



Boron Mobility in Various Plant Species

- Boron is a micronutrient required for all plant nutrition.
- While it has been generally accepted that boron is phloem-immobile in plants, recent research has shown that boron is mobile in the phloem tissue in a number of species.
- Diagnosis of boron deficiencies and the most efficient methods of boron application differ in plant species with respect to boron mobility or immobility.
- Knowledge of the relative mobility of boron within a particular plant species will improve the ability to diagnose boron deficiencies and supply the needed boron for optimum crop production.

Boron (B) is required for all plant growth. It is essential that B is available for new vegetative growth and reproductive development. Therefore, B must remain available for plant uptake during the entire growth period unless it can be translocated from older to new tissues in the plant.

Plant uptake of B is a passive (non-metabolic) process and B is transported in the xylem vessels (transpiration stream) of all plant species. Therefore, B is mobile in the xylem system of all plants. It has been generally accepted that it is an immobile nutrient in the phloem tissue of plants. Once incorporated into a given tissue (such as leaves), B can not be remobilized to supply the needs of other plant tissues. However, results of recent research by Dr. P. H. Brown and associates of the University of California, Davis, have demonstrated that the phloem mobility of B varies significantly among plant species.

These results show that B is now known to be mobile in all plant species that use simple sugars (known as polyols) as primary compounds in photosynthetic processes. Boron forms a complex with these polyols and is transported in the phloem tissues to active growing regions in the plant.

In those plant species which do not produce significant quantities of polyols, B can not re-enter the phloem stream after it has been delivered to leaf tissues in the transpiration stream (xylem tissue). This B will tend to accumulate in the leaves and B is said to be immobile in these species.

Research Results

Evidence of phloem mobility or immobility can also be found by studying the distribution of B within different tissues of a given species. For example, under field conditions, pistachio and walnut contained the highest B concentrations in the leaves, and the lowest B concentrations in fruit and seed. This indicates that the B from these leaves does not translocate to the fruit and seed. In contrast,

almond and apple trees grown in the same field had the highest B concentrations in the hulls and fruit, respectively, with much lower B in the leaves. Data in Table 1 give B concentrations in various tissues of the four tree species.

Tissue	B – immobile		B – mobile	
	Pistachio	Walnut	Almond	Apple
Leaf	130	295	42	41
Hull	33	40	170	51 (peel)
Shell	2	9	34	34 (pulp)
Kernel	1	4	43	54 (core)

P. H. Brown and B. J. Shelp. 1997. Boron mobility in plants. *Plant and Soil* 193: 85-101.

The concentrations of B in leaves of different ages on the same plant also provides evidence of B mobility in a species (Table 2). Higher B concentrations in basal (older) than apical (younger) leaves indicates B immobility. In contrast, higher B concentrations in younger leaves (in the lower section of Table 2) indicates B mobility, since younger leaves have transpired less water than the older leaves.

Species	Location of leaves along the shoot			Remarks
	Basal	Middle	Apical	
Pecan	303	119	30	B – immobile
Strawberry	512	176	68	B – immobile
Tomato	721	318	94	B – immobile
Walnut	304	127	48	B – immobile
Apple	50	56	70	B – mobile
Apricot	45	45	81	B – mobile
Celery	32	494	104	B – mobile
Grape	74	55	88	B – mobile
Loquat	72	101	162	B – mobile
Olive	42	51	56	B – mobile
Peach	53	57	208	B – mobile
Pear	42	57	62	B – mobile
Pomegranate	21	20	111	B – mobile

P. H. Brown and H. Hu. 1997. Boron Mobility and Consequent Management in Different Crops. *Better Crops with Plant Food* 82 (2): 28-31.

Table 3 summarizes the current knowledge of grouping agronomic and horticultural crops as B-mobile or B-immobile. Agronomic crops and most vegetables are B-immobile species. However, relatively more species of fruit and nut crops are B-mobile species. Clearly, there is a need to study all economically important plant species with respect to B mobility. Such knowledge will improve the grower's ability to diagnose B deficiencies and use the most effective methods of applying B fertilizers for optimum crop yields.

Diagnosis and Correction of B Deficiency

Knowledge of B mobility or immobility in various plant species is important in interpreting plant analysis results. Table 2 shows that B accumulates in the older leaves of B-immobile species. Therefore, recently matured or fully expanded leaves

Table 3: Boron mobility or immobility in some agronomic and horticultural crops

B – immobile		
Agronomic crops	Vegetables	Tree and vine crops
Alfalfa	Bean	Figs
Corn	Lettuce	Pecans
Cotton	Potato	Pistachio
Peanuts	Tomato	Strawberry
Sorghum		Walnut
Sugar Beet		
Tobacco		
Wheat		
B – mobile		
Agronomic crops	Vegetables	Tree and vine crops
Canola (limited)	Asparagus	Almond
	Beans	Apple
	Broccoli	Apricot
	Carrot	Cherry
	Cauliflower	Coffee
	Celery	Grapes
	Onion	Loquat
	Pea	Nectarine
	Radish	Olive
	Rutabaga	Peach
		Pear
		Plum
		Pomegranate

should not be sampled to diagnose for deficiency because these leaves may not reflect the B status of the growing tissues, for which a constant B supply is critical. Diagnosis of B deficiency in B-immobile species can only be done by sampling growing tissues.

In contrast, sampling mature leaves of B-mobile species to diagnose for B deficiency is appropriate. The B content of mature leaves reflects the B status of the entire plant, including the young, actively growing tissues. In these species, a decrease in B uptake will not affect the growing tissues until the soluble-B pool of the mature tissues has been depleted by translocation to the younger tissues.

Correction of B deficiency is directly affected by B mobility or immobility in plants. In those species in which B is immobile, foliar-applied B will not be translocated from the site of application. This B cannot supply the B requirements of tissues not yet formed. Therefore, B applications must be made directly to developing tissues, such as flower buds and flowers, to ensure an adequate B supply during their critical time of development.

In contrast, foliar sprays of *Solubor* can be applied to B-mobile plants at any time that functional leaves are present. The applied B can correct current B deficiencies and also supply B to future developing flowers and fruit tissues. Benefits of foliar B applications in fruit set have been observed in B-mobile tree species such as almond, apple, plum and prune.

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