Presentation developed by
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During the Master in Boron fertilization in Maize Crops at Universidade Federal do Parana – Brazil
Lesson developed by Fabiano Silvestrin
and presented to Post Graduation at
Federal University of Parana
Boron and Plant Nutrition

Curitiba
2011
BORON MINERAL NUTRITION OF PLANTS.
Unlike other micronutrients, B has predominance in sedimentary rocks.
The Boron concentration in the soil is variable, ranging between 7 and 80 mg.kg\(^{-1}\), with average value of 10 mg.kg\(^{-1}\) (KRAUSKOPF, 1972).

According to Jackson (1970), the total concentration of boron in the soil can vary between 4 and 98 mg.dm\(^{-3}\), and for regions where there is the presence of clay soils and moisture, the content of that nutrient in the soil is between 30 and 60 mg.dm\(^{-3}\) and in sandy soils variation occurs between 2 and 6 mg.dm\(^{-3}\).
A factor of concern among researchers for boron is the existence of a narrow band between the limits of its sufficient concentration in soil and the toxic level for most plants (Motta et al., 2007, GOLDBERG, 1997).
In most agricultural soils, B is in the form of boric acid (H$_3$BO$_3$), which is a weak acid.
BORON FORMS IN SOIL

Total (primary minerals and fixed in O. M)

No part of the solution of the soil

In the soil solution

Absorbable form by plants
The greatest availability of B in the soil is in the pH range between 5.0 and 7.0.
AVAILABLE NUTRIENTS IN EACH VARIATION OF pH.
The oxides and hydroxides of Fe and Al adsorb large amounts of B, especially in the pH range between 6.0 and 9.0.
The adsorption increases with increasing pH, temperature, content of the adsorbent materials and with decreasing soil moisture (GOLDBERG, 1993).

The oxides and hydroxides comprise the clay fraction of the soils; therefore, the greater the clay content of the soil, the greater the adsorption of B (Toner IV & Sparks, 1995).
Adsorption of boron in the soil.

Boron Adsorption the pH oxides 6.0

20 X GREATER

AI OXIDES

Fe OXIDES
Adsorption of boron by clays.

BORON ADSORPTION IN SOIL

ILITA
ARGILA 2:1

MONTMORILONITA
ARGILA 2:1

CAULINITA
ARGILA 1:1
Adsorption of boron to iron oxide in solutions containing 5 mg B.L\(^{-1}\) (GOLDBERG & GLAUBIG, 1985).
BORON IN THE SOIL. (Under drought conditions).

TWO REASONS DROUGHT CONDITIONS ACCELERATE APPEARANCE BY THE DEFICIENCY B:

- MINOR DECOMPOSITION OF ORGANIC MATTER SOIL
- TRANSPORT OF THE B SOIL IS REDUCED (MASS FLOW).
LeNOBLE et al. (1993), LUKASZEWSKI & BLEVINS (1996) and Cabrera (2006) found that, in dicotyledons, boron provided the root development even under conditions of toxic aluminum.

The second paper explained the phenomenon by the increased production of ascorbate in plants supplied with boron. Plants with boron deficiency recovered the root development with the addition of ascorbate to the medium.
The availability of boron in the soils is directly related to soil textural class.

Under conditions of predominantly sandy soils, associated with high rainfall, there is a high degree of B losses by leaching, decreasing its availability in the soil (ABREU; LOPES; SANTOS, 2007).
Cl⁻ - NO₃⁻ - H₃BO₃ - SO₄⁻² - MoO₄⁻²

K⁺ > NH₄⁺ > Mg⁺² > Ca⁺²

GREATER

anions

cations

SMALLER

Adapted Vitti, 2009.

