Introduction and objectives

- Fertiliser microdosing is currently promoted in semi-arid areas of sub-Saharan Africa as a means to increase crop productivity, profitability and resource use efficiency.
- However, little is still known regarding the main management and environmental factors that govern yield response to this technique in smallholder farmers’ fields.
- The specific objectives of our study were: (i) to quantify the response of maize to fertiliser microdosing alone or combined with manure in smallholder farmers’ fields, (ii) to determine the main factors that govern such responses and (iii) to evaluate the economic risk associated with each treatment based on the distribution of value-cost ratios.

Materials and methods

Study zone

- Multi-locational participatory farmer trials during two years (18 sites in 2014 and 32 in 2015), one farmer field = one replicate with six treatments:
  - i) Control (no fertiliser, no manure),
  - ii) Microdosing option 1 (M1): 2 g NPK 15-15-15 per hill at 10-14 days after sowing, DAS + 1 g urea per hill at 45-50 DAS;
  - iii) Microdosing option 2 (M2): 4 g NPK 15-15-15 per hill at 10-14 DAS + 1 g urea per hill at 45-50 DAS;
  - iv) M1 + hill-placed farmyard manure at 31 DM ha⁻¹ (M1+F),
  - v) M2 + hill-placed farmyard manure at 31 DM ha⁻¹ (M2+F) and
  - vi) Spot-placed recommended rate (RR): 200 kg NPK 15-15-15 ha⁻¹ at 10-14 DAS + 100 kg urea ha⁻¹ at 45-50 DAS.
- Maize (DMR-ESR variety) was planted at a density of 62,500 plants ha⁻¹.

Data collection and analysis

- Field history: previous crops, previous fertilization, distance from the village
- Soil and land characteristics, seasonal rainfall, cumulative rainfall between sowing and maturity, sowing date, weed pressure
- Maize grain yields (GY)
- Economic analysis: VCR = [(GYy - GYy_control)] / Costs of fertilizer + manure + labor

Results

Maize grain yields

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2014 Mean</th>
<th>2015 Mean</th>
<th>2014 SD</th>
<th>2015 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1089a</td>
<td>1049a</td>
<td>264</td>
<td>351</td>
</tr>
<tr>
<td>M1</td>
<td>2240b</td>
<td>2183b</td>
<td>332</td>
<td>541</td>
</tr>
<tr>
<td>M2</td>
<td>2330b</td>
<td>2248b</td>
<td>343</td>
<td>677</td>
</tr>
<tr>
<td>M1+F</td>
<td>3072c</td>
<td>2889c</td>
<td>431</td>
<td>687</td>
</tr>
<tr>
<td>M2+F</td>
<td>3268c</td>
<td>3001c</td>
<td>206</td>
<td>862</td>
</tr>
<tr>
<td>RR</td>
<td>2590b</td>
<td>2319b</td>
<td>490</td>
<td>646</td>
</tr>
<tr>
<td>P value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Strong positive response at all sites to both M1 and M2 (+110 % on average).
- Adding manure further increase grain yield by 36% on average compared to the sole M1 and M2.
- There was a large variability in yields among farmers.

Factors explaining yield variability

- In addition to the experimental treatments, yield variability can be explained by the rainfall and related factors, weed pressure, previous crop and some topsoil characteristics (distance from village, clay+silt, total N and C content).

Economic profitability and risk analysis

- For average input and output price (S0), VCRs were 2.1 and 1.5 times greater in M1 and M2 treatments, respectively, compared to RR [P < 0.001].
- Combining manure with M1 significantly decreased VCR by 1.0 compared to the sole M1 (P<0.001), while there was no significant difference between M2 and M2+F.
- Irrespective of the scenario, applying microdosing alone or combined with manure was economically profitable for more than 80 % of the sites (VCR ≥ 2), while only 60 % achieved a VCR ≥ 2 for the RR treatment.

Conclusions

- Fertiliser microdosing is better adapted to the realities of smallholder farmers than the recommended rate while still ensuring very significant yield increases and economic benefits.
- However, there is a need to evaluate this technology across a wider zone and for a larger number of farms to better predict crop responses.