


# U.S. Borax

Final Report

# “Study of Boron in Brazilian Agriculture”

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Piracicaba, May/2016


# Sugarcane First Year Trial

# Sugarcane Trial

- Place – Cruzeiro Farm
- City – Morro Agudo/SP
- Variety – CTC 15
- Planting date – 11/04/2014
- Application treatments date : 11/04/2014
- Spacing: 1.5 m
- Plots – 5 rows x 10  meters length
- 9 treatments and 4 replications = 36 parcels
- Blocks randomized

# Sugarcane Trial – São Paulo State

# Sugarcane Trial – São Paulo State


# Treatments

| Treatment | Source | B rate | Source rate | |
|---|---|---|---|---|
| | | kg/ha | kg/ha | g/10m |
| 1 | Control | 0 | 0 | 0.0 |
| 2 | Ulexite | 0.75 | 7.5 | 11.3 |
| 3 | Ulexite | 1.5 | 15 | 22.5 |
| 4 | *Granubor®* | 0.75 | 5.36 | 8.0 |
| 5 | *Granubor* | 1.5 | 10.71 | 16.1 |
| 6 | Boric acid | 0.75 | 4.41 | 6.6 |
| 7 | Boric acid | 1.5 | 8.82 | 13.2 |
| 8 | *Solubor®* | 0.75 | 3.75 | 5.6 |
| 9 | *Solubor* | 1.5 | 7.50 | 11.3 |

All parcels were fertilized with:

Blend 05-25-25 + 1,5%S, 450 kg/ha

Ulexite and *Granubor* were applied directly on sugarcane stems at furrow

Boric acid and *Solubor* was applied with water solution in the furrow.

# Croquis

| Block I | | Block II | | Block III | | Block IV | |
|---|---|---|---|---|---|---|---|
| Parcel | Treatment | Parcel | Treatment | Parcel | Treatment | Parcel | Treatment |
| 1 | 1 | 10 | 8 | 19 | 3 | 28 | 9 |
| 2 | 2 | 11 | 7 | 20 | 4 | 29 | 8 |
| 3 | 3 | 12 | 2 | 21 | 9 | 30 | 5 |
| 4 | 4 | 13 | 5 | 22 | 1 | 31 | 2 |
| 5 | 5 | 14 | 9 | 23 | 6 | 32 | 7 |
| 6 | 6 | 15 | 1 | 24 | 8 | 33 | 3 |
| 7 | 7 | 16 | 3 | 25 | 7 | 34 | 6 |
| 8 | 8 | 17 | 6 | 26 | 5 | 35 | 4 |
| 9 | 9 | 18 | 4 | 27 | 2 | 36 | 1 |

# Area Before Fertilization (sugarcane stems at furrow)

# Granular Fertilizers Application

# Soluble Fertilizers Application

# Evaluations

- Tissue evaluation, in January 2015
- Canes per meter
  - ✓ 270 days after planting, in January 2015
- Biometric evaluation, in September 2015 (18 months after planting)
  - ✓ t/ha of canes
  - ✓ t/ha of sugar
- Soil tests per plot to evaluate B content, in October 2015

# 50 days After Planting (May 2014)

# 180 days After Planting (September 2014)

# 270 days After Planting (January 2015)

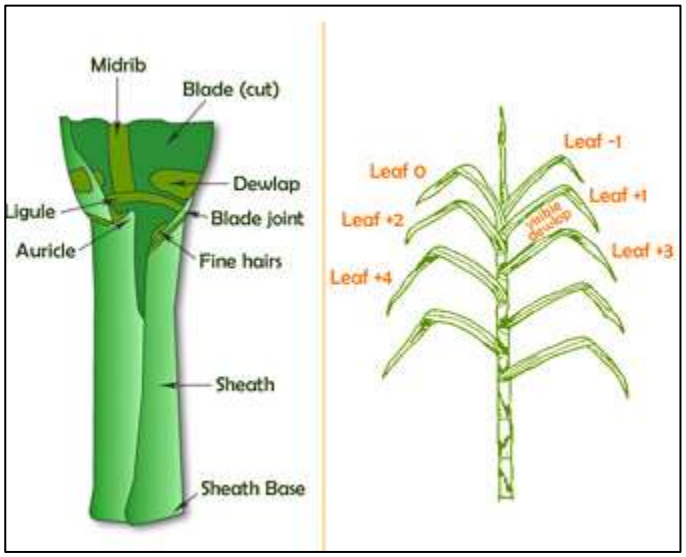

# Tissue Evaluation

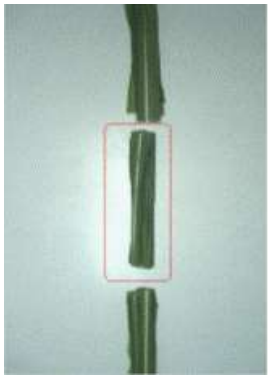
Sampling – January, 2015

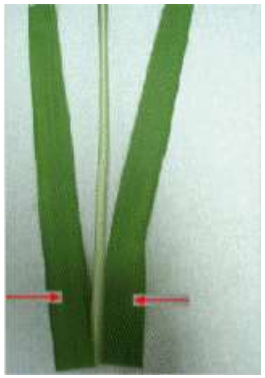
# Methodology

- Leaf +1 → the first leaf from the apex downwards having dewlap visible;
- 6 plants per plot;
- Use the central part of the leaf. Discard the midrib. Dividing each sheet into three parts. Discard the tip and the part with the sheath

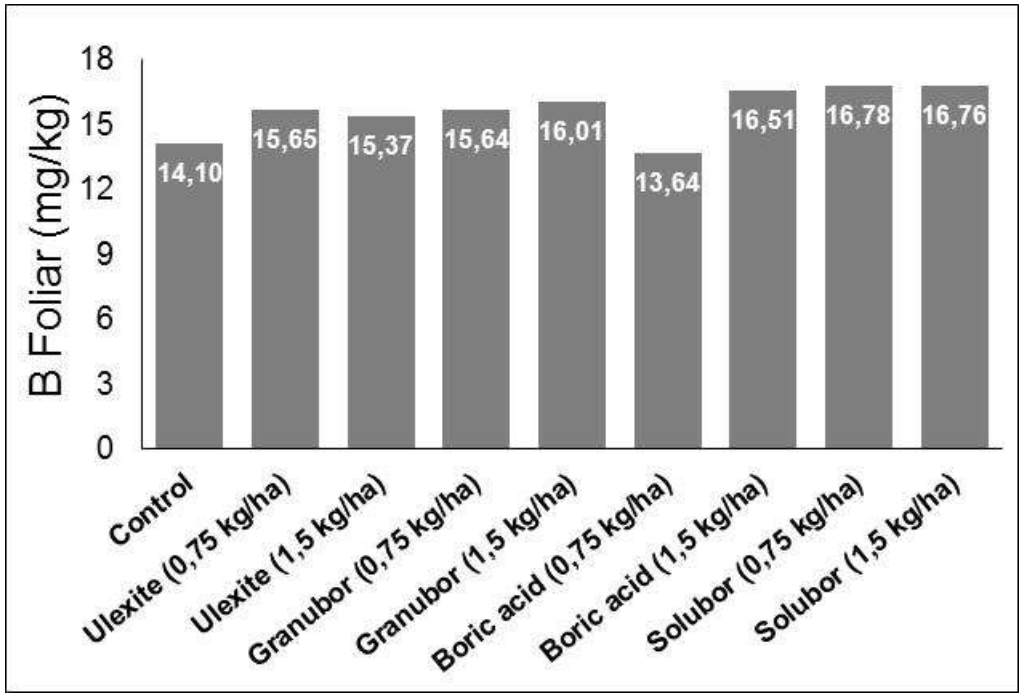
Suitable level for B to sugarcane = 10-30 mg/kg