NUTRIENT LEACHING.
LEACHING

ANIONS  
(\(\text{Cl}^- > \text{NO}_3^- > \text{H}_3\text{BO}_3 > \text{SO}_4^{2-} > \text{MoO}_4^{2-}\))

CATIONS  
(\(\text{K}^+ > \text{NH}_4^+ > \text{Mg}^{2+} > \text{Ca}^{2+}\))

MECHANISMS OF NUTRIENT ABSORPTION:

ROOT INTERCEPTION:  \(\text{Ca}^{2+}, \text{Mg}^{2+}\)

MASS FLOW:  
\(\text{Cl}^- > \text{H}_3\text{BO}_3 > \text{NO}_3^- > \text{SO}_4^{2-} > \text{MoO}_4^{2-} > \text{Na}^+ > \text{K}^+ > \text{NH}_4^+ > \text{Mg}^{2+} > \text{Ca}^{2+}\)

SPREADING:  
\(\text{H}_2\text{PO}_4^- > \text{Cu}^{2+} > \text{Mn}^{2+} > \text{Zn}^{2+} > \text{Fe}^{2+} > \text{K}^+\)

A RECOMMENDATION OF FERTILIZING CAN BE BASED IN:

MASS FLOW: GROOVE FERTILIZING OR IN COVERAGE.

SPREADING: IN PLANTING (SOWING), ALWAYS NEAR THE ROOT SYSTEM, IMPROVING THE EFFICIENCY OF FERTILIZATION, MAINLY FOR MICRONUTRIENTS (Cu, Fe, Mn e Zn).

Adapted Vitti, 2009
Extraction of Boron in soils by hot water was suggested by Berger and Truog in 1939 and it is today considered one of the best methods to use.

For the compound $\text{H}_3\text{BO}_3$, the diffusion value for boron in water is $10.1 \times 10^{-6} \text{ cm}^2\text{s}^{-1}$ (ELLIS et alii, 1983) and in the soil SULAIMAN & KAY (1972) found an average of $2.5 \times 10^{-6} \text{ cm}^2\text{s}^{-1}$.
BORON IN THE PLANT

- B is absorbed by the plant in the form of boric acid ($\text{H}_3\text{BO}_3$) and/or borate ion ($\text{H}_4\text{BO}_4^-$).

- B is immobile in plants and translocated mainly through the xylem, having a very limited mobility in the phloem.

- The accumulation of B occurs in the older leaves, specially at the tips and margins.
As a rule, boron is immobile in the phloem.

Exceptions are plants that produce polyols – as sorbitol, mannitol, dulcitol – which complex boron, making it mobile in the phloem, as it occurs in almond, apple and nectarine tree (Potafós, June 2000).

B deficiencies are observed in younger leaves.
FUNCTIONS OF BORON ON THE PLANT.

- Transport of sugars.
- Summary of cell wall, lignification, cell wall structure.
- Carbohydrate metabolism, RNA metabolism.
- Respiration and metabolism of AIA, phenolic metabolism, ascorbate metabolism and plasmatic membrane integrity.
- Ripening of flowers and pollen tube growth.
FUNCTIONS OF BORON ON THE PLANT.

- Boron is involved in absorption and metabolism of cations, especially Ca, in the formation of cell membrane pectine.

- Boron acts in the nitrogen metabolism and in the activity of hormones.
The work of POWER & WOODS (1997) provides a lot of information related to boron, with great practical implication:

- The absorption of potassium increases in the presence of boron and it hardly occurs in its absence; or many cases of potassium deficiency may, in fact, be boron deficiency.
- Boron has an important role in the transport of P through the membranes, and as in the case of K, many cases of P deficiency can actually reflect B deficiency.
B and Zn are essential for the optimal functioning of the ATPase and the plasmatic membrane redox systems; without B there can be a reduced efficiency and Zn and vice versa.

The urease enzyme is inhibited by boric acid – a warning or explanation for cases of failures in the foliar application of urea along with boric acid.
The concentration of B in plants range between 12 and 50 mg kg\(^{-1}\) of dry weight of the tissue.

For a good growth of most crops, B concentrations in the leaf tissue should be between 30 to 50 mg kg\(^{-1}\).

