Response of Corn and Bean Seedlings to Preplant Application of Island Commodities, Inc. Bone Meal

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Oahu food processors, wholesalers, retailers and restaurants that market livestock and fish products generate waste by-product. Island Commodities, Inc. collects an average 75 to 100 tons of waste by-products per week and process into re-cycled products. Using heat and steam they extract and separate 7.5 to 10 tons of oil that is used to fuel their steam generation boilers and produce 15 to 20 tons of bone meal on a weekly basis. Since the process only uses heat, steam and mechanical means of producing the end products, the bone meal qualifies to be an "organic" source of soil amendment. The bone meal produced is the size of fine grain. This trial examines the response of corn and bean seedlings to different rate of bone meal added to potting media, Sunshine mix #1. Six treatments were evaluated. The treatment rates were potting media only, urea 45-0-0 at 222 lbs/ac and bone meal at rates of 625, 1250, 2500 and 5000 lbs per acre. The nutritional content of the bone meal is not consistent and will depend on the proportion of livestock and fish by-products combined to process each particular batch of bone meal. Each batch should be analysis if you wish to obtain more certain nutritional value of the bone meal batch.

Example of Bone Meal Soil Amendment

Analysis by CTAHR-Agriculture

Diagnostic Service Center

	%							ppm				
Sample	N	C	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu	B
A	8.77	47.37	2.31	.73	4.15	.14	.66	1179	14	78	17	5
B	8.88	46.96	3.28	.67	6.14	.17	.65	1045	12	88	16	4

The nutritional sample results indicate that there is nutritional value that could benefit plant growth. For this trial, the treatments were applied at pre plant mixed into the potting media. The label on the potting media state that dolomite and gypsum were added into the media. Each treatment was replicated 4-times in 4" pots that contained 150 grams of potting media each. Three corn and bean seeds were planted in each pot. Fresh plant weight and plant tissue samples were collected 17 days after seeding. 1-plant from each of the 4 replicate was cut at media level and collected to make up a composite sample that represented each treatment.

Discussion and Results

Analysis indicates that there were significant treatment effects at P=5% level in the fresh weight of the seedings. P values for bean and corn were .0002 and .0001 respectively. The comparison of means analysis at 5% level separated the mean plant weight into 3 groupings for both beans and corn in which the means were not significantly different at from one another.

Treatment Effect on Seedling Weight (g)

Average Weight of Bean Seedling Samples at 17 Days Old

Treatment	Application Rate Lbs/Acre	Mean Bean Seedling Wt. (g)	Groupings
Bone Meal	5000	10.498	A
Bone Meal	2500	9.053	AB
Bone Meal	1250	7.738	BC
Bone Meal	625	6.801	BC
Urea	222	6.729	BC
Media Only	0	5.364	C

Critical Value for Comparison 2.6171

The mean bean seedling weights in treatment equivalents of 5000, 2500, 1250 and 625 pounds per acre of bone meal were greater than 222 lbs of urea and media only treatments. Statistically there were 3 groups, A, B, and C, in which the means were not significantly different from one another. Urea treatment shared homogenous grouping with bone meal treatments rates of 2500, 1250 and 625 pounds per acre; and media only treatment shared statistical grouping with bone meal treatments of 1250, 625 and urea treatment.

Beans From Left to Right: Media only, Urea 222 lbs/ac, BM 50 lbs/ac, BM 1250 lbs/ac, BM 2500 lbs/ac, BM 5000 lbs/ac

Average Weight of Corn Seedling Samples at 17 Days Old

Treatment	Application Rate Lbs/Acre	Mean Corn Seedling Wt. (g)	Groupings
Bone Meal	5000	10.632	A
Bone Meal	2500	8.796	AB
Bone Meal	1250	8.242	AB
Urea	222	8.065	B
Bone Meal	625	6.787	BC
Media Only		5.249	C

Critical Value for Comparison 2.5209

The mean corn seedling weights treated with an equivalent of 5000, 2500 and 1250 pounds per acre of bone meal were greater than 222 lbs of urea and media only treatments. Statistically there were 3 groups, A, B, and C, in which the means were not significantly different from one another. Urea treatment shared homogenous grouping with bone meal treatments rates of 2500, 1250 and 625 pounds per acre; and media only treatment shared statistical grouping with bone meal treatment at 625.

