



Sources and rates of foliar-applied boron to enhance[±] productivity of maize

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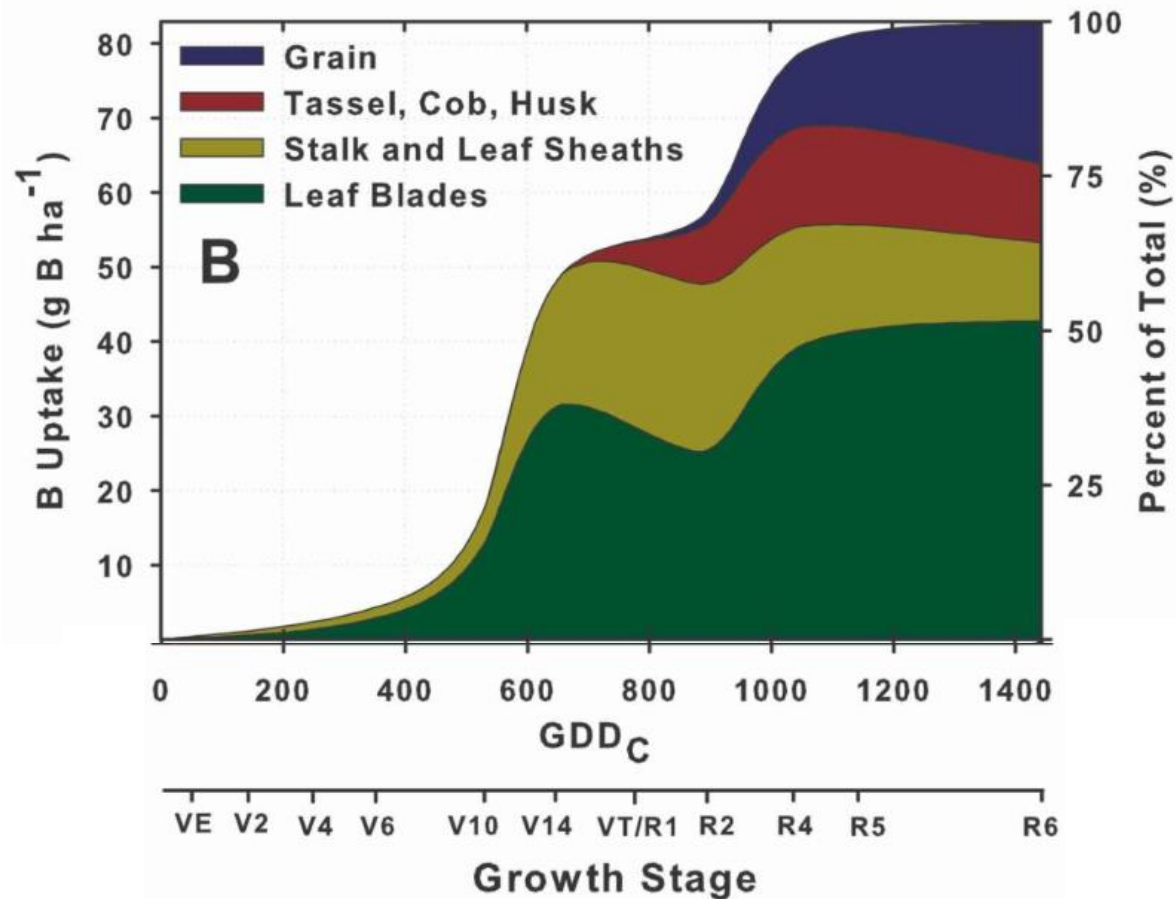
What is Boron's role?