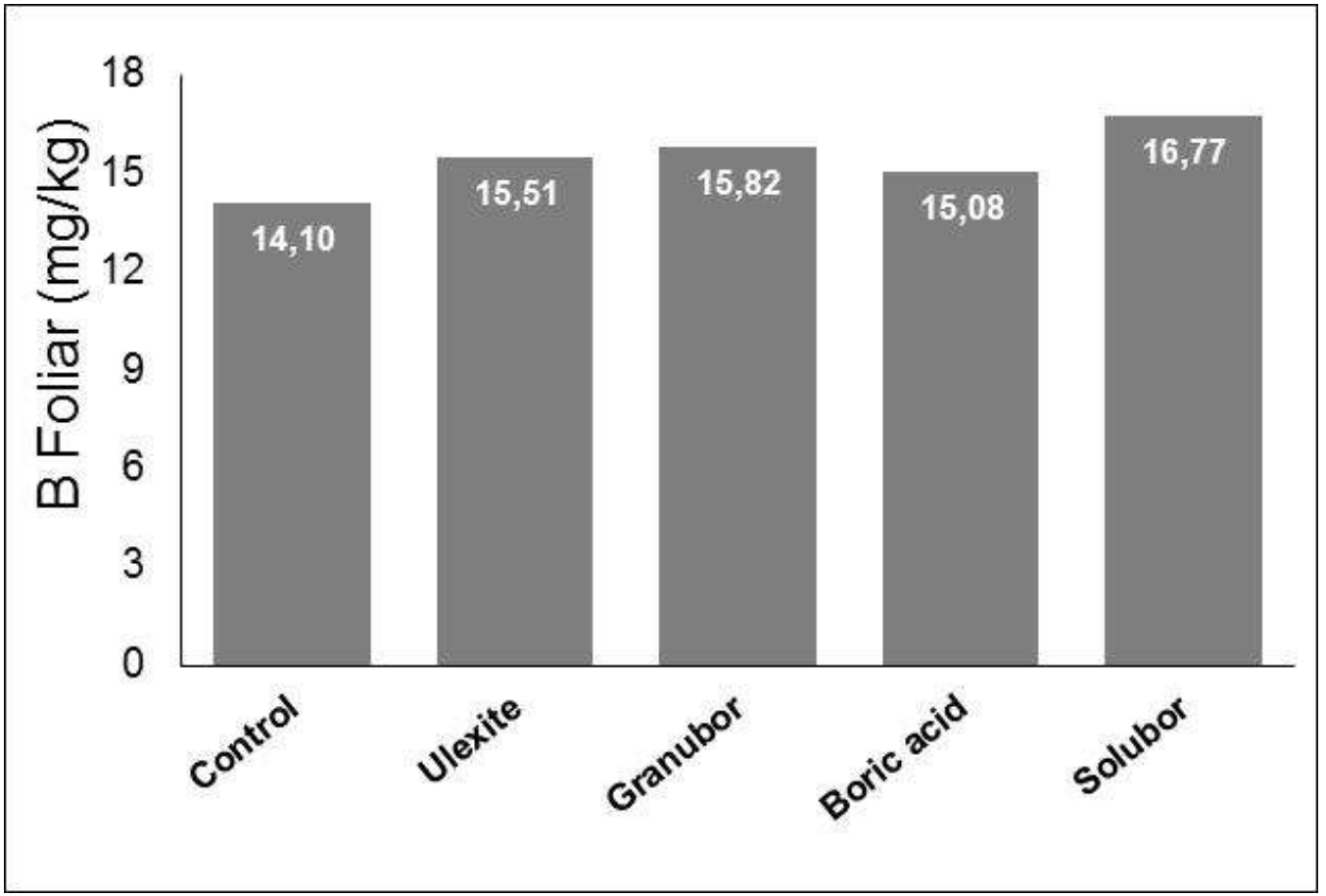
# B Foliar - Treatments




| Treatment | | B in leaves mg/kg | Tukey 5% |
|---|---|---|---|
| 1 | Control | 14,10 | a |
| 2 | Ulexite (0,75 kg/ha) | 15,65 | a |
| 3 | Ulexite (1,5 kg/ha) | 15,37 | a |
| 4 | Granubor (0,75 kg/ha) | 15,64 | a |
| 5 | Granubor (1,5 kg/ha) | 16,01 | a |
| 6 | Boric acid (0,75 kg/ha) | 13,64 | a |
| 7 | Boric acid (1,5 kg/ha) | 16,51 | a |
| 8 | Solubor (0,75 kg/ha) | 16,78 | a |
| 9 | Solubor (1,5 kg/ha) | 16,76 | a |
| | average | 15,61 | |
| | VC (%) | 15,54 | |
| | smd | 5,83 | |

- Values are the average of 4 replicates
- Means followed by the same letter do not differ statistically by the Tukey test at 5% probability

# B Foliar - Sources




# Canes per Meter

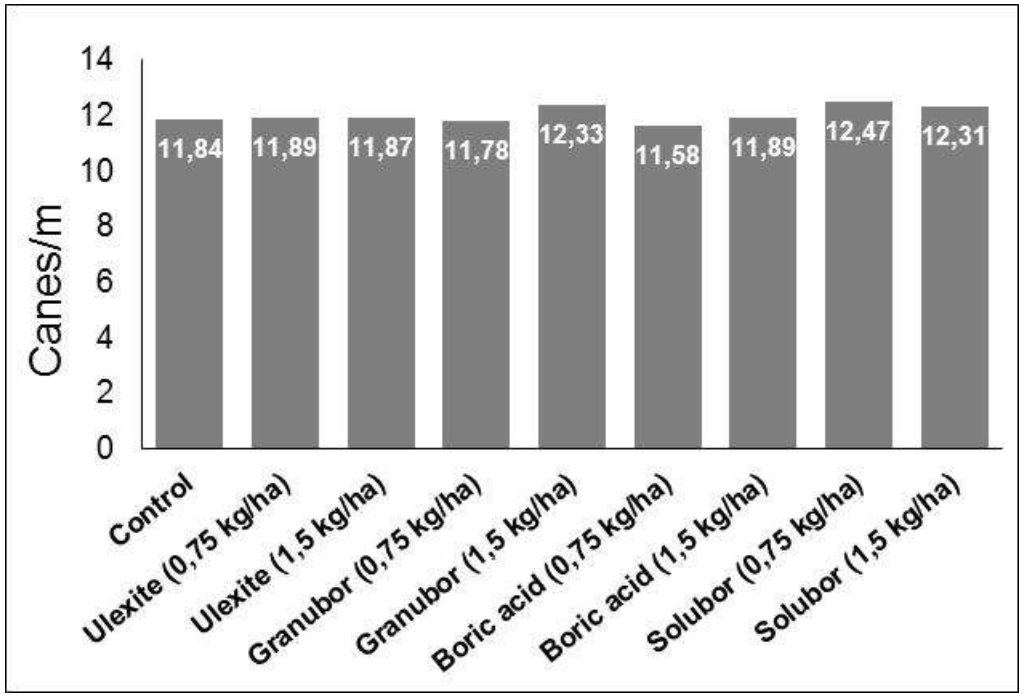
270 days after planting

January 2015

# Canes/m

- Methodology
  - ✓ Count of stems present in the three central rows of each plot
  - ✓ Canes/m is the average result