Corn From Left to Right: Media only, Urea 222 lbs/ac, BM 50 lbs/ac, BM 1250 lbs/ac, BM 2500 lbs/ac, BM 5000 lbs/ac

Plant Tissue Analysis

Bean Seedlings

There were no visual nutritional deficient symptoms in the bean seedlings of all treatments.

Nitrogen: Urea and bone meal at 5000 lbs per acre treatments exceeded the average average critical nutritional tissue standard for N of 4.5%.

Phosphorus: Media only, urea and and bone meal at 5000 lbs per acre treatments exceeded the average average critical nutritional tissue standard for P of .5%.

Potassium (K): Urea and bone meal at 5000 lbs per acre treatments exceeded the average average critical nutritional tissue standard for K of 2.9%.

Calcium: The media used in the trial, Sunshine Mix #1, contained gypsum and dolomite. Both contain Ca. All treatments exceeded the average average critical nutritional tissue standard for Ca of 1.9%.

Magnesium: The media used in the trial, Sunshine Mix #1, contained dolomite. Dolomite contains Mg. All treatments exceeded the average critical nutritional tissue standard for Mg of .625.

Iron (Fe): All treatments exceeded the average for Fe of 225 ppm.

Manganese: All treatments exceeded the average critical nutritional tissue standard for Mn of 165 ppm.

Zinc: Media only treatment exceeded the average critical nutritional tissue standard for Zn of 60 ppm.

Copper: No treatments exceeded the average critical nutritional tissue standard for Cu of 12 ppm.

Boron: No treatments exceeded the average critical nutritional tissue standard of B of 47.5 ppm.

The bone meal by itself will not adequately provide all the required nutritional needs to grow bean seedlings.

Corn Seedlings

There were visible plant nutritional deficient symptoms in the corn seedlings of treatments media only and all bone meal treatments. There were purpling on the stems and yellowing of the early mature leaves. While the symptoms are visible they are more prevalent lower rate bone meal treatments. The leaves of the higher rate bone meal treatments displayed chlorotic symptom similar to Mn deficiencies.

Nitrogen: Urea and bone meal at 5000 lbs per acre treatments exceeded the average critical nutritional tissue standard for N of 4%.

Phosphorus: All treatments exceeded the average critical nutritional tissue standard for P of .4%.

Potassium (K): Media only, urea and bone meal 625 lbs per acre treatments exceeded the average critical nutritional tissue standard for K 3.3%.

Calcium: The media used in the trial, Sunshine Mix #1, contained gypsum and dolomite. Both contain Ca. All treatments, except media only treatment, exceeded the average critical nutritional tissue standard for Ca of .5%.

Magnesium: The media used in the trial, Sunshine Mix #1, contained dolomite. Dolomite contains Mg. All treatments, except media only treatment, exceeded the average critical nutritional tissue standard for Mg of .35%.

Iron (Fe): No treatments exceeded the average critical nutritional tissue standard for Fe of 175 ppm.

Manganese: No treatments exceeded the average critical nutritional tissue standard for Mn of 166 ppm.