Deficient plants exhibit leaf concentrations less than 15 mg kg\(^{-1}\). (Malavolta, 1980; Malavolta et al., 1989; Pais & Jones Junior, 1996; Furlani, 2004).
FOLIAR LEVELS OF BORON CONSIDERED TO BE IDEAL FOR MAIZE: VALUES BETWEEN 10 – 25 mg kg\(^{-1}\). (EMBRAPA, 1999).
Extraction and export of Boron from some agricultural crops.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Extraction g.t⁻¹ of grain</th>
<th>Export g.t⁻¹ grain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean</td>
<td>77</td>
<td>22</td>
</tr>
<tr>
<td>Corn</td>
<td>18.3</td>
<td>4.4</td>
</tr>
<tr>
<td>Wheat</td>
<td>19.9</td>
<td>2.9</td>
</tr>
<tr>
<td>Bean</td>
<td>66.3</td>
<td>13.3</td>
</tr>
</tbody>
</table>

Adapted Pauletti, 2004
SYMPTOMS OF BORON DEFICIENCY IN PLANTS.

- Reduced growth and deformation in the zones of growth (in plants with B deficiency, the new cells are not differentiated).
- Decreased foliar surface with deformed, thickened, brittle and small leaves. They may exhibit chlorosis or even a more intense green color.
- Reduced root growth.
- Floral abortion.
SYMPTOMS OF BORON DEFICIENCY IN PLANTS.

- Cracks in branches, petioles and sometimes in the fruits.
- Decrease in chlorophyll concentration.
- Decrease in resistance to infections.
- Decreased activity of oxidizing enzymes (catalase, peroxidase and polyphenol oxidase).
Summary presentation of Master Degree
Application and determination of the critical levels of boron in maize

Curitiba
2011
INTRODUCTION

SOURCE: SILVESTRIN, 2009
Boron in soil

- Sand soils
  B losses by leaching.
BORON IN THE PLANT

- Absorption: $\text{H}_3\text{BO}_3$ and $\text{H}_4\text{BO}_4^-$

- Immovable in most plants, translocated via the xylem.

- Accumulation of B occurs in older leaves, corners and edges
LEVELS OF BORON CONSIDERED SUFFICIENT IN FOLIAR TISSUE FOR A GOOD DEVELOPMENT OF MAIZE.

<table>
<thead>
<tr>
<th>AUTHORS</th>
<th>Levels of B – mg kg(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAIJ et al., 1996</td>
<td>10 – 25</td>
</tr>
<tr>
<td>EMBRAPA, 2009</td>
<td>10 – 25</td>
</tr>
<tr>
<td>OLIVEIRA, 2002</td>
<td>10 – 25</td>
</tr>
<tr>
<td>MALAVOLTA et al., 1997</td>
<td>15 – 20</td>
</tr>
<tr>
<td>REHM, 2002</td>
<td>6 – 40</td>
</tr>
<tr>
<td>LOPES, 1998</td>
<td>5 – 25</td>
</tr>
</tbody>
</table>
Recommendation of collection of leaf tissue for chemical analysis of boron

1st sheet below and opposite the spike

1/3 middle

30 leaves

Malavolta et al., 1997; Oliveira, 2002; Pauletti, 2004
OBJECTIVES

SILVESTRIN, 2009.
GENERAL OBJECTIVE

- Check the response of maize crop to the application of increasing doses of boron and determination of critical levels of this nutrient in plants.
SPECIFIC OBJECTIVES

- Evaluate the effect of boron application on the productivity in maize crop
- Determine the critical levels of B in plants for maize crop
- Determine which part of the leaf or plant tissue best expresses the critical level of boron in the maize plant
ASSUMPTIONS

- Fertilization with boron increases productivity in maize crop.

- The different plant tissues analyzed should have different critical levels of boron for maize crop.
MATERIAL AND METHODS

TWO EXPERIMENTS WERE PERFORMED:

- LATOSSOLO Bruno Dystrophic, medium texture (EMBRAPA, 2006).
  - Ipiranga – Parana state
  - Altitude of 905 meters
  - 25°59’15.8” South and 50°41’54.9” West

- LATOSSOLO Vermelho Dystrophic, medium texture (EMBRAPA, 2006).
  - Ipiranga – Parana state
  - Altitude of 890 meters
  - 25°01’43.6” South and 50°42’53.8” West
Presence of Boron in soils of Parana State (Brazil)