- Meristematic tissue cell division and elongation
- Petal and leaf bud formation
- Sugar and hydrocarbon metabolism and their transfer,
- Protein cytoskeletal function, membrane stability
- Stimulation of reproductive tissues

(Lu et al., 2015; Shireen et al., 2018; Shelp, 1993; Marschner, 1995)

Maize Uptake of Boron **I**



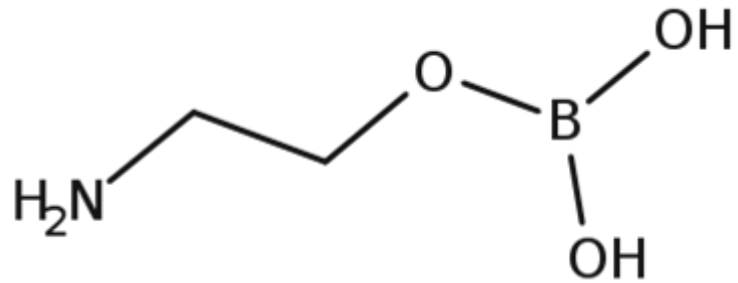
- Boron uptake peaks between V8 and V14
- Boron has limited remobilization from leaf and stalk material

(Bender et al., 2015)

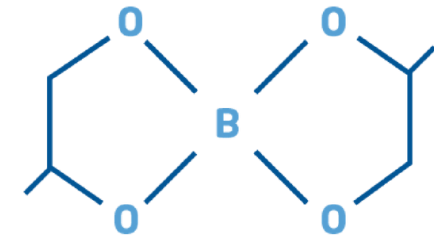
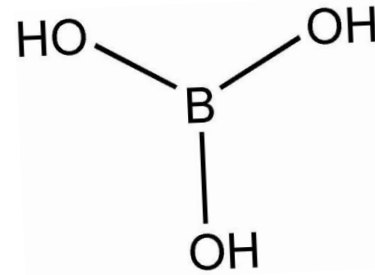
Foliar-Applied Boron Sources



Boron Ethanolamine



Boric Acid



BRANDT Smart B



Objectives



- Assess if vegetative (V5) foliar applications of boron can influence maize growth and grain yield.
- Determine if the mobility of foliar-applied boron can be influenced by different sources (boric acid or boron ethanolamine) and rates.

Foliar Boron Treatments

Treatment †	Product Rate L ha ⁻¹	Total Boron Applied g ha ⁻¹
Untreated Check	-	-
Boric Acid Derivative (5%)	1.17	75
Boron Ethanolamine (10%)	0.55	75
Boric Acid Derivative (5%) (x3)	1.17 (3x)	225
Boron Ethanolamine (10%) (x3)	0.55 (3x)	225

† Boric acid supplied as Brandt Smart B, and boron ethanolamine supplied as Brandt Liquid Boron;
All treatments applied at V5

Foliar Boron Treatments I

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Boron Ethanolamine (10%)	0.55	75
Boric Acid Derivative (5%) (x3)	1.17 (3x)	225
Boron Ethanolamine (10%) (x3)	0.55 (3x)	225
Boron Ethanolamine (10%) High	4.67	625

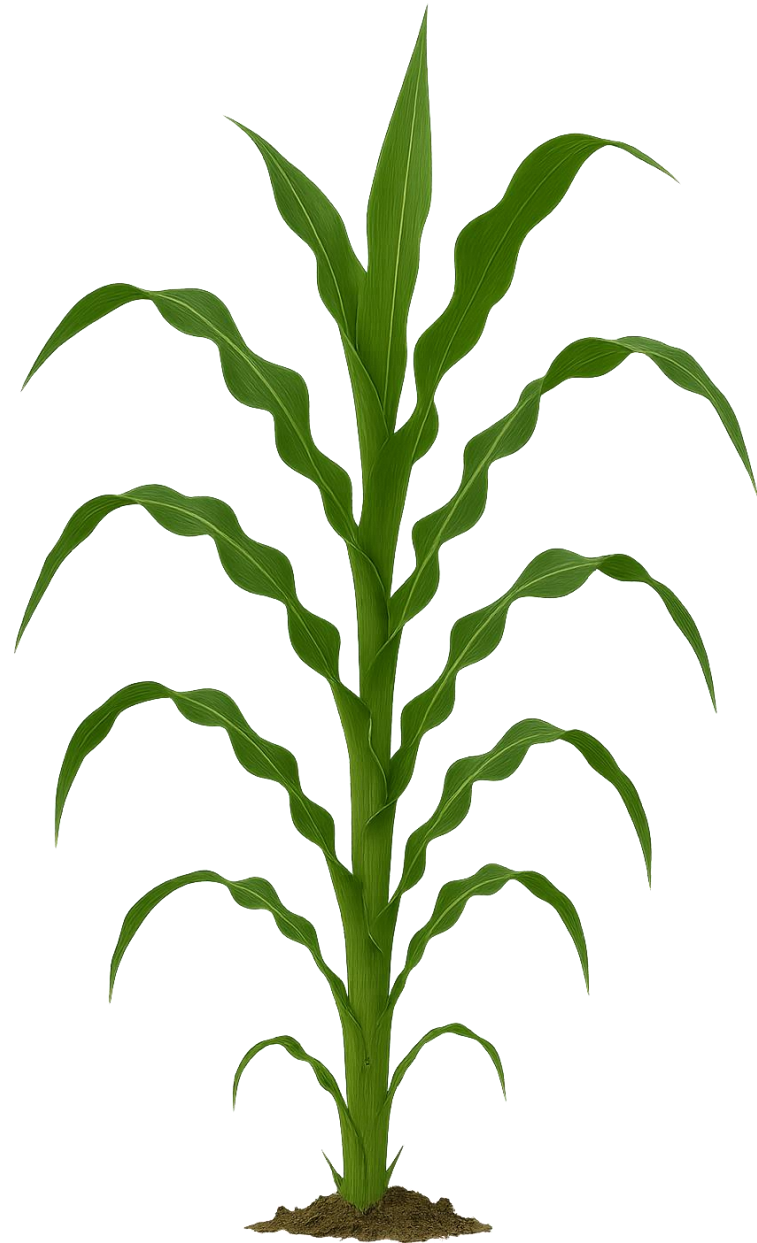
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All treatments applied at V5