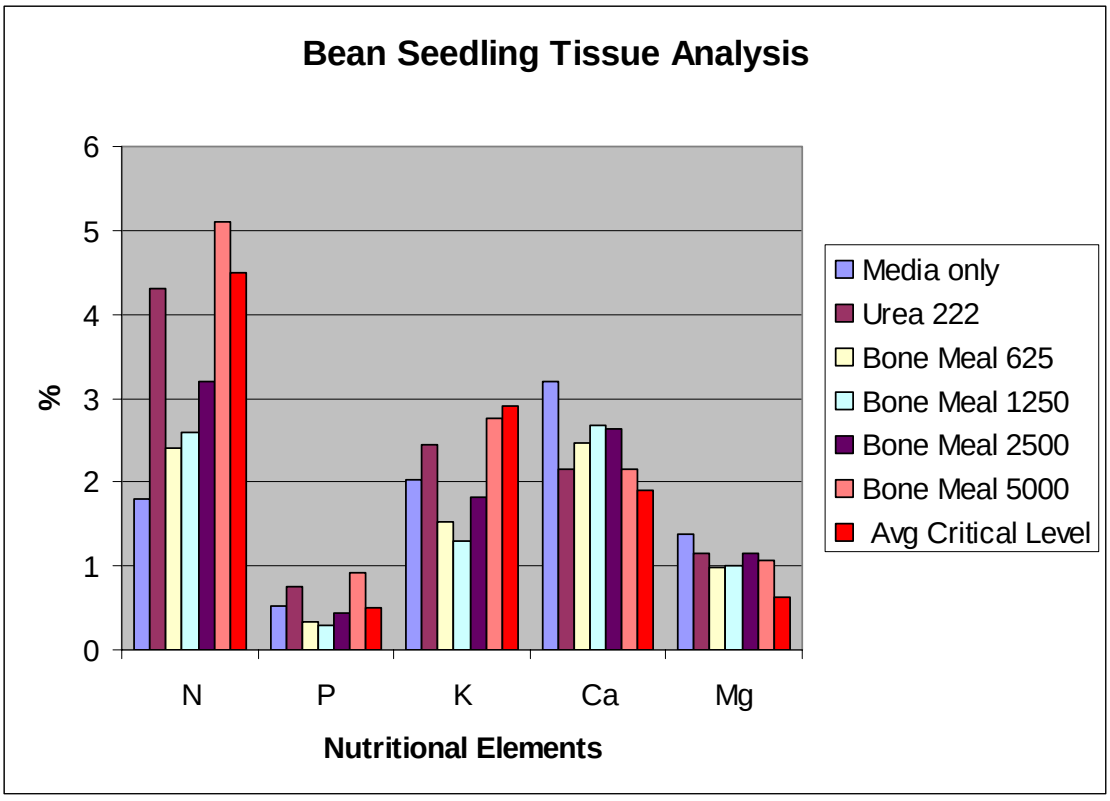
Zinc: All treatments exceeded the average critical nutritional tissue standard for Zn of 15 ppm.

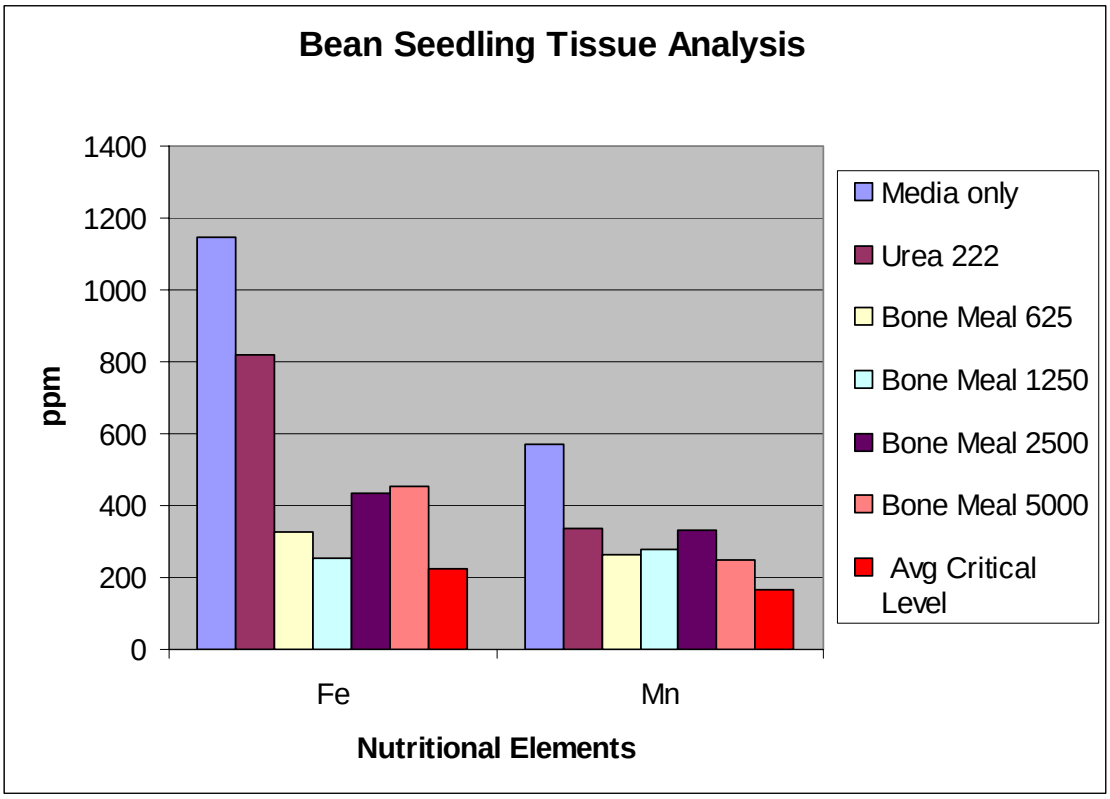
Copper: All treatments exceeded the average critical nutritional tissue standard for Cu of 4 ppm.