# Canes/m - Treatments




| Treatment | | Number Canes/m | Tukey 5% |
|---|---|---|---|
| 1 | Control | 11,84 | a |
| 2 | Ulexite (0,75 kg/ha) | 11,89 | a |
| 3 | Ulexite (1,5 kg/ha) | 11,87 | a |
| 4 | Granubor (0,75 kg/ha) | 11,78 | a |
| 5 | Granubor (1,5 kg/ha) | 12,33 | a |
| 6 | Boric acid (0,75 kg/ha) | 11,58 | a |
| 7 | Boric acid (1,5 kg/ha) | 11,89 | a |
| 8 | Solubor (0,75 kg/ha) | 12,47 | a |
| 9 | Solubor (1,5 kg/ha) | 12,31 | a |
| | average | 11,99 | |
| | VC (%) | 4,69 | |
| | smd | 1,35 | |

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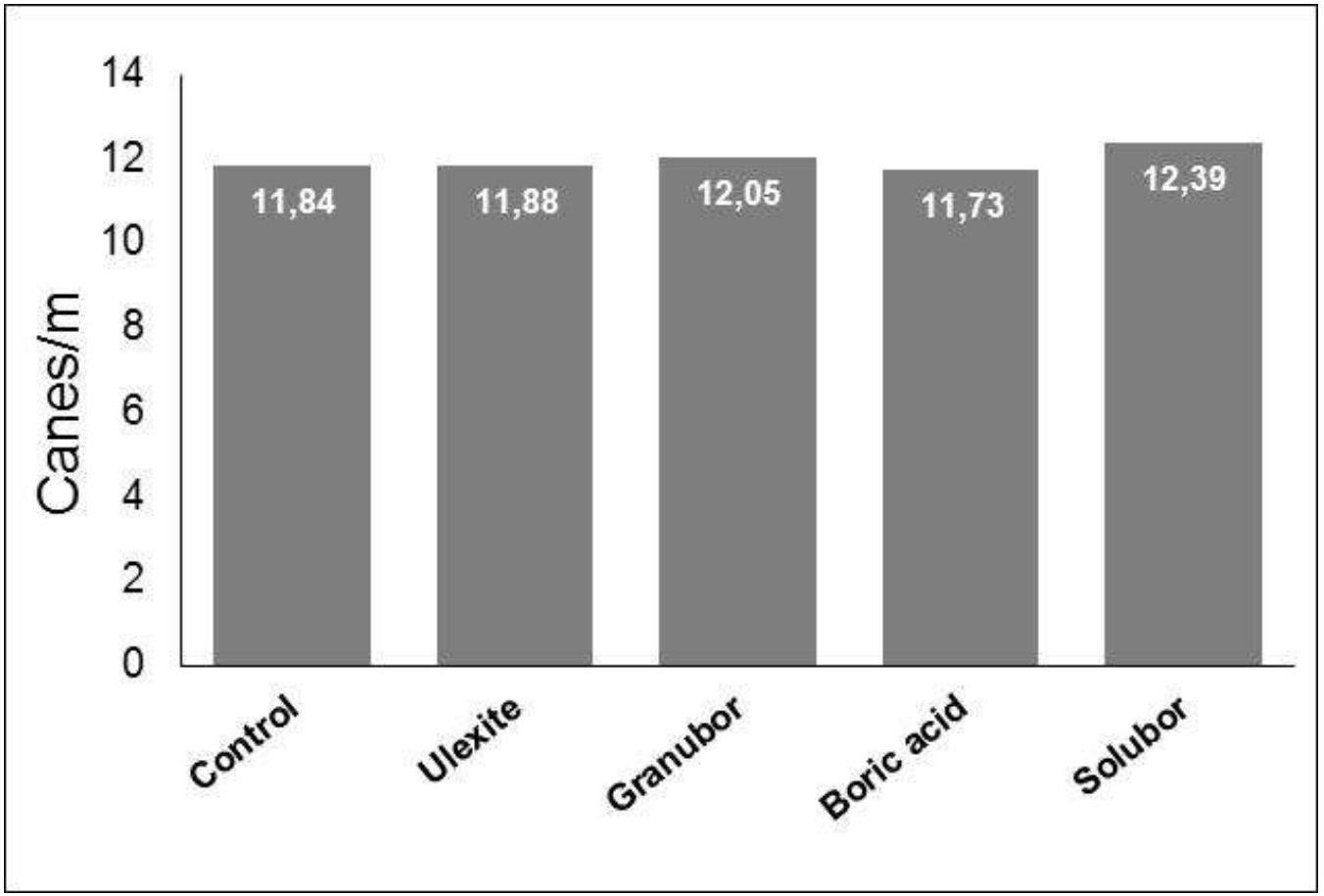
# Canes/m - Sources