Data Collection

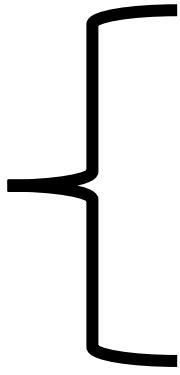


- Plant partitioning at V14
 - Pairs of leaves
 - Stalks
 - Reproductive Tissues

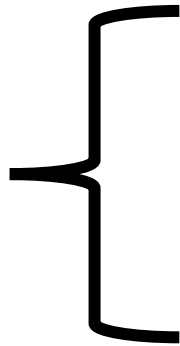




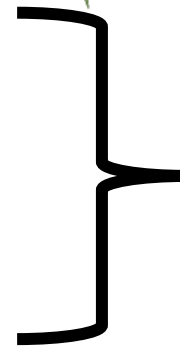
Leaves 10 & 11



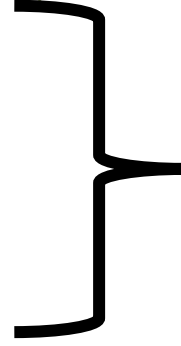
Leaves 6 & 7



Leaves 8 & 9

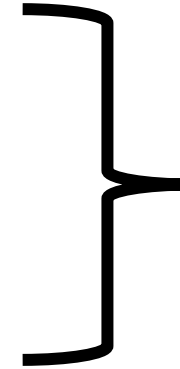
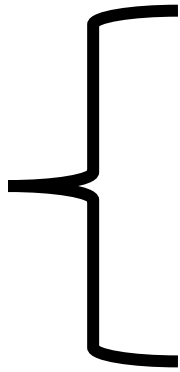


Leaves 4 & 5



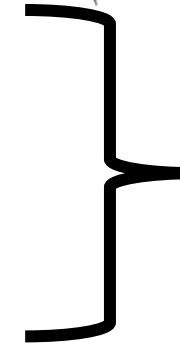
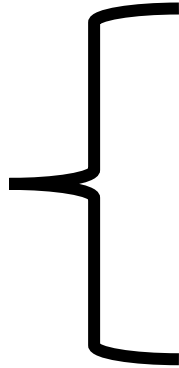


Whorl



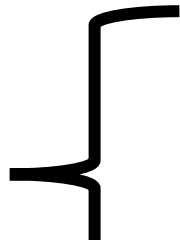
Leaves 12 & 13

Leaves 10 & 11



Leaves 8 & 9

Leaves 6 & 7

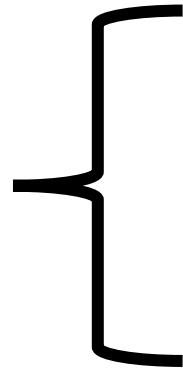




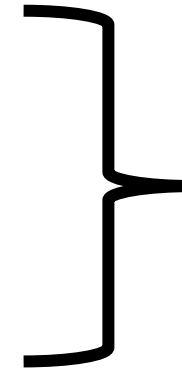
Reproductive Tissues
(ear shoots and tassel)