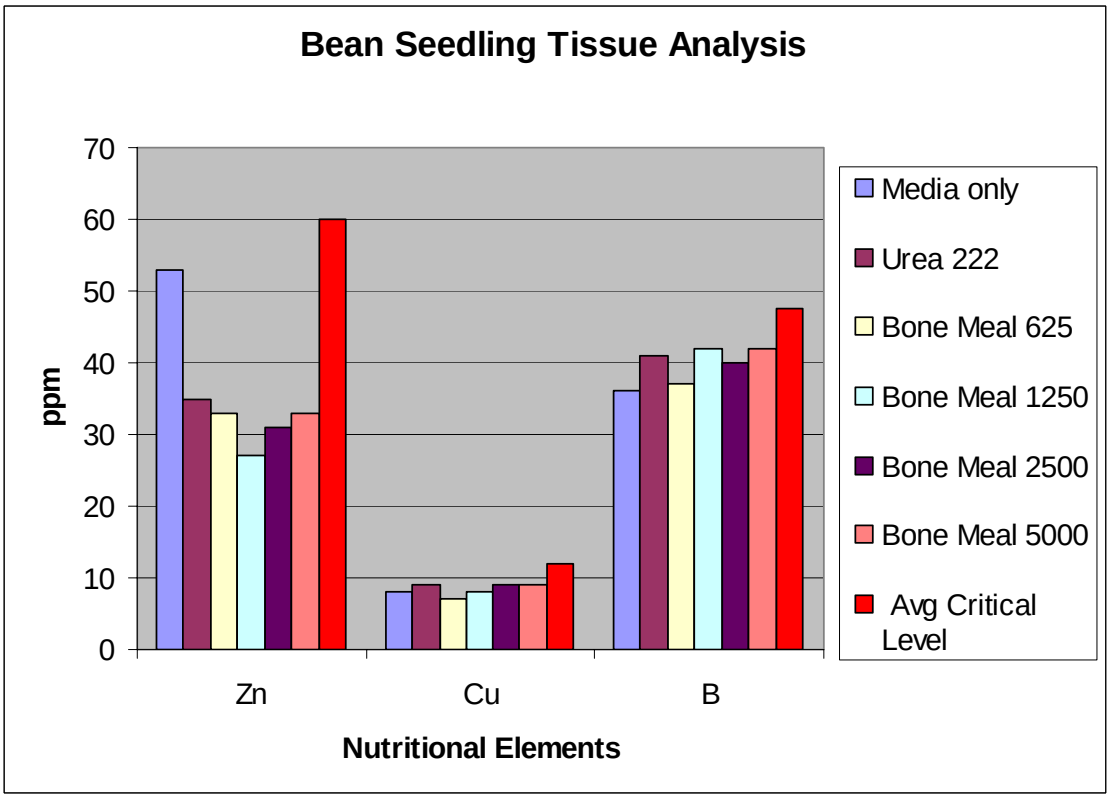
Analyzing plant nutrition deficiency can be complex. Beside visual symptoms associated to a single nutrient, symptoms of combination of nutritional deficiencies can also be displayed, thus making analysis more difficult. The purpling of plant parts is typical of P deficiency. But the tissue analysis indicated that the P levels of all treatments exceeded the average critical nutritional level. But the treatments that displayed the visual symptoms the strongest, included treatments media only and bone meal treatments of 625, 1250 and 2500 lbs per acre also had tissue sample deficiencies in N, Fe and Mn. This combination of deficiencies could have played a role in localizing the purpling like a P deficiency on the stems.