# Biometric Evaluation

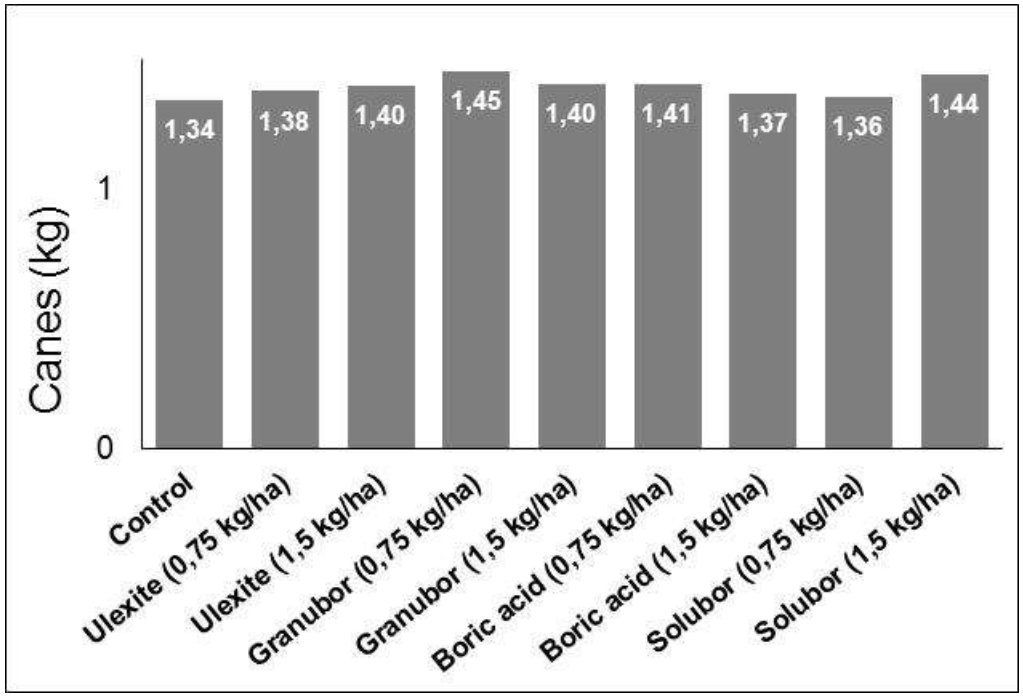
September 2015

# Biometric Evaluation

- Methodology
  - ✓ Ten cleaned canes were collected following at the midpoint of each of the three central lines of each parcel and weighing through dynamometer
  - ✓ Obtained the average weight of stems
  - ✓ Multiplicand the number of canes/m by weight of canes, result in the estimated the average yield of each plot

# Biometric Evaluation

# Canes Weight - Treatments




| Treatment | | Weight kg | Tukey 5% |
|---|---|---|---|
| 1 | Control | 1,34 | a |
| 2 | Ulexite (0,75 kg/ha) | 1,38 | a |
| 3 | Ulexite (1,5 kg/ha) | 1,40 | a |
| 4 | Granubor (0,75 kg/ha) | 1,45 | a |
| 5 | Granubor (1,5 kg/ha) | 1,40 | a |
| 6 | Boric acid (0,75 kg/ha) | 1,41 | a |
| 7 | Boric acid (1,5 kg/ha) | 1,37 | a |
| 8 | Solubor (0,75 kg/ha) | 1,36 | a |
| 9 | Solubor (1,5 kg/ha) | 1,44 | a |
| | average | 1,39 | |
| | VC (%) | 5,84 | |
| | smd | 0,20 | |

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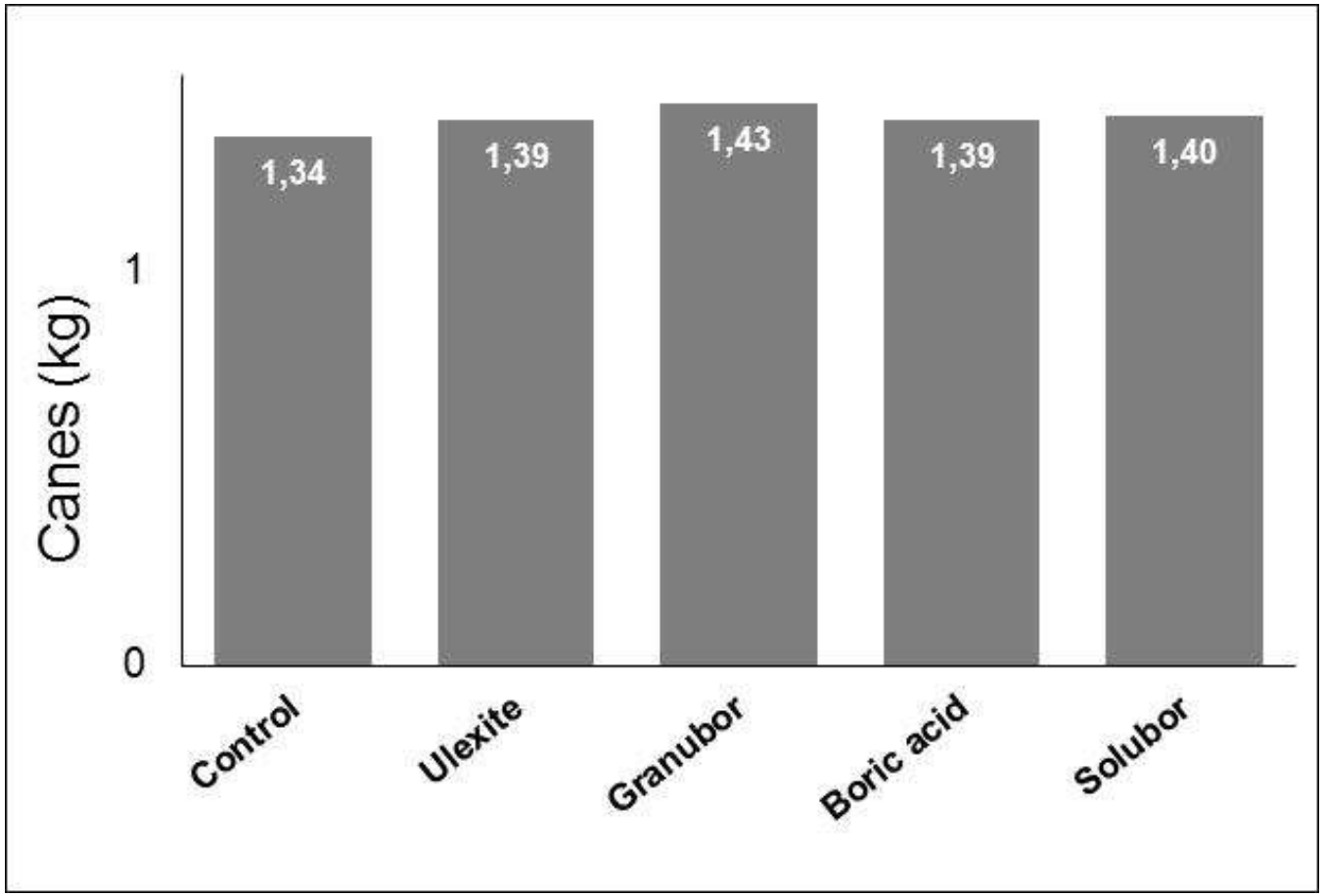
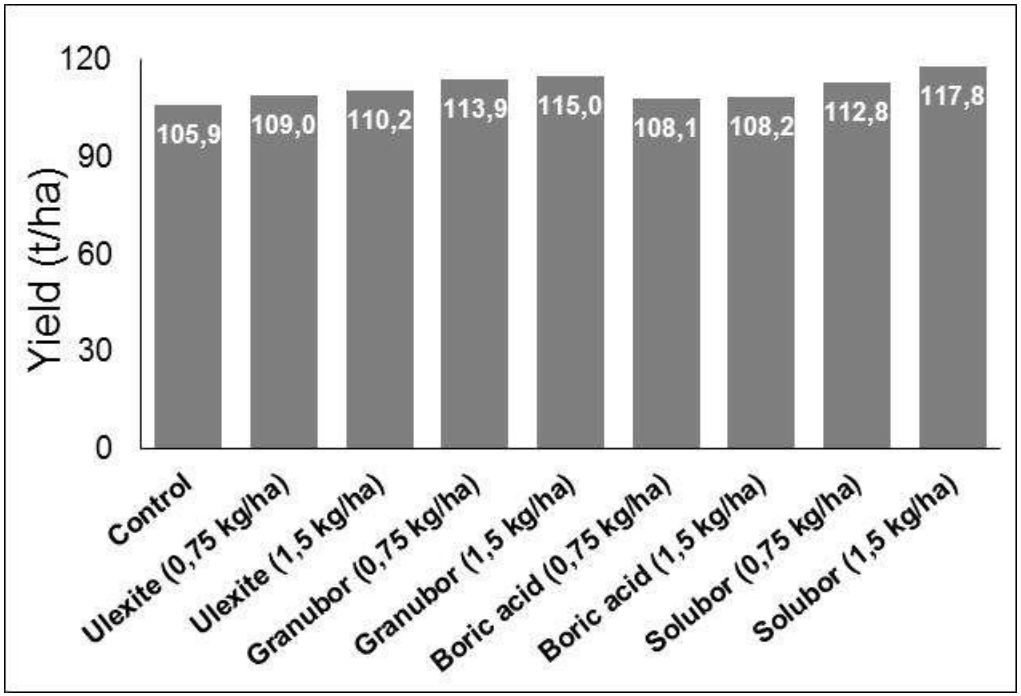
# Canes Weight - Sources



