TECHNICAL BROCHURE

Effect of doses and different sources of boron on soybean and 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 boron, its solubility and dissolution time (release of boron) may vary, affecting the recommended dosage and the handling of boron in cultivation. Another concern is what dose of boron should be recommended in relation to the texture of the soil. Research shows that there is a high correlation between the content of clays (iron and aluminum oxyhydroxides) and the adsorption of boron by these clays. The amount of boron adsorbed by these minerals is greater, the higher the soil's pH. In other words, the higher the soil's pH and clay content, the greater the adsorption of boron, 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 soy and corn to some sources available on the market, Schaich (2021) conducted two fieldwork experiments comparing sources and dosages of boron. 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 boron in the same granule (58% K_2O and 0.5% B). *Granubor* is a sodium tetraborate pentahydrate-based fertilizer and the sources of boron 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 of medium texture (Tables 1 and 2). The experimental design used randomized blocks with four repetitions. For each crop, all of the treatments received the same quantity of NPK nutrients. In the soy experiment, the dose of potassium (K_2O) used was 151 kg/ha, while for corn it was 116 kg/ha.

Table 1: Chemical and physical characteristics of the soil in experimental areas before the experiments were set up. PhysioAtac, Cruz Alta, RS, 2019-20

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
Soy	0-20 cm	5.6	3.9	1.9	0	3.2	5.6	79	6.9
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
Soy	0-20 cm	38	2.3	65.2	9.2	2.3	5.4	0.2	6

Table 2: Chemical and physical characteristics of the soil in areas used for experiments before implementation of experiments. Cruz Alta, RS, 2019-20

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	5.0	1.5	0.6	0.1	4.6	56	98	11.1
Soy	0-20 cm	5.4	4.3	0.1	0.1	4.4	12.8	88	10.2
Exp	Depth	Clay	MO	V	CTC	Zn	Cu	B	Mn
	cm	%	g/dm^{-3}	%	$cmolc/dm^{-3}$	mg/dm^{-3}			
Corn	0-20 cm	37	2.1	33.8	6.9	4.7	2.4	0.5	7
Soy	0-20 cm	54	2.8	60.2	11.1	4.0	10	0.4	30

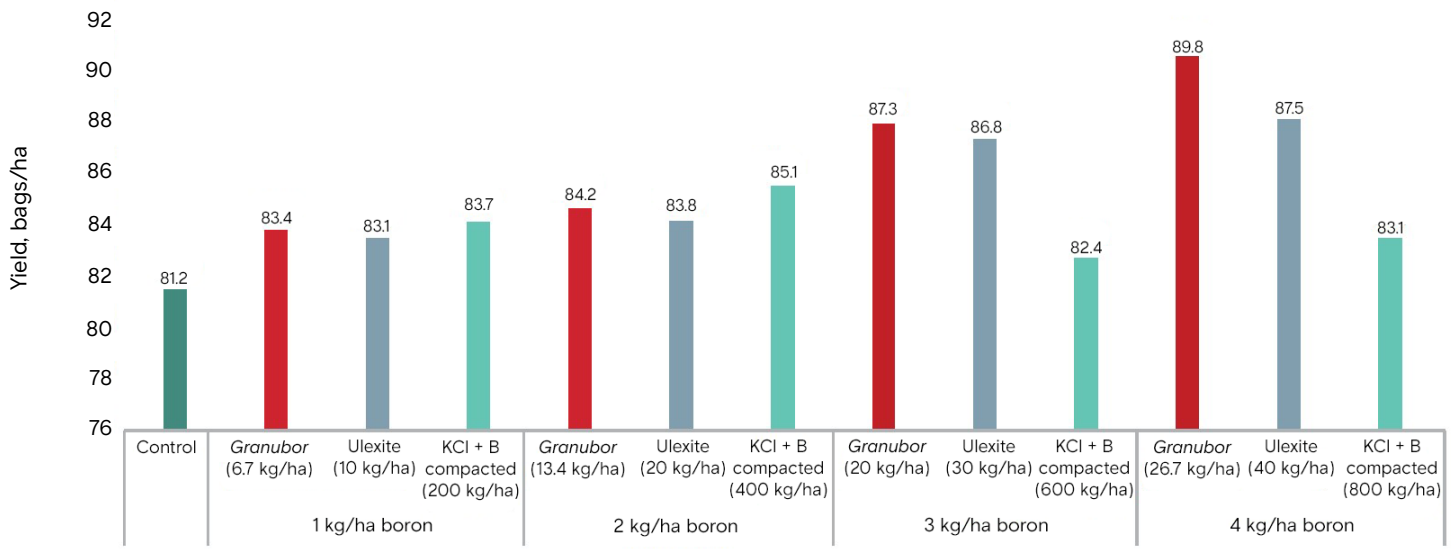
[1] UNISC Analytical Center; Santa Cruz do Sul - RS. Extractors: P, K, Cu, Fe, Mn and Zn (Mehlich-1); S (ammonium acetate); Ca, Mg and Al (KCl 1N); OM (sodium dichromate); B (hot water); clay (densimeter method).