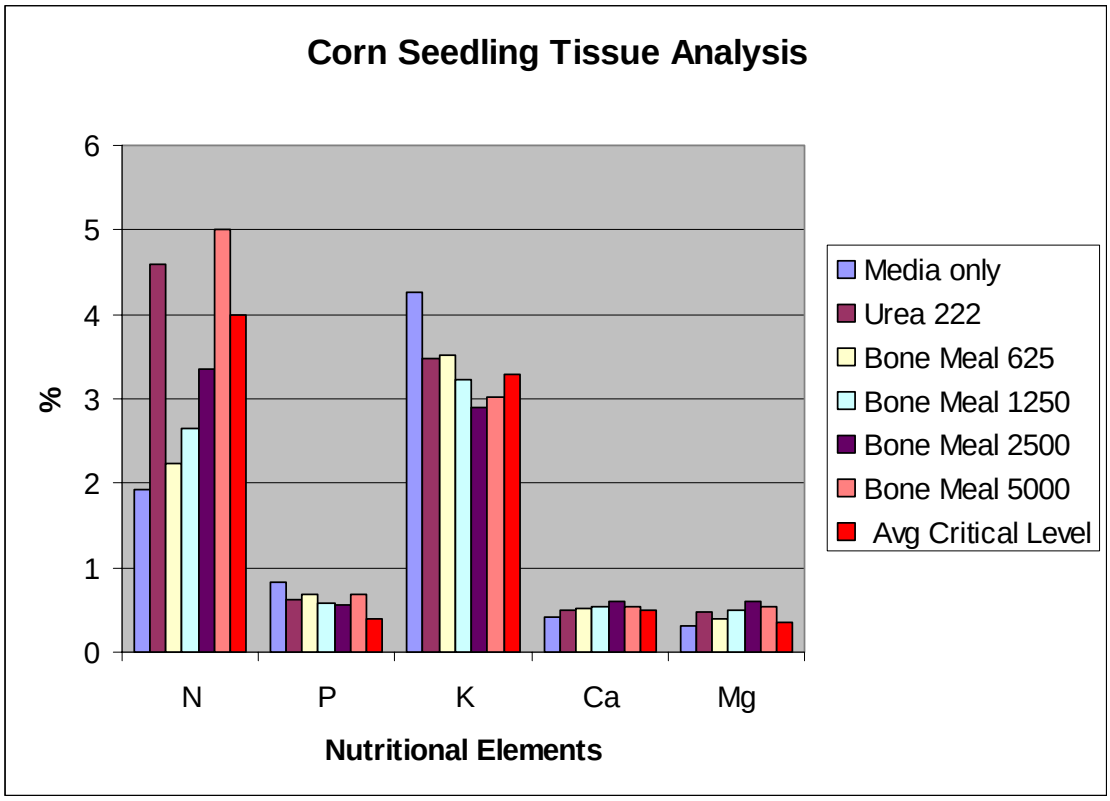
The interveinal chlorosis symptoms on the corn seedlings, typical of Fe deficiencies, were observed on the leaves of the highest bone meal treatments, 2500 and 5000 lbs per acre. The symptoms only appeared treatments that had received high N levels from the bone meal. Urea treatments had high N tissue levels and shared deficiencies in Fe and Mn, but did not display interveinal chlorosis symptoms.