# Yield - Treatments




| Treatment | | Yield t/ha | Tukey 5% |
|---|---|---|---|
| 1 | Control | 105,9 | a |
| 2 | Ulexite (0,75 kg/ha) | 109,0 | a |
| 3 | Ulexite (1,5 kg/ha) | 110,2 | a |
| 4 | Granubor (0,75 kg/ha) | 113,9 | a |
| 5 | Granubor (1,5 kg/ha) | 115,0 | a |
| 6 | Boric acid (0,75 kg/ha) | 108,1 | a |
| 7 | Boric acid (1,5 kg/ha) | 108,2 | a |
| 8 | Solubor (0,75 kg/ha) | 112,8 | a |
| 9 | Solubor (1,5 kg/ha) | 117,8 | a |
| | average | 111,19 | |
| | VC (%) | 5,89 | |
| | smd | 15,75 | |

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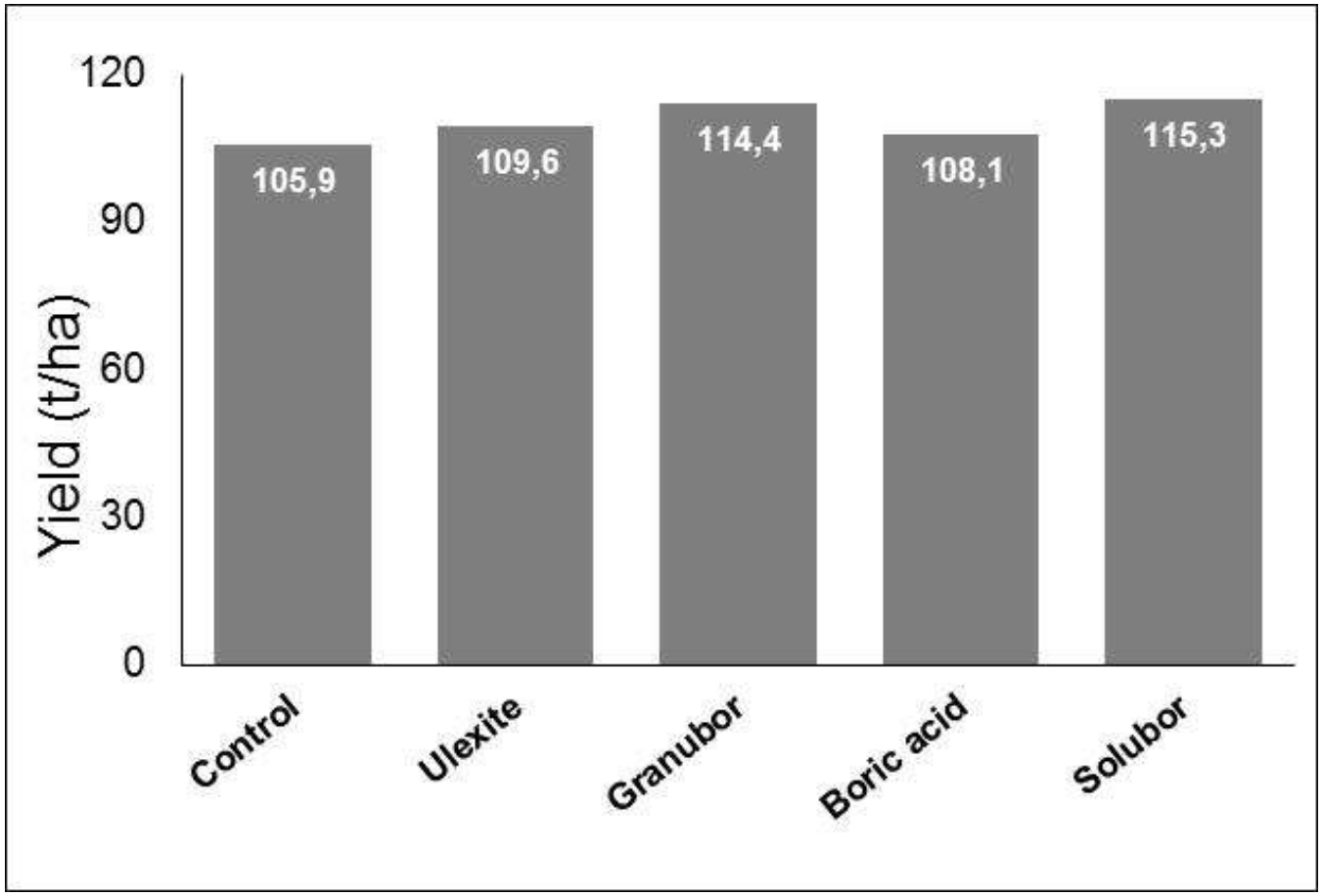
# Yield - Sources