Boron levels in the soil

High levels

Medium levels

Low levels

Source: Professor Ph.D Motta, Universidade Federal do Parana
### PHYSICAL ANALYSIS OF SOILS – 0 to 20 cm

<table>
<thead>
<tr>
<th></th>
<th>Sand</th>
<th>Clay</th>
<th>Silt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latossolo Bruno Dystrophic, medium texture. (crop 2008/09)</td>
<td>587 g Kg(^{-1})</td>
<td>283 g Kg(^{-1})</td>
<td>130 g Kg(^{-1})</td>
</tr>
<tr>
<td>Latossolo Vermelho Dystrophic, medium texture. (crop 2009/10).</td>
<td>532 g Kg(^{-1})</td>
<td>332 g Kg(^{-1})</td>
<td>136 g Kg(^{-1})</td>
</tr>
</tbody>
</table>

### CHEMICAL ANALYSIS OF SOIL – 0 to 20 cm

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>P (mg dm(^{-3}))</th>
<th>K (mmolc dm(^{-3}))</th>
<th>Ca (mmolc dm(^{-3}))</th>
<th>Mg (mmolc dm(^{-3}))</th>
<th>Al (mmolc dm(^{-3}))</th>
<th>O. M. (g dm(^{-3}))</th>
<th>B (mg dm(^{-3}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latossolo Bruno Dystrophic</td>
<td>4.9</td>
<td>11</td>
<td>1.1</td>
<td>24</td>
<td>12</td>
<td>1.9</td>
<td>31.63</td>
<td>0.17</td>
</tr>
<tr>
<td>Latossolo Vermelho Dystrophic</td>
<td>5.1</td>
<td>14</td>
<td>1.4</td>
<td>29</td>
<td>14</td>
<td>0</td>
<td>22.17</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Silvestrin, 2010
EXPERIMENTS: CROPS 2008/09 and 2009/10

- Hybrid: Pioneer 30P34
- Spacing between lines: 0.7 meters
- Seeds: 70,000 ha\(^{-1}\)
- Boron source: Boric Acid
Fertilization:

- Planting: 320 kg ha\(^{-1}\) of NPK12–25–12
- Broadcast: 165 kg ha\(^{-1}\) of urea (V4) and 180 kg ha\(^{-1}\) of NPK 20–00–20 (V6)

Totaling: 150 kg ha\(^{-1}\) de N, 80 kg ha\(^{-1}\) of P\(_2\)O\(_5\) and 72 Kg ha\(^{-1}\) of K\(_2\)O
<table>
<thead>
<tr>
<th>SEASON OF APPLICATION</th>
<th>DOSES OF BORON – Kg ha(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLANTING (SEM)</td>
<td>0</td>
</tr>
<tr>
<td>V6</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Boron source: \(\text{H}_3\text{BO}_3\)
SEASONS OF APPLICATION OF BORON

FIRST APPLICATION: PLANTING (SEM)

SECOND APPLICATION: V6 STADIUM

SOURCE: EMBRAPA
Randomized blocks with 3 replications.
STATEMENT OF PORTION

7 meters

4.2 meters

SHARE: 29.4 m²
ANALYSIS OF TISSUES – B

FIRST LEAF BELOW AND OPPOSITE THE COB

1/3 INFERIOR
1/3 MIDDLE
1/3 SUPERIOR
WHOLE LEAF

COB LEAF

FEMALE INFLORESCENCE
1st sheet below and opposite the spike

1/3 inferior

1/3 middle

1/3 superior
SPIKE LEAF
(collect for chemical analysis)

SILVESTRIN, 2009

SOURCE: GOOGLE
Female inflorescence of maize "spike hair"

SILVESTRIN, 2009
YIELD COMPONENTS

- Productivity
- 1000 Seeds
- Cob Sizes
- Number of Ears
- Number of Plants
SOIL COLLECTION

(20 sub-samples per plot)

- 0 – 20 cm
- 20 – 40 cm
Rainfall between months from October to April of 2008/09 and 2009/10 seasons.

• The results were analyzed for normality by the Shapiro–WilK test.

