Trace Element Nutrition

“Healthy Plants & Healthy Communities”
OUTLINE

• Why Trace Elements are important
• Worldwide situation with Trace Elements
• Situation in Australia
• Conclusions
2009 Travel

TRIP1 Contemporary Scholars Conference
TRIP2 Global Focus
TRIP3 Trace Element Research
WHY are TRACE ELEMENTS important?
Zinc deficiency in humans

- Reduced appetite, taste acuity
- Stunted growth
- Skin lesions
- Diarrhea & infections vulnerability
- Type 2 nutrient = dilution
World Map – Zinc Deficiency

Increased health risks associated with low Selenium

- Poor immune function
- Impaired thyroid function
- Compromised male infertility
- Increased risk of cancer
Optimal SELENIUM level for cancer prevention

Fig. 1. Mean selenium intake levels (μg/d) in different countries (Combs, 2001; Rayman 2004) and the range of selenium intake believed to be required for optimal activity of plasma glutathione peroxidase (Thomson et al. 1993, Duffield et al. 1999).

Copper and zinc concentrations in wheat grain from Broadbalk at Rothamstead UK since 1845

Copper and zinc concentrations in wheat grain from Broadbalk at Rothamstead UK since 1845.
Dilution and transport phenomena

TRACE ELEMENTS ARE LEFT BEHIND!
TRACE ELEMENTS IN AGRICULTURE WORLDWIDE
Less than 25% of the yield potential is realized worldwide at the moment, mainly due to abiotic stresses (e.g. drought, heat, flooding, low nutrient status...).

We spend a majority of our time and resources on **BIOTIC** stresses, however there is much more to be gained by tackling **ABIOТИC** stresses.

Source: Bray et al., 2000, In Molecular Biology and Biochemistry of Plants, ASPP
Any imbalance in these hormone cycles at any time can irreversibly reduce genetic expression.
Zinc Mobilization During Germination

Wheat seeds

Seed Zn: 17 ppm

Low Zinc

Seed Zn: 61 ppm

High Zinc

Ozturk et al., 2005
GRIMWAY FARMS CALIFORNIA
IOWA
<table>
<thead>
<tr>
<th>Trace Elements</th>
<th>Nutrient Concentration PPM (dry basis)</th>
<th>Grams nutrient / ton of Chicken litter</th>
<th>Kilograms of nutrient applied/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boron</td>
<td>20</td>
<td>13.6</td>
<td>0.102</td>
</tr>
<tr>
<td>Iron</td>
<td>492</td>
<td>386</td>
<td>2.90</td>
</tr>
<tr>
<td>Manganese</td>
<td>808</td>
<td>630</td>
<td>4.73</td>
</tr>
<tr>
<td>Copper</td>
<td>29</td>
<td>23</td>
<td>0.173</td>
</tr>
<tr>
<td>Zinc</td>
<td>684</td>
<td>535</td>
<td>4.01</td>
</tr>
<tr>
<td>Macro Elements</td>
<td>Mg/kg</td>
<td>Grams/ton</td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>16248</td>
<td>18872</td>
<td>14.7</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>21904</td>
<td>25441</td>
<td>19.9</td>
</tr>
</tbody>
</table>

The chicken litter is applied at 7.5 tonnes/ha.
Ismail Cakmak – Sabansci University Turkey, IPNC, Fresno, California
Seed Zinc concentrations in TURKEY

- 36 ppm
- 80 ppm
- 147 ppm

Higher seed Zn content is particularly important under stressful conditions!
AUSTRALIA

THE CURRENT SITUATION WITH TRACE ELEMENTS
RHIZOCTONIA

+ Zinc

- Zinc

NUFFIELD AUSTRALIA
FARMING SCHOLARS
Critical Level

Max yield level WITH variability and Critical Level accounted for

Level of excess

Canola Molybdenum (Tissue test results)
WHAT WE CAN DO ABOUT IT?
## Cost of the Brew (per Ha)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
<th>Price</th>
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</thead>
<tbody>
<tr>
<td>Triad Fungicide @ 250g (product)</td>
<td></td>
<td>$5.77</td>
</tr>
<tr>
<td>Zinc (1.5kg ZnSu) @ 375g (active)</td>
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<td>$2.16</td>
</tr>
<tr>
<td>Moly 10g (NaMo) @ 4g (active)</td>
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<td>$0.50</td>
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<tr>
<td>Copper (Big Red) 80ml @ 50g (active)</td>
<td></td>
<td>$0.90</td>
</tr>
<tr>
<td>Supalink @ 40ml (product)</td>
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<td>$0.44</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$9.77</strong></td>
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</tbody>
</table>

**Triad** = $5.77  
**Trace Elements** = $4.00
## Cost-to-benefit, China

<table>
<thead>
<tr>
<th>Treatment</th>
<th>ZnSulph. (kg/ha)</th>
<th>Yield (kg/ha)</th>
<th>Yield increase (kg/ha)</th>
<th>Value of applicat. (US$)</th>
<th>Fertilizer cost (US$)</th>
<th>Cost-to-benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter in soil</td>
<td>22.5</td>
<td>9668</td>
<td>1082</td>
<td>141.5</td>
<td>10</td>
<td>1:14</td>
</tr>
<tr>
<td>Seed mixed</td>
<td>0.36</td>
<td>9502</td>
<td>916</td>
<td>128.2</td>
<td>0.1</td>
<td>1:1280</td>
</tr>
<tr>
<td>Foliar, 3 times</td>
<td>2.25</td>
<td>9463</td>
<td>877</td>
<td>121.9</td>
<td>0.9</td>
<td>1:122</td>
</tr>
<tr>
<td>Untreated</td>
<td>0</td>
<td>8586</td>
<td>n/a</td>
<td>n/a</td>
<td>0</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Source: Sun et al., 2005
Conclusions

- Benchmark soil and tissue test Trace Element values on-farm based on best economics and production.
- Know what a ‘critical value’ is.
- Set-up a liquid system to “row load” Trace Elements.
- Learn to visually assess your crops for Trace Element deficiencies.
- Look for alternative Trace Element fertilisers.
- Quality based on Trace Element concentrations in grain is the future (new industry quality standards).
- Assess your diets intake of essential Trace Elements.
THANKS

• FAMILY
• GGA
• Nuffield