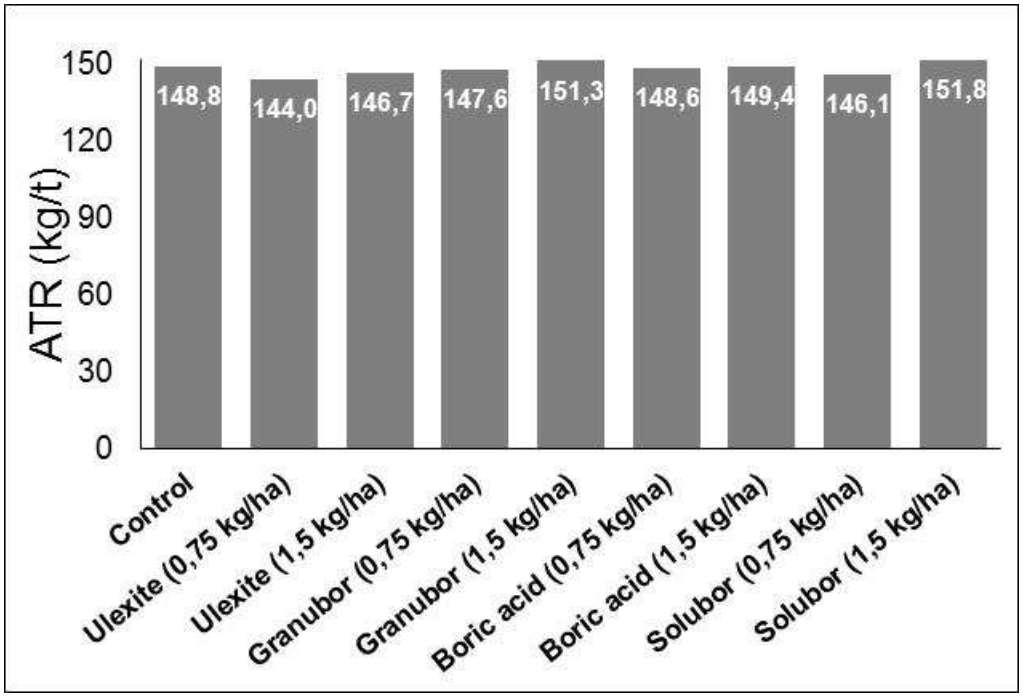



# Total Sugar Recovered (ATR)

# ATR evaluation

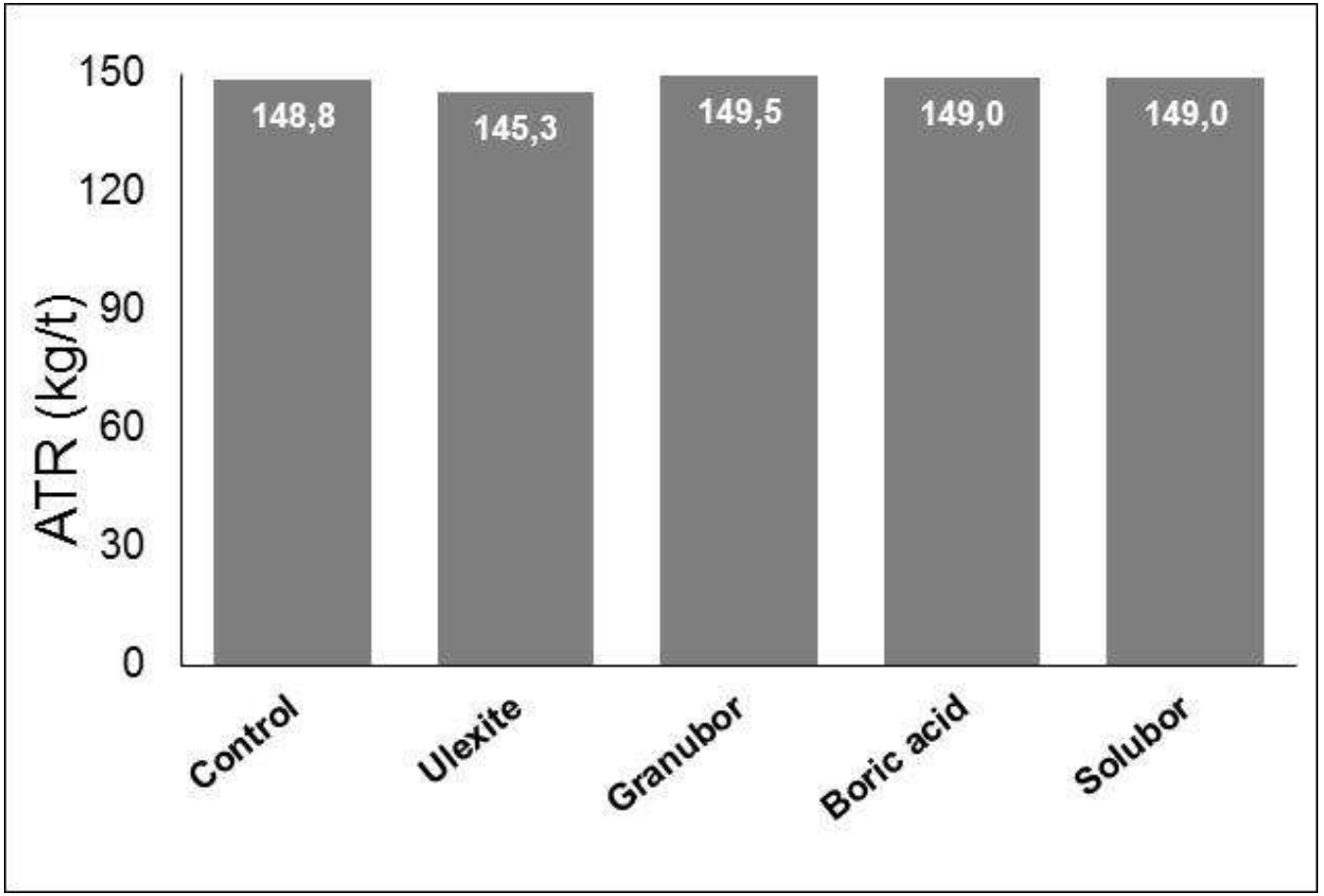
- Methodology
  - ✓ 10 canes in each plot were randomly selected after weighing and sent to the laboratory for determination of ATR (sugar recovered from canes), in kilograms of sugar per ton of cane (one sample per treatment, without consider replication)
  - ✓ Sugar yield estimated was obtained by multiplying the yield of sugarcane by the ATR.

