TECHNICAL BROCHURE

Effect of doses and different sources of boron on corn yield in argillaceous soils

The micronutrient boron (B) has been used in Brazilian agriculture for a number of years. Several options for boron fertilizers exist on the market, which can generate some confusion for farmers and agronomists. Depending on the source of B, its solubility and dissolution time (release of B) may vary, affecting the recommended dosage and the handling of B in cultivation. Another concern is the dose of B that should be recommended in relation to the texture of the soil, organic matter, type of clays, and soil pH. Research shows that there is a high correlation between the content of clays and the adsorption of B by these clays (illite > montmorillonite > kaolinite). B adsorption by Al_2O_3 > Fe_2O_3. The amount of B adsorbed by these minerals is greater, the higher the soil's pH. In other words, the higher the soil's pH, organic matter, and clay content, the greater the adsorption of B, and the lower the availability of this element in soil solution for the roots to be able to absorb it. So for more clayey soils, should the dose be higher than it would be for a more sandy-textured soil?

In order to aid in understanding the response of corn to some sources available on the market, some experiments were conducted by renowned researchers in Brazil.

Schaich (2021) conducted two fieldwork experiments (during the crops of 2019/20 and 2020/21) comparing sources and doses of B. Among the sources of B tested were the fertilizer *Granubor*® (15% B), granulated ulexite (10% B) and a technology based on potassium chloride (KCl) + two sources of B in the same granule (58% K_2O and 0.5% B). *Granubor* is a sodium tetraborate pentahydrate-based fertilizer and the sources of B in the KCl + B product are based on anhydrous sodium tetraborate (50%) and colemanite (50%). The experiments were carried out in the city of Cruz Alta, RS, with red latosol clayey-textured (Table 1). The experimental design used randomized blocks with four repetitions.

Gitti (2021) conducted a fieldwork experiment (during the crop of 2020/21) comparing sources and doses of B. Among the sources of B tested were the fertilizer *Granubor* (15% B) and granulated ulexite (10% B). The experiment was carried out at Fundacao MS, in the municipality of Maracaju, MS, in a clayey-textured dystroferric red latosol (Table 2). The experimental design used randomized blocks with five repetitions.

Table 1: Chemical and physical characteristics of the soil in experimental areas before the experiments were set up. PhysioAtac, Cruz Alta, RS, 2020.

Exp	Depth	pH	Ca	Mg	Al	Al+H	P	K	S
	cm	H_2O	$cmol_c/dm^{-3}$				mg/dm^{-3}		
Corn	0-20 cm	5.9	8.3	1.7	0	2.2	18	160	8.0
Exp	**Depth**	**Clay**	**MO**	**V**	**CTC**	**Zn**	**Cu**	**B**	**Mn**
	cm	**%**	g/dm^{-3}	**%**	$cmolc/dm^{-3}$	mg/dm^{-3}			
Corn	0-20 cm	42	3.2	82.6	12.0	3.3	6.1	0.5	4.3

[1] UNISC Analytical Center; Santa Cruz do Sul - RS. Extractors: P, K, Cu, Fe, Mn and Zn (Mehlich-1); S (ammonium acetate); Ca, Mg and Al (KCl 1N); OM (sodium dichromate); B (hot water); clay (densimeter method).

Table 2: Chemical and soil texture characterization of experimental area at depths of 0-20 and 20-40 cm. MS Foundation, Maracaju/MS, Brazil, 2020.

Prof cm	pH		MO	P		K	Ca	Mg	Al	H+Al	SB	T	V
	$CaCl_2$	H_2O	g/dm^{-3}	Mehlich		$mmol_c/dm^{-3}$							%
0-20	5.0	5.7	37.9	24.4		5.6	57.8	15.6	0.0	66.4	79.1	145.5	54.3
20-40	5.2	5.9	24.7	2.4		2.1	55.6	12.5	0.0	48.3	70.3	118.6	59.3
Prof cm	**S**	**Zn**	**B**	**Cu**	**Mn**	**Fe**	**Relationship**	**K**	**Ca**	**Mg**	**H**	**Al**	**Clay**
	mg/dm^{-3}						Ca/Mg	% da CTC					%
0-20	18.8	10.2	0.4	6.2	176.9	19	3.7	3.8	39.73	10.7	45.7	0.0	50
20-40	18.3	0.8	0.2	6.8	97.3	20	4.4	1.8	46.8	10.6	40.7	0.0	50

*Soil sample collected on 05/20/2020. Farm Alegria plot area 1, Maracaju/MS, Brazil. Code FMS 0-20 cm 11074, and 20-40 cm 11075.

Results

In the experiments carried out in Cruz Alta, RS, regardless of the source, the application of B boosted productivity. This shows the importance of the annual application of B in the soil for productivity gains in summer corn, regardless of the boron content available in the soil analysis (Table 1). The numerical increase in yield from *Granubor* was the greatest among the compared sources for all the doses tested (Figure 1). In the clayey soil, condition of the experiments (42% clay, Table 1), the boost in yield with the dose of 6.7 kg/ha *Granubor* (1 kg/ha B) was 504 kg/ha (8.4 bags/ha), with the dose of 13.4 kg/ha *Granubor* (2 kg/ha B) was 312 kg/ha (5.2 bags/ha), with the dose of 20 kg/ha *Granubor* (3 kg/ha B) was 546 kg/ha (9.1 bags/ha) and with the dose of 26.7 kg/ha *Granubor* (4 kg/ha B) was 696 kg/ha (11.6 bags/ha), when compared to the control. This result shows how important it is to be familiar with the available B sources and the clay content of the soil, to better gauge what dose should be applied.