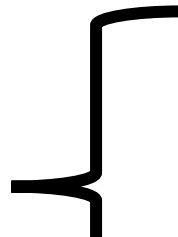
Whorl



Leaves 12 & 13



Leaves 10 & 11

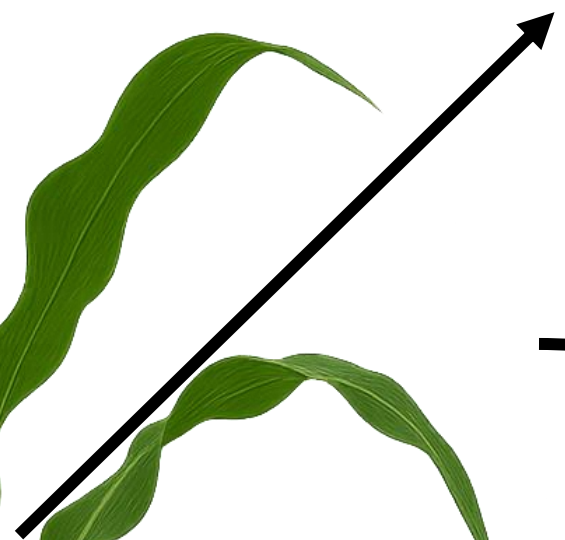




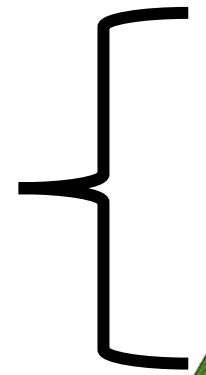
Reproductive Tissues
(ear shoots and tassel)



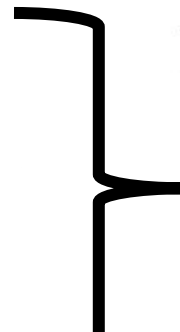
Stalk



Whorl



Leaves 12 & 13



V14 Boron Content Within Plant Parts

Treatment †	Leaves 4 & 5	Leaves 6 & 7	Leaves 8 & 9	Leaves 10 & 11	Leaves 12 & 13	Whorl	Reproductiv e Tissues	Stalks	Total
boron accumulation (g per hectare)									
Untreated Check	3.0	3.9	5.7	7.2 CD	9.2 B	17.3	18.3	18.3	39.2
Boric Acid Derivative	2.7	3.7	5.5	7.8 ABC	10.2 AB	19.9	18.5	19.0	39.6
Boron Ethanolamine	2.9	3.6	5.3	7.5 BCD	10.3 A	20.8	20.8	21.0	40.3
Boric Acid Derivative (x3)	3.0	3.7	5.3	7.1 D	10.5 A	19.6	19.6	19.6	38.7
Boron Ethanolamine (x3)	2.3	4.0	5.8	8.2 AB	10.6 A	19.1	19.1	19.2	39.5
Boron Ethanolamine High	2.7	4.0	5.5	8.2 A	11.1 A	21.0	21.0	21.0	41.4
LSD	NS	NS	NS	0.7	0.9	NS	NS	NS	NS
p-value	0.96	0.11	0.59	0.05	0.06	0.10	0.26	0.27	0.77

† Boric acid supplied as Brandt Smart B, and boron ethanolamine supplied as Brandt Liquid Boron;
All treatments applied at V5