• ANOVA
  • (Significance of Contents 5%)

• For doses regression equations were adjusted using the mean polynomial of higher degree.
RESULTS AND DISCUSSION
# Effect of season

<table>
<thead>
<tr>
<th>Season</th>
<th>Yield</th>
<th>M.M.G</th>
<th>Plants</th>
<th>Spikes</th>
<th>Cob Size</th>
<th>0-20 cm</th>
<th>20-40 cm</th>
<th>B - Only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg ha^{-1}</td>
<td>g</td>
<td>cm</td>
<td>mg kg^{-1}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2008_09</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td>8228 a</td>
<td>289.72 a</td>
<td>63672 a</td>
<td>59636 a</td>
<td>15.38 a</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>V6</td>
<td>7769 a</td>
<td>286.12 a</td>
<td>63695 a</td>
<td>58916 a</td>
<td>15.34 a</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>CV</td>
<td>9.11</td>
<td>3.37</td>
<td>3.05</td>
<td>4.69</td>
<td>3.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2009_10</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td><strong>8548</strong> a</td>
<td>347.17 a</td>
<td><strong>65928</strong> a</td>
<td>65061 a</td>
<td><strong>15.24</strong> a</td>
<td>0.22 b</td>
<td>0.23 b</td>
<td></td>
</tr>
<tr>
<td>V6</td>
<td>7576 b</td>
<td>345.39 a</td>
<td>62118 b</td>
<td>62066 a</td>
<td>14.76 b</td>
<td><strong>0.44</strong> a</td>
<td><strong>0.39</strong> a</td>
<td></td>
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<tr>
<td>CV</td>
<td>12.21</td>
<td>6.7</td>
<td>9.44</td>
<td>8.61</td>
<td>3.3</td>
<td>42.65</td>
<td>41.89</td>
<td></td>
</tr>
</tbody>
</table>

Silvestrin, 2010
# Effect of season

<table>
<thead>
<tr>
<th>Season</th>
<th>Spike leaf</th>
<th>Below sheet</th>
<th>1/3 average</th>
<th>1/3 superior</th>
<th>1/3 inferior</th>
<th>Hair</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2008_09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td>11.33 a</td>
<td>12.75 a</td>
<td>8.76 a</td>
<td>20.48 b</td>
<td>11.02 b</td>
<td>17.99 a</td>
</tr>
<tr>
<td>V6</td>
<td>11.73 a</td>
<td>12.15 a</td>
<td>10.18 a</td>
<td><strong>22.66</strong> a</td>
<td><strong>11.53</strong> a</td>
<td>16.81 a</td>
</tr>
<tr>
<td>CV</td>
<td>28.33</td>
<td>51.21</td>
<td>35.6</td>
<td>13.29</td>
<td>11.83</td>
<td>21.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2009_10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td>7.74 b</td>
<td>10.12 a</td>
<td>8.40 b</td>
<td>10.83 b</td>
<td>7.99 b</td>
<td>23.31 a</td>
</tr>
<tr>
<td>V6</td>
<td><strong>9.65</strong> a</td>
<td>11.35 a</td>
<td><strong>10.49</strong> a</td>
<td><strong>13.86</strong> a</td>
<td><strong>9.69</strong> a</td>
<td>26.58 a</td>
</tr>
<tr>
<td>CV</td>
<td>28.4</td>
<td>31.73</td>
<td>20.52</td>
<td>23.15</td>
<td>22.04</td>
<td>21.58</td>
</tr>
</tbody>
</table>
BORON CONCENTRATION IN THE SOIL “LATOSSOLO VERMELHO DISTRÓFICO”, medium texture. (mg Kg\(^{-1}\)). DEPTHS OF 0–20 and 20–40 cm.

\[ V6 \ y = -0.0013x^2 + 0.0727x + 0.2087 \quad R^2 = 0.9861^{**} \]

\[ V6 \ y = -0.002x^2 + 0.0872x + 0.1313 \quad R^2 = 0.9437^{**} \]

Source: Silvestrin, 2010
Rainfall between months from October to April of 2008/09 and 2009/10 seasons.

