Diversity of iron & zinc in seed of common bean genotypes in East Africa


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Introduction
Malnutrition is a major contributor to infant mortality in Sub-Saharan Africa and deficiency of micronutrients such as iron (Fe), zinc (Zn) and vitamin A affect at least half of the world’s population. Utilization of bio-fortified crops in diets provides a feasible and sustainable option to address malnutrition. Common bean (Phaseolus vulgaris L) a leading staple after maize in East and Central Africa (ECA) is a good source of bioavailable Fe and Zn. However, the concentration of these micronutrients is highly variable among bean genotypes, ranging from 55ppm to 110ppm for iron and 25ppm to 60ppm for zinc. This study sought to identify superior genotypes with high iron and zinc among the regional nurseries for the ECA region.

Results

Fe and Zn concentrations in the seed

• There were significant differences (P ≤ 0.001) in seed Fe and Zn signifying diversity.
• Seed Fe and Zn ranged from 44-93ppm and 20-47ppm (Table 1) for XRF.
• Confirmation of findings by ICPAES in selected varieties resulted in lower values ranging from 48-70ppm (Fe) and from 27-38ppm (Zn).
• In addition, longer days to maturity tended to depict higher seed Fe concentration in this study.
• A total of 55 varieties had seed Fe concentration greater than the value obtained in the high Fe check (Table 1).

Resistance to Pythium and Fusarium root rot

Several varieties were resistant to either Pythium and Fusarium root rot (Fig. 1). Among the high Fe beans in SOH nursery RW 582, RW 721, RW 806 and RW 839 were resistant to both pathogens.

Conclusions

• There is variability in seed Fe and Zn concentration among genotypes collected from East Africa.
• Twelve entries including; CAB 2, RW 547, Ndirimukija, Jesca, UGK72, RW 846, UGK116, UGK85, RW 1180, RWV 3006, RWV1129 and UGK39 were confirmed as high in seed Fe and are being promoted in the region.
• RW 582, RW 721, RW 806 and RW 839 which were resistant to root rot also had Fe concentration ≥75ppm in two seasons and are useful breeding parents for root rot resistance and high Fe seed concentration.

Methods

A total of 304 bean varieties from four nurseries (Table 1) were field evaluated in either randomized complete block or alpha lattice design, for both agronomic traits, and Fe and Zn concentrations, over a three year period at the CIAT Uganda station based at the National Agricultural laboratories (NARL), Kawanda. Some varieties were also screened for resistance to Pythium and Fusarium root rot.

• Fe and Zn analysis involved sampling 25 well-filled pods hanging above the soil, from each plot before the main harvest.
• A 200gm seed sample was taken (Stangouilis and Sison, 2008) and sent to Rubona Agriculture Research Centre, Rwanda where a sub-sample of 5-10 grams per replication was analyzed using X-ray fluorescence (XRF).
• Varieties with Fe and Zn levels higher than the high Fe check (MIB 465) were selected and confirmed using Inductively Coupled Plasma Atomic Emission Spectrometry (ICPAES) at Waite Analytical Services in Adelaide, Australia.

Acknowledgements

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Table 1: Distribution of seed Fe and Zn concentration in tested bean varieties

<table>
<thead>
<tr>
<th>Nursery</th>
<th>No. of varieties</th>
<th>Year</th>
<th>Fe (ppm)</th>
<th>Zn (Feppm)</th>
<th>Fe(ppm) in High Fe check</th>
<th>No. of varieties with Fe &gt; High Fe check</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) SOH</td>
<td>61</td>
<td>2011b</td>
<td>56-89</td>
<td>24-44</td>
<td>74(MIB465)</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>2012a</td>
<td>59-93</td>
<td>28-47</td>
<td>88(MIB465)</td>
<td>28</td>
</tr>
<tr>
<td>(ii) PABRA 1st track</td>
<td>14</td>
<td>2011b</td>
<td>44-89</td>
<td>27-40</td>
<td>75(MIB465)</td>
<td>2</td>
</tr>
<tr>
<td>(iia) RNN “Bush”</td>
<td>14</td>
<td>2012b</td>
<td>56-76</td>
<td>24-39</td>
<td>76(MIB465)</td>
<td>0</td>
</tr>
<tr>
<td>b. RNN “Climbers”</td>
<td>23</td>
<td>2012b</td>
<td>60-89</td>
<td>26-42</td>
<td>76(CAB2)</td>
<td>2</td>
</tr>
<tr>
<td>(iv) Uganda collection</td>
<td>187</td>
<td>2011b</td>
<td>36-89</td>
<td>25-40</td>
<td>75(MIB465)</td>
<td>8</td>
</tr>
</tbody>
</table>

Figure 1: Frequency of Pythium and Fusarium root rot scores among SOH

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