# ATR - Treatments

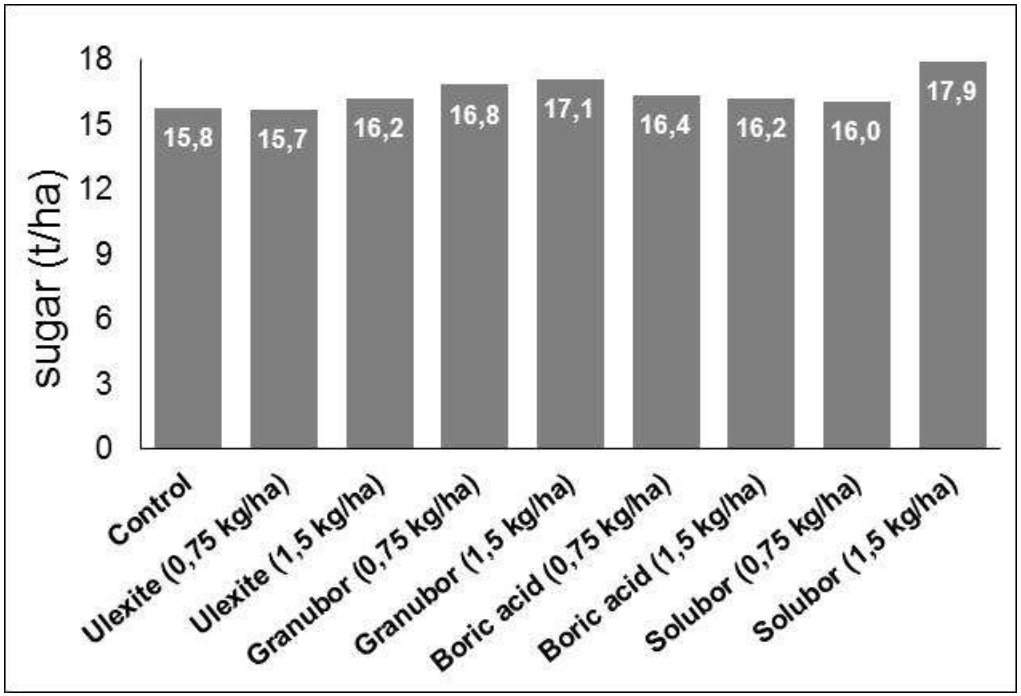



| Treatment | | ATR |
|---|---|---|
| | | kg/t |
| 1 | Control | 148,8 |
| 2 | Ulexite (0,75 kg/ha) | 144,0 |
| 3 | Ulexite (1,5 kg/ha) | 146,7 |
| 4 | Granubor (0,75 kg/ha) | 147,6 |
| 5 | Granubor (1,5 kg/ha) | 151,3 |
| 6 | Boric acid (0,75 kg/ha) | 148,6 |
| 7 | Boric acid (1,5 kg/ha) | 149,4 |
| 8 | Solubor (0,75 kg/ha) | 146,1 |
| 9 | Solubor (1,5 kg/ha) | 151,8 |

# ATR - Sources


150
120
90
60
30
0
ATR (kg/t)
148,8
145,3
149,5
149,0
149,0
Control
Ulexite
Granubor
Boric acid
Solubor

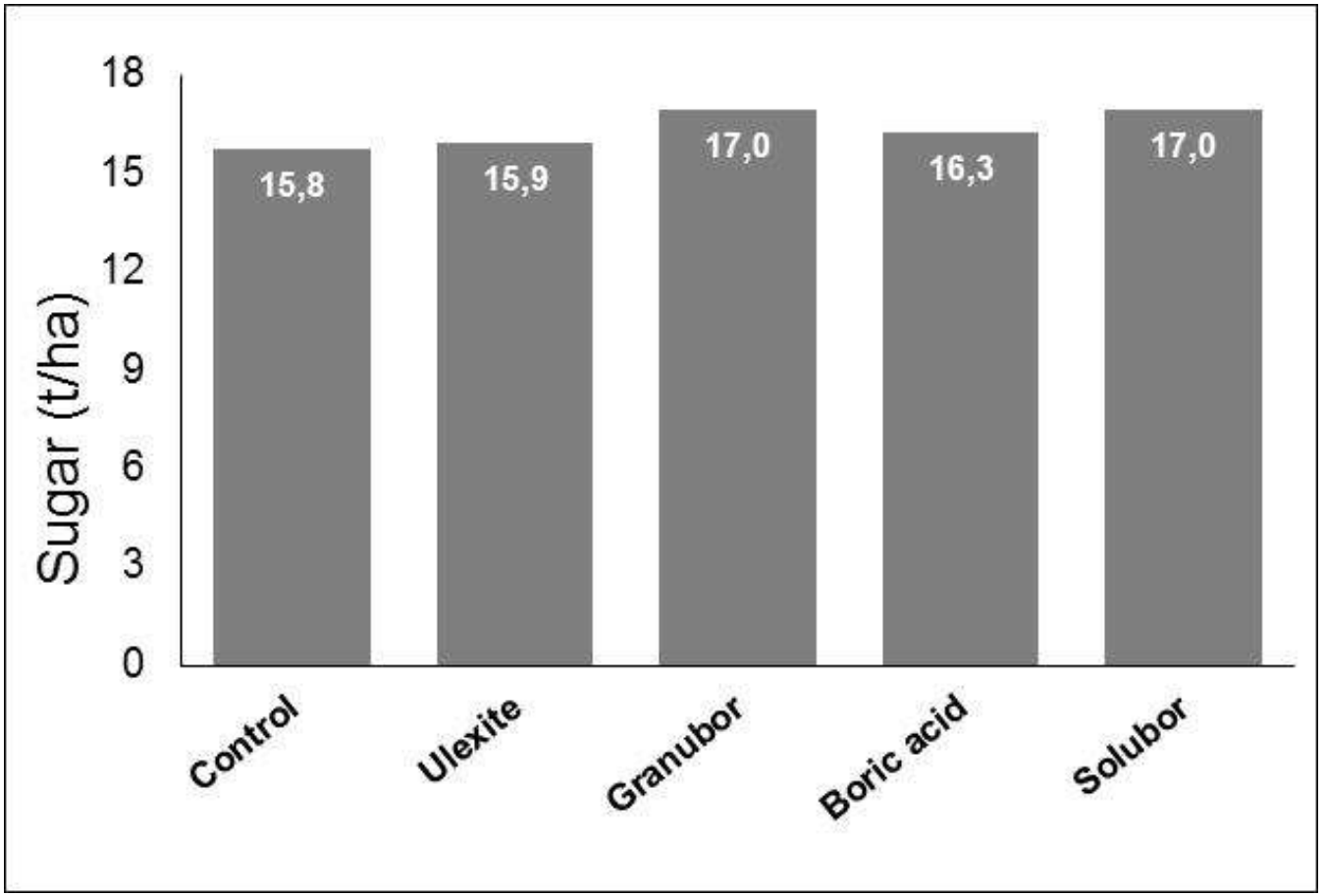
# Estimated Sugar - Treatments




| Treatment | | Sugar t/ha | Tukey 5% |
|---|---|---|---|
| 1 | Control | 15,8 | a |
| 2 | Ulexite (0,75 kg/ha) | 15,7 | a |
| 3 | Ulexite (1,5 kg/ha) | 16,2 | a |
| 4 | Granubor (0,75 kg/ha) | 16,8 | a |
| 5 | Granubor (1,5 kg/ha) | 17,1 | a |
| 6 | Boric acid (0,75 kg/ha) | 16,4 | a |
| 7 | Boric acid (1,5 kg/ha) | 16,2 | a |
| 8 | Solubor (0,75 kg/ha) | 16,0 | a |
| 9 | Solubor (1,5 kg/ha) | 17,9 | a |
| | average | 16,44 | |
| | VC (%) | 5,82 | |
| | smd | 2,30 | |