Figure 1: Response of corn to application of B in increasing doses (1; 2; 3; and 4 kg/ha) using different sources available on the market, 2019/20 and 2020/21

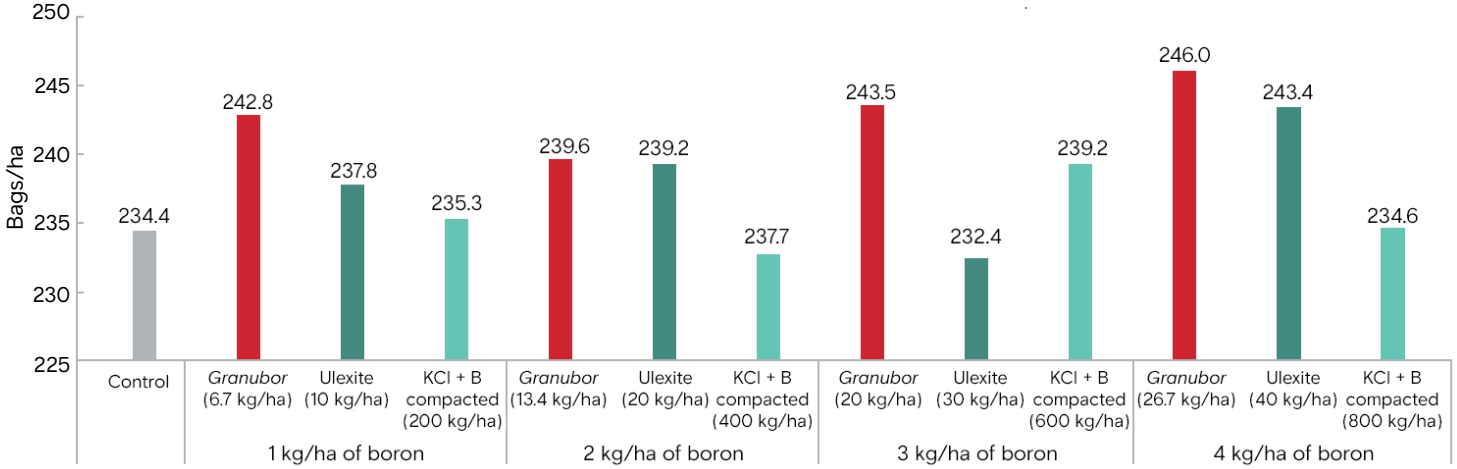
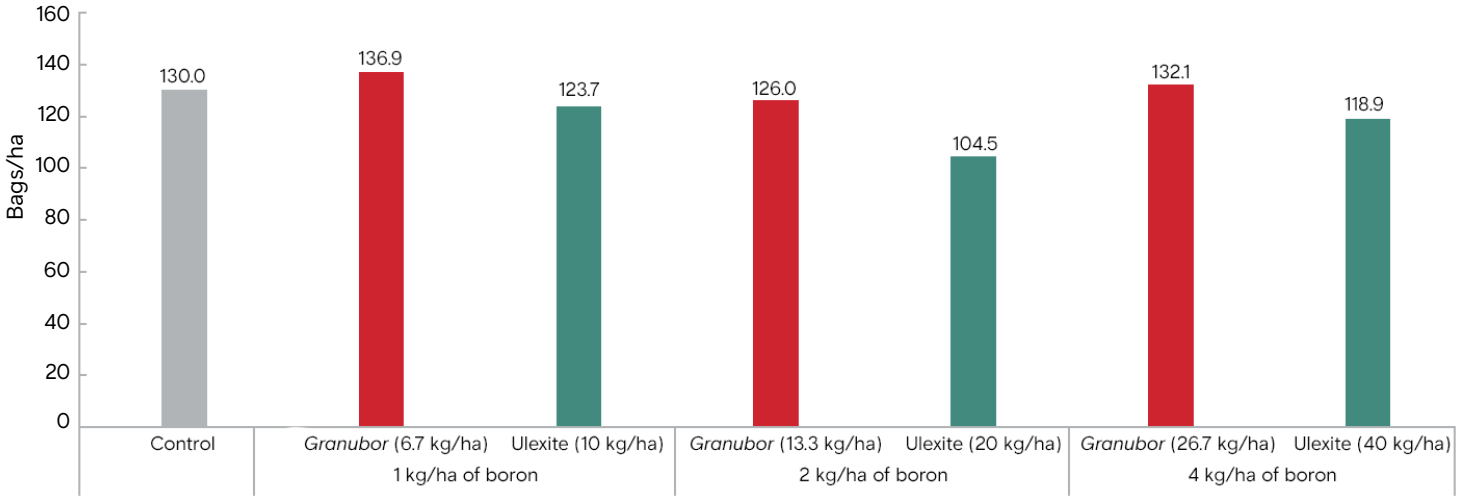


Figure 2: Response of corn to application of B in increasing doses (1; 2; and 4 kg/ha) using different sources available on the market, 2020/21



References: Gabriel Schaich, 2021. Physioatac. || Douglas Gitti, 2021. Fundação MS.

About U.S. Borax

U.S. Borax, part of Rio Tinto, is a global leader in the supply and science of borates—naturally-occurring minerals containing boron and other elements. We are 1,000 people serving 650 customers with more than 1,800 delivery locations globally. We supply around 30% of the world's need for refined borates from our worldclass mine in Boron, California, about 100 miles northeast of Los Angeles.

Our local agriculture experts understand the uses and benefits of boron on crops. In addition to a global sales team, we have a number of agronomists on staff to help fertilizer distributors maximize the benefits of borates in agriculture applications. Our ag team can answer individual growers' questions and concerns about their particular crop.

High quality, high reliability, high performance borate products. It's what we're known for.

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