Gatari1
1Institute of Natural Sciences & Technology, College of Agriculture & Engineering, University of Nairobi, P. O. Box 30877-00100, Nairobi, Kenya.
2World Agroforestry Centre (ICRAF), P. O. Box 30877-00100, Nairobi, Kenya.

Introduction

Micronutrients are essential for growth of plants and although they are required in small quantities, inadequate supply of one or more of these results in reduced yields and quality of crop products. They are transferred through the food chain to human beings and other animals and are essential for health, growth and development. It is important to carry out research on the levels of micronutrients in crops and this would be helpful in the establishment of crop quality monitoring systems as well as micronutrient bank and management systems in Kenya so as to monitor plant health and come up with possible interventions.

The study was aimed at finding out crop response to micronutrients available in the soils on which they are grown and compare levels of micronutrients in crops and this would be helpful in the establishment of crop quality monitoring systems as well as micronutrient bank and management systems in Kenya so as to monitor plant health and come up with possible interventions.

Materials and Methods

The study followed a random sampling design in which offset grid sampling pattern was used.

Fig 1: Sampling design

Leaves/whole crop samples of beans (Phaseolus vulgaris), potatoes (Solanum tuberosum) and maize (Zea mays) were Sampled.

Fig 2: Sampling

The samples were cleaned with deionized water and oven dried at 60 °C for 48 hours. They were then ground to between 20 - 53 µm using a micronizing mill.

45 mg of sample was weighed and 2.5 ml aqueous Triton X-100 added. 40 µl of 1000 ppm Sc was added as internal standard.

45 mg of sample was weighed and 2.5 ml aqueous Triton X100 added. 40 µl of 1000 ppm Sc was added as internal standard.

10 µl of sample was pipetted to a siliconized sample carrier and dried at 50 °C for 10 minutes. Analysis was then carried out for 600 s using Total reflection X-ray Fluorescence (TXRF).

Fig 3 & 4: Sample preparation

Results and Discussion

Essential micronutrients, that is, Manganese (Mn), Iron (Fe), Nickel (Ni), Copper (Cu) and Zinc (Zn) were studied.

<table>
<thead>
<tr>
<th></th>
<th>Mn</th>
<th>Fe</th>
<th>Cu</th>
<th>Ni</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Element means for the three crop species and soil (all concentration levels are in units of mg/kg)

The nutrient levels varied among the three crops with beans showing the highest levels of Mn and Ni. Highest levels of Fe and Zn were observed in maize while potatoes had the highest levels of Cu.

Fig 5: Bench top TXRF for sample analysis

Fig 6: Graphs of measured concentration per element for the three crop species and soil

There was a good correlation among all the elements per plant and soil when data from all the sampling points was used. Therefore, for comparison of soil and plants, the mean values were used.

Table 2: Plant/soil ratios for all micronutrients analyzed for the three crop species.

<table>
<thead>
<tr>
<th></th>
<th>Maize</th>
<th>Potatoes</th>
<th>Leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The plant/soil ratios (mobility ratio, MR) values for Zn and Pb were greater than 1 for Cu in all the three crop species and for Fe and Zn in beans and maize. This showed that all the crop species had the capability of enriching Cu while beans and maize enriched Fe and Zn.

The MR values were less than 1 for Ni in the three crop species and Zn in potatoes. This was an indication of low micronutrient translocation from soil to the crops. Therefore, these crops behaved as excluders of these elements.

Fe and Zn in potatoes had MR values close to 1.

Very low levels, MR < 0.1, were observed for Mn in all the crop species and also Ni in Maize. This was an indication of limited ability of these crops to uptake these micronutrients from the soils.

Conclusion

Cu was the micronutrient that was most enriched in all the crop species. Substantial differences were observed in relative enrichment of micronutrients from plant to plant with potatoes being the best enrichers of Cu while maize best enriched Fe and Zn and this can be attributed to efficient transport systems.

Poor translocation of Mn and Ni in all crops and Fe & Zn in potatoes could be as a result of inability of roots to access sufficient nutrients in the soil, root injury or even plant genetics.

In these soil conditions, potatoes showed the poorest micronutrient translocation from the soil with Mn, Ni and Zn ratios being less than 1 while Fe ratio was just around 1.