YIELD – Kg ha\(^{-1}\) 2008/09 and 2009/10 seasons.

\[ y = -44.911x^2 + 440.41x + 7749.8 \]

\[ R^2 = 0.8888^{**} \]

SEM \( y = 8228 \) N.S

V6 \( y = 7765 \) N.S

CROP 2008/2009

CROP 2009/10

Silvestrin, 2010
BORON CONCENTRATION OF SPIKE LEAF (mg Kg$^{-1}$). PLANTING (Sem) AND V6 STADIUM OF MAIZE.

**CROP 2008/09.**

\[
y = 0.047x^2 + 0.338x + 9.056 \\
R^2 = 0.856^{**}
\]

**CROP 2009/10.**

\[
y = 0.012x^2 + 0.2337x + 7.4909 \\
R^2 = 0.82^{**}
\]

Silvestrin, 2010
BORON CONCENTRATION IN THE FIRST LEAF BELOW AND OPPOSITE THE SPIKE (mg Kg\(^{-1}\)). PLANTING (Sem) AND V6 STADIUM OF MAIZE.

\[ y = -0.003x^2 + 1.262x + 8.228 \]
\[ R^2 = 0.926** \]

\[ y = 0.0608x^2 + 0.1332x + 9.0952 \]
\[ R^2 = 0.9709* \]

CROP 2008/2009

CROP 2009/10

Silvestrin, 2010
BORON CONCENTRATION IN THE THIRD BOTTOM OF THE FIRST LEAF BELOW AND OPPOSITE THE SPIKE (mg Kg\(^{-1}\)). PLANTING (Sem) AND V6 STADIUM OF MAIZE.

**CROP 2008/2009**

\[ y = 0.047x^2 + 0.410x + 8.634 \]
\[ R^2 = 0.984** \]

**CROP 2009/10**

\[ y = 0.0369x^2 + 0.1518x + 8.0637 \]
\[ R^2 = 0.9746** \]

Silvestrin, 2010
BORON CONCENTRATION IN THE THIRD MIDDLE OF THE FIRST LEAF BELOW AND OPPOSITE THE SPIKE (mg Kg\(^{-1}\)). PLANTING (Sem) AND V6 STADIUM OF MAIZE.

\[ y = 0.073x^2 - 0.092x + 7.869 \]
\[ R^2 = 0.976** \]

\[ V6 \ y = 0.0591x^2 - 0.0113x + 8.8202 \]
\[ R^2 = 0.9255** \]

CROP 2008/2009

CROP 2009/10
BORON CONCENTRATION IN THE THIRD TOP OF THE FIRST LEAF BELOW AND OPPOSITE THE SPIKE (mg Kg$^{-1}$) PLANTING (Sem) AND V6 STADIUM OF MAIZE.

**B accumulation tips and margins**

- **CROP 2008/2009**
  
  \[\text{SEM } y = 0.1182x^2 + 1.6764x + 10.904 \quad \text{R}^2 = 0.9901^{**}\]

- **CROP 2009/10**
  
  \[\text{V6 } y = 0.1589x^2 + 2.2864x + 11.858 \quad \text{R}^2 = 0.9915^{**}\]

\[\text{V6 } y = 0.0865x^2 + 0.2583x + 10.402 \quad \text{R}^2 = 0.9654^{**}\]

Silvestrin, 2010
BORON CONCENTRATION IN THE FEMININE INFLORESCENCE "HAIR" (mg Kg⁻¹). PLANTING (Sem) AND V6 STADIUM OF MAIZE.

V6 \[ y = 0.1724x^2 - 0.5335x + 23.539 \]

\[ R^2 = 0.9851^* \]
COB SIZE - cm

CROP 2008/2009

SEM $y = -0.0273x^2 + 0.284x + 15.125$
$R^2 = 0.4574^*$

V6 $y = -0.038x^2 + 0.5342x + 14.489$
$R^2 = 0.9805^*$

CROP 2009/10

SEM = $-0.0226x^2 + 0.247x + 14.985$
$R^2 = 0.615$

V6 = $-0.0168x^2 + 0.0769x + 14.965$
$R^2 = 0.972$

Silvestrin, 2010
THANK YOU!