Results

The data shown in Figures 1 and 2 correspond to the average yield obtained in the 2019/20 and 2020/21 crops. For soy, regardless of the source and dose, the application of boron boosted productivity. This average increment was 2.2; 3.2; 4.3; and 5.6 bags/ha for the dose of 1, 2, 3, and 4 kg/ha B, respectively, when compared to the control (Figure 1). This shows the importance of annual application of boron in the soil for productivity gains in soy, regardless of the boron content available in the soil analysis (see Tables 1 and 2).

In the clayey soil condition of the experiments (≥38% clay, see tables 1 and 2), even though the differences in yield were not statistically that different, the greatest boost in yield was with the doses of 3 and 4 kg/ha B, for the source *Granubor*. This result shows how important it is to be familiar with the available B sources and the clay content of the soil, the better to gauge what dose should be applied. For soils with sandier texture, the results of our experiments show that the best dose of *Granubor* is between 6.7 – 10 kg/ha (1 – 1.5 kg/ha B).

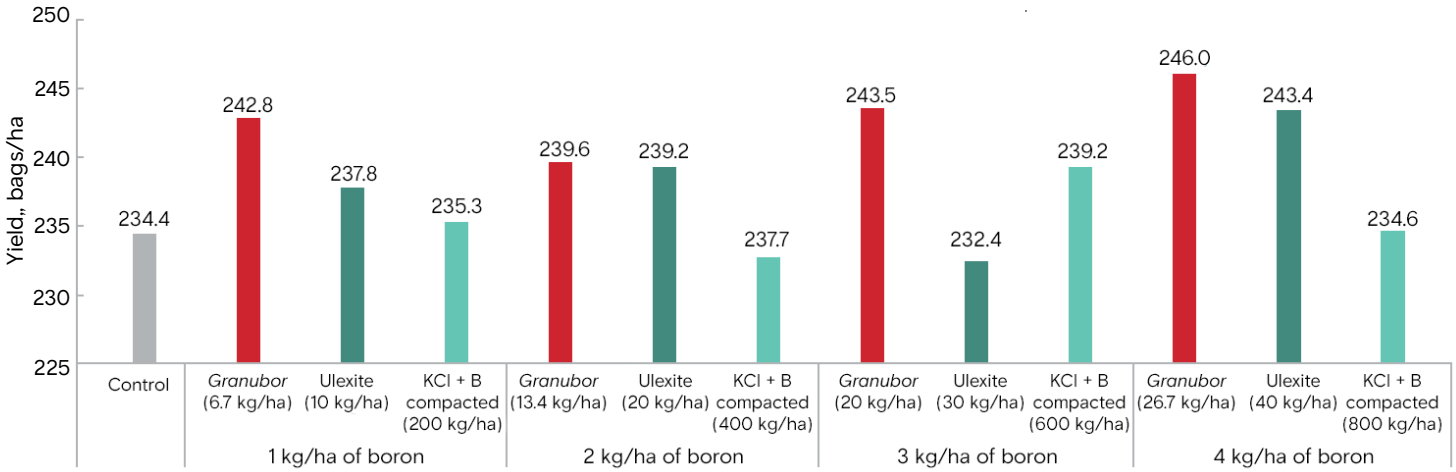
Figure 1: Response of soy to the application of B in increasing doses (1; 2; 3 and 4 kg/ha) using different sources available on the market. Average yield of 2019/20 and 2020/21 crops



In corn, regardless of the source, the application of boron boosted productivity. This average increase was 4.2; 2.8; 4.0; and 6.9 bags/ha, for the dose of 1, 2, 3, and 4 kg/ha B, respectively, when compared to the control (Figure 2). This shows the importance of annual boron application in the soil for productivity gains in summer corn, regardless of the boron content available in the soil analysis (see tables 1 and 2). Even though the differences in yield were not statistically different, the numerical increase in yield from *Granubor* was the greatest among the compared sources for all the doses tested (Figure 2).

In the clayey soil condition of the experiments (≥37% clay, see Tables 1 and 2), the greatest boost in yield was with the dose of 4 kg/ha B, for the source *Granubor*. This result shows how important it is to be familiar with the available boron sources and the clay content of the soil, the better to gauge what dose should be applied. For soils with sandier texture, the results of our experiments show that the best dose of *Granubor* is between 6.7 - 10 kg/ha (1 - 1.5 kg/ha B).

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



References: Gabriel Schaich, 2020. Physioatac.

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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