Relative plant tolerance to available boron supply

- Boron is essential for all plant growth. It aids in the transfer of sugars and nutrients from leaves to fruit, and increases pollination and seed development.
- Plant species vary considerably in their tolerance to the boron supply in the root environment.
- Plant species also vary considerably in their boron requirement.
- Reports show that many of those crops with higher boron requirements also usually have a greater tolerance to higher levels of available boron, so applying recommended boron rates and methods should not result in problems with excessive boron.
- Growers should know the relative boron needs for each specific crop, as well as the available boron supply in the soil to determine the optimum rate and method of applying sufficient boron for optimum yields.

Boron (B) was first shown to be an essential micronutrient for plant growth and development by Warington in 1923.

Results of numerous experiments since then have shown that the range in soil B levels that may result in B deficiencies or in possible toxicity symptoms is relatively narrow, compared with ranges of most other plant nutrients. This is because the levels of available B in soils are low (generally < 2 ppm), but the amounts of B to satisfy plant needs also are low. The recommended application rate of B fertilizers usually ranges from 0-4 lbs. of B/acre.

Boron nutrition is a special concern in crop production; growers want to ensure that the available B supply is sufficient for optimum nutrition but not so high as to result in reduced yields from an over-supply.

Current evidence shows that many plant species can tolerate much higher rates of applied B than previously thought.

Because B toxicities in plants – resulting from naturally-occurring high levels of available B in soils or an over-application rate of fertilizer B – result in reduced growth and development, growers may be overly cautious in applying sufficient B to assure optimum yields.

It is important to know the supply of available soil B, the specific crop's B needs, and the intended method of B application. Plant analyses are another useful tool in determining the general B status of crops during the growing season.

Boron-sufficiency ranges of many agronomic and horticultural crops are listed in Borax Agronomy Note, Boron Deficiency Symptoms, of this series.

Crops vary in B tolerance

Plant uptake of B is related primarily to the B concentration of the soil solution in the root zone. Soluble B is very mobile in soils and can be easily absorbed by plant roots.

Experiments to determine the relative tolerance of various species of plants have been conducted in sand cultures to reduce the number of factors (such as soil reactions) which affect the actual B concentrations in the soil solution of the root zone.

Toxicities in some plant species, which may be ascribed to B, may also be confounded with problems due to excessive salt accumulations in the soil, most of which may be ions other than the borate ion.

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Therefore, it's best to discuss plant tolerance to B in relative categories (tolerant, moderately tolerant, moderately sensitive, and sensitive) rather than by the actual soluble B concentrations in the root zone.

A list of the relative tolerance of some of the most common agronomic and horticultural crops is given in Table 1.

Table 1: Relative tolerance to B of some agronomic and horticultural crops

Tolerant	Moderately tolerant	Moderately sensitive	Sensitive
Alfalfa	Barley	Broccoli	Avocado
Beet	Cabbage	Carrot	Bean
Cotton	Celery	Cucumber	Grape
Grain sorghum	Corn	Pea	Grapefruit
Oat	Squash	Pepper	Lemon
Sugar beet	Sweet clover	Potato	Orange
Tomato	Turnip	Radish	Wheat

Maas, E.V., Salt tolerance of plants. In Handbook of Plant Science in Agriculture, IB.R. Christie (ed) CRC Press, Boca Raton, FL. Vol.2, p. 57. 1987.

Crops vary in B requirement

It is well known that agronomic and horticultural crops vary considerably in their B requirement. Growers should know if crops have high, intermediate, or low B requirements.

Table 2 lists crops with high, intermediate and low B requirements. It has been thought that legumes generally have higher B requirements than grass crops (monocotyledons). In reality, there are considerable differences in B requirements within each group. For example, alfalfa has a high B requirement but dry beans and soybeans have much lower B requirements. Crops with low-B requirements still require an adequate B supply to produce optimum yields.

It is important to note that some of the main crops listed in the tolerant and semi-tolerant categories of Table 1 also are those listed in Table 2 with high B requirements. Conversely, those crops in Table 1 which are sensitive to B also are those with low B requirements (in Table 2).

Because most of the crops fertilized with B are those which have high B requirements and also are tolerant of higher B levels in the root zone, applying the recommended B rates should not result in problems with excessive B levels in plants.

Table 2: Relative requirements of B for some agronomic and horticultural crops		
Grain, fiber and oilseed crops		
High	**Intermediate**	**Low**
Canola	Corn	Barley
Cotton	Flax	Rice
Eucalyptus	Grain sorghum	Rye
Oil palm		Soybean
Sunflower		Wheat
Forage crops		
High	**Intermediate**	**Low**
Alfalfa	Coastal bermudagrass	Grasses
	Clovers	
Fruit and nut crops		
High	**Intermediate**	**Low**
Apple	Citrus	Pecan
Grape	Peach	Pineapple
Olive	Pear	Strawberry
Peanut	Tomato	
Vegetable crops		
High	**Intermediate**	**Low**
Beet	Brussels sprout	Bean
Broccoli	Cabbage	Cucumber
Carrot	Onion	Melons
Cauliflower	Peppers	Pea
Celery	Potato	Pumpkin
Rutabaga	Spinach	Squash
Turnip	Sweet Corn	Sweet Potato
Specialty crops		
High	**Intermediate**	**Low**
Carnation	Herbs	Rubber
Coffee	Tea	Sugarcane
Gladiolus	Tobacco	
Sugar beet	Turf	

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