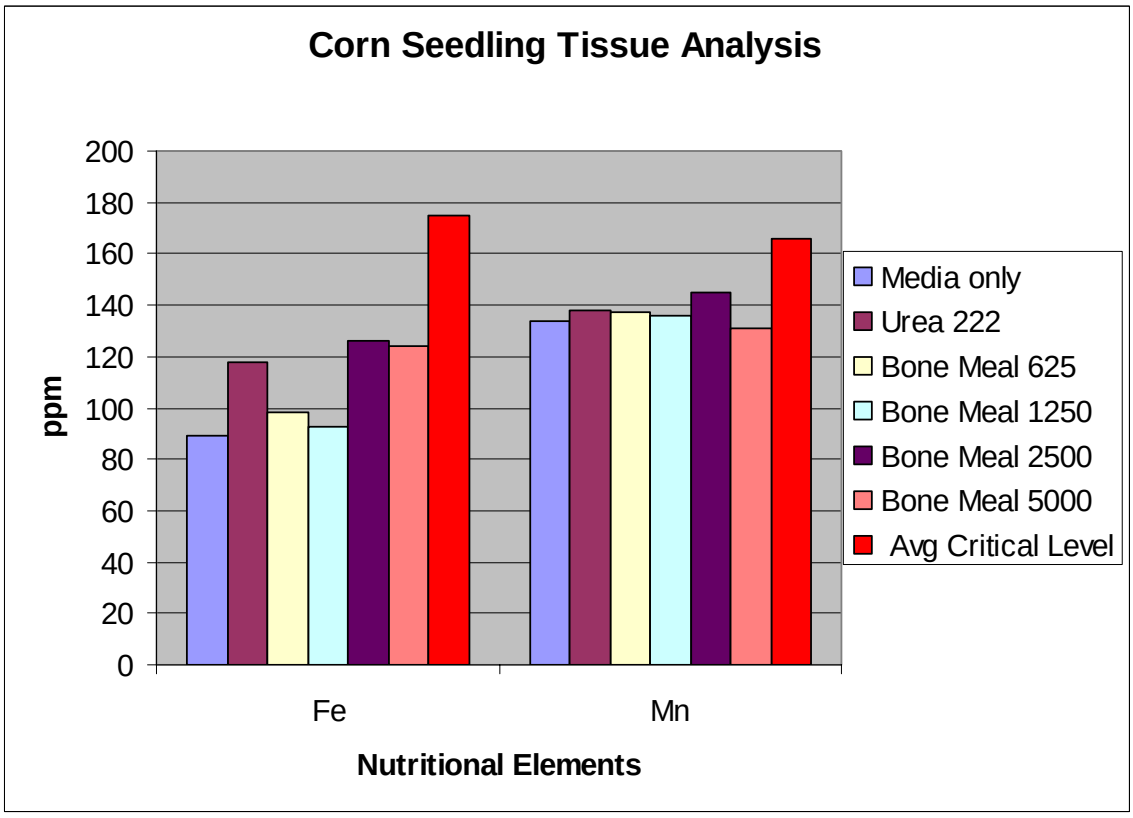
Charts below depicts nutritional values of both bean and corn seedlings.