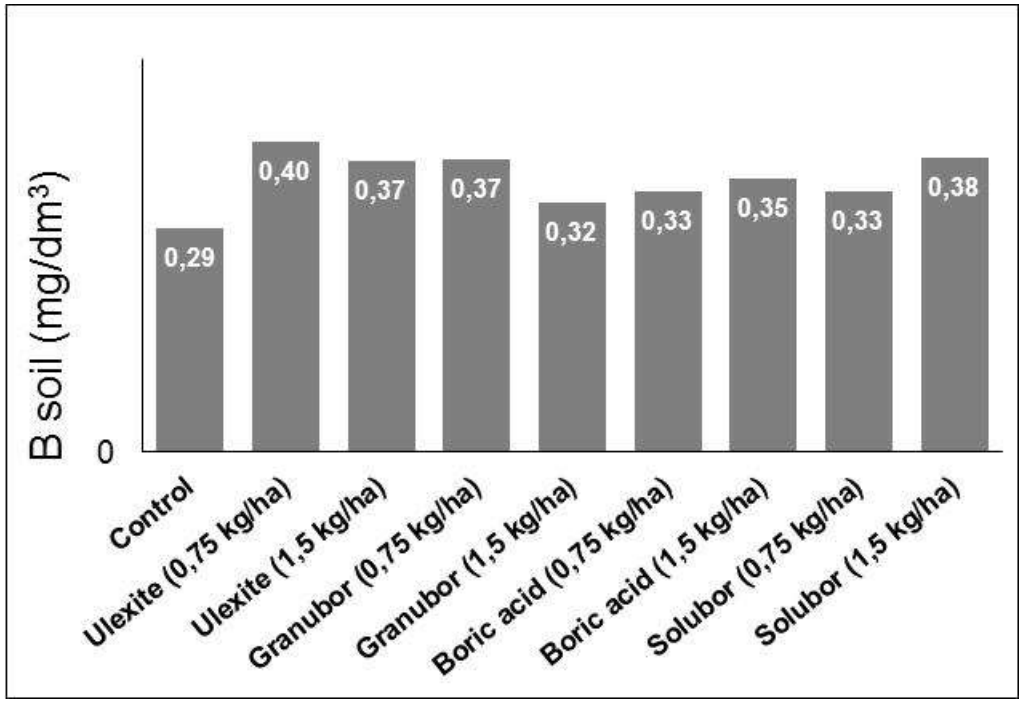
- Values are the average of 4 replicates
- Means followed by the same letter do not differ statistically by the Tukey test at 5% probability

# Estimated Sugar - Sources




# B in Soil After Harvesting

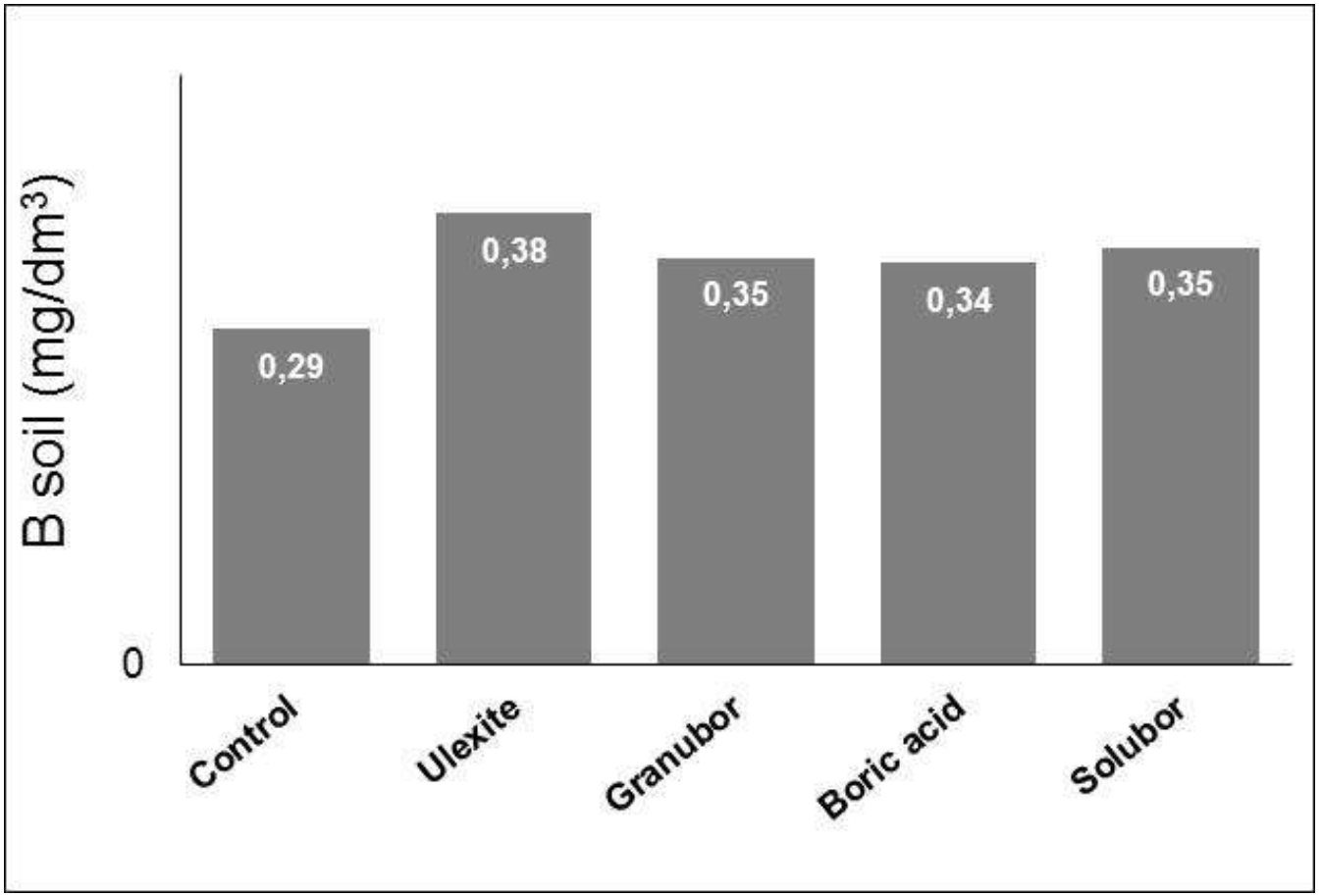
# B in Soil - Treatments




| Treatment | | B soil mg/dm3 | Tukey 5% |
|---|---|---|---|
| 1 | Control | 0,29 | a |
| 2 | Ulexite (0,75 kg/ha) | 0,40 | a |
| 3 | Ulexite (1,5 kg/ha) | 0,37 | a |
| 4 | Granubor (0,75 kg/ha) | 0,37 | a |
| 5 | Granubor (1,5 kg/ha) | 0,32 | a |
| 6 | Boric acid (0,75 kg/ha) | 0,33 | a |
| 7 | Boric acid (1,5 kg/ha) | 0,35 | a |
| 8 | Solubor (0,75 kg/ha) | 0,33 | a |
| 9 | Solubor (1,5 kg/ha) | 0,38 | a |
| | average | 0,35 | |
| | VC (%) | 24,35 | |
| | smd | 0,20 | |

- Values are the average of 4 replicates
- Means followed by the same letter do not differ statistically by the Tukey t test at 5% probability

# B in Soil - Sources



# Conclusions

- Despite the lower B in soil, Suitable level of B in leaves for all treatments
- Even without significant differences for Tukey 5% of probability, the sources *Solubor*® and *Granubor*® (1,5 kg/ha) showed superior results in yield of sugarcane and sugar
- It is suggested to conduct more experiments in other conditions of soil and climate, and other varieties.