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Untreated Check	3.0	3.9	5.7	7.2 ^{CD}	9.2 ^B	17.3	18.3	18.3	39.2
Boric Acid Derivative	-0.3	-0.2	-0.2	+0.6 ^{ABC}	+1.0 ^{AB}	+2.6	+0.2	+0.6	+0.4
Boron Ethanolamine	-0.1	-0.3	-0.4	+0.3 ^{BCD}	+1.1 ^A	+3.5	+2.5	+2.6	+1.1
Boric Acid Derivative (x3)	±0.0	-0.2	-0.4	-0.1 ^D	+1.3 ^A	+2.2	+1.2	+1.2	-0.5
Boron Ethanolamine (x3)	-0.7	+0.1	+0.1	+1.0 ^{AB}	+1.5 ^A	+1.8	+0.8	+0.9	+0.2
Boron Ethanolamine High	-0.3	+0.1	-0.2	+1.0 ^A	+1.9 ^A	+3.6	+2.6	+2.6	+2.2
LSD	NS	NS	NS	0.7	0.9	NS	NS	NS	NS
p-value	0.96	0.11	0.59	0.05	0.06	0.10	0.26	0.27	0.77

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V14 Plant Biomass Accumulation

Treatment †	Leaves 4 & 5	Leaves 6 & 7	Leaves 8 & 9	Leaves 10 & 11	Leaves 12 & 13	Whorl	Reproductive Tissues	Stalks	Total
————— plant biomass accumulation (kg per hectare) —————									
Untreated Check	146	398	776	1048	1001	1488	214	2720	7828
Boric Acid Derivative	129	391	760	1042	1020	1620	210	2831	8188
Boron Ethanolamine	130	384	745	1029	1034	1648	282	2537	7884
Boric Acid Derivative (x3)	148	380	743	988	1004	1587	300	2839	7956
Boron Ethanolamine (x3)	101	398	744	1018	1023	1540	264	2789	7899
Boron Ethanolamine High	127	397	764	1052	1077	1653	301	2683	8054
LSD	NS	NS	NS	NS	NS	NS	51	172	NS
p-value	0.802	0.468	0.377	0.421	0.645	0.478	0.018	0.091	0.202

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————— plant biomass accumulation (kg per hectare) —————									
Untreated Check	146	398	776	1048	1001	1488	214	2720	7828
Boric Acid Derivative	-17	-7	-15	-7	+19	+132	-4	+111	+361
Boron Ethanolamine	-16	-15	-30	-20	+34	+161	+68	-184	+57
Boric Acid Derivative (x3)	+2	-18	-32	-60	+3	+99	+85	+118	+129
Boron Ethanolamine (x3)	-45	-1	-32	-30	+22	+53	+50	+68	+71
Boron Ethanolamine High	-19	-2	-12	+4	+77	+166	+87	-37	+227
LSD	NS	NS	NS	NS	NS	NS	51	172	NS
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What about yield?



Data Collection



- Plant partitioning at V14
 - Pairs of leaves
 - Stalks
 - Reproductive Tissues
- Grain Yield and Yield Components
 - Kernel number per m²
 - Individual weight per kernel



Yield Components

Treatment †	Grain Yield (Mg/ha)	Kernel Number (kernels/m ²)	Kernel Weight (mg)
Untreated Check	14.1	4599	306
Boric Acid Derivative	14.2	4578	311
Boron Ethanolamine	14.7	4727	311
Boric Acid Derivative (x3)	14.5	4581	317
Boron Ethanolamine (x3)	14.0	4503	313
Boron Ethanolamine High	14.4	4676	308
LSD	NS	NS	NS
p-value	0.106	0.37	0.67

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All treatments applied at V5

Yield Components

Treatment †	Grain Yield (Mg/ha)	Kernel Number (kernels/m2)	Kernel Weight (mg)
Untreated Check	14.1	4599	306
Boric Acid Derivative	+0.16	-21.65	+4.69
Boron Ethanolamine	+0.64	+127.90	+4.75
Boric Acid Derivative (x3)	+0.44	-18.82	+10.55
Boron Ethanolamine (x3)	-0.11	-96.57	+6.57
Boron Ethanolamine High	+0.36	+76.20	+1.97
LSD	NS	NS	NS
p-value	0.106	0.37	0.67

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All treatments applied at V5

Conclusions



- Foliar-applied Boron stunted the early growth, but enhanced the growth of leaves and reproductive tissues that developed after the application
- Treatments enhanced Boron mobilization to the growth of newer leaves
- Most treatments had a slight response in yield, associated with heavier kernel weight



Thank You!



More Information Available at:

Crop Physiology Laboratory

University of Illinois

<http://cropphysiology.cropsci.illinois.edu>