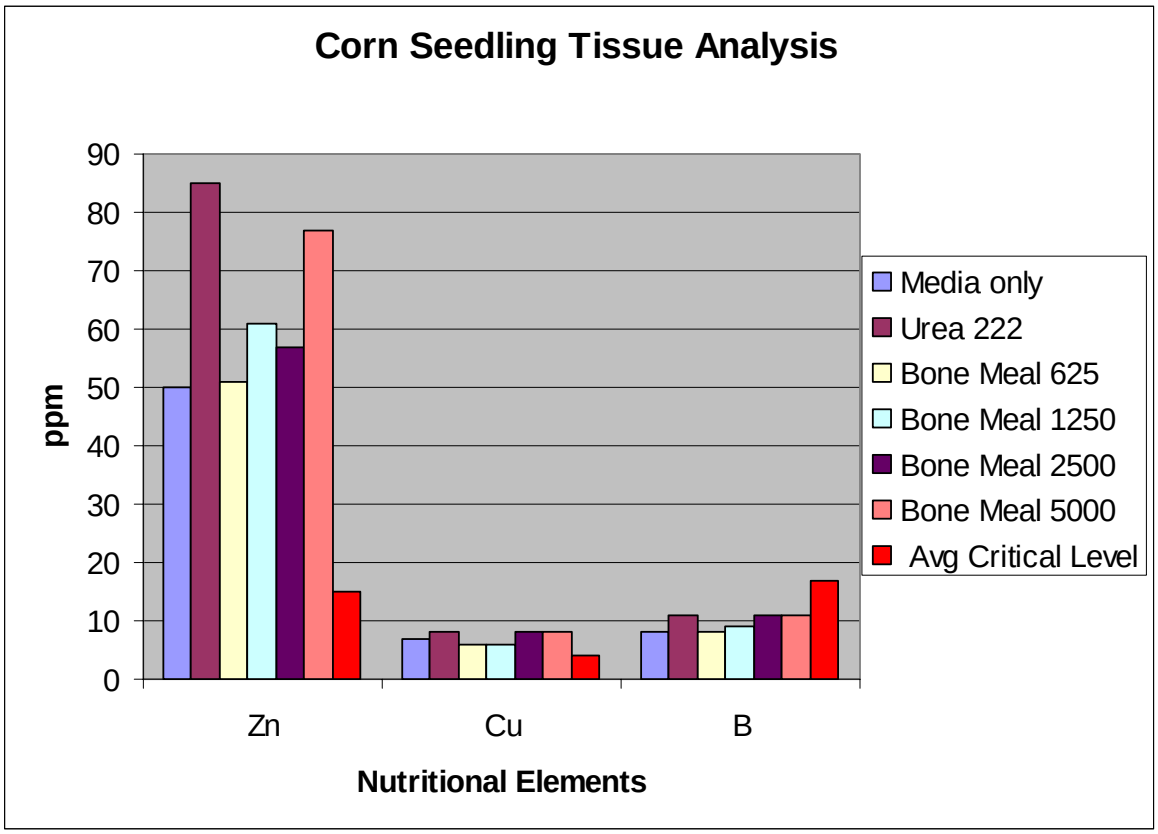



Bean Seedling Tissue Analysis
1400
1200
1000
800
600
400
200
0
ppm
Fe
Mn
Nutritional Elements
Media only
Urea 222
Bone Meal 625
Bone Meal 1250
Bone Meal 2500
Bone Meal 5000
Avg Critical Level


Bean Seedling Tissue Analysis
70
60
50
40
30
20
10
0
ppm
Zn
Cu
B
Nutritional Elements
Media only
Urea 222
Bone Meal 625
Bone Meal 1250
Bone Meal 2500
Bone Meal 5000
Avg Critical Level


Corn Seedling Tissue Analysis
%
6
5
4
3
2
1
0
N
P
K
Ca
Mg
Nutritional Elements
Media only
Urea 222
Bone Meal 625
Bone Meal 1250
Bone Meal 2500
Bone Meal 5000
Avg Critical Level


Corn Seedling Tissue Analysis
ppm
200
180
160
140
120
100
80
60
40
20
0
Fe
Mn
Nutritional Elements
Media only
Urea 222
Bone Meal 625
Bone Meal 1250
Bone Meal 2500
Bone Meal 5000
Avg Critical Level


Corn Seedling Tissue Analysis
90
80
70
60
50
40
30
20
10
0
ppm
Zn
Cu
B
Nutritional Elements
Media only
Urea 222
Bone Meal 625
Bone Meal 1250
Bone Meal 2500
Bone Meal 5000
Avg Critical Level