Analysis of fertilizer (CWT) used in Lazyman Soil Doctor
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Experiments conducted

A total of 14 greenhouse experiments were conducted as listed below. The first four experiments had four treatments: CWT at 1 oz/gallon; CWT at 2 oz/gallon; the formulation control at 1 oz/gallon; and the formulation control at 2 oz/gallon. The other experiments had two treatments: CWT at 2 oz/gallon and the formulation control at 2 oz/gallon. In experiments 1 – 9, there were 6 replications per treatment, and in experiments 10 – 14, there were 10.

1. AUO 101 A. Evaluation of CWT at two rates on tomato transplants in field soil.
2. AUO 101 B. Evaluation of CWT at two rates on pepper transplants in field soil.
3. AUO 101 C. Evaluation of CWT at two rates on snapdragon transplants in Promix.
4. AUO 101 D. Evaluation of CWT at two rates on dianthus transplants in Promix.
5. AUO 102 A. Evaluation of CWT at one rate on tomato transplants in Promix.
6. AUO 102 B. Evaluation of CWT at one rate on pepper transplants in Promix.
7. AUO 102 C. Evaluation of CWT at one rate on snapdragon transplants in Promix.
8. AUO 103 A. Evaluation of CWT at 2 oz/gallon on tomato transplants in field soil from E.V. Smith research center.
9. AUO 103 B. Evaluation of CWT at 2 oz/gallon on pepper transplants in field soil from E.V. Smith research center.
10. AUO 104 A. Evaluation of CWT at 2 oz/gallon on seeded tomato in Promix.
11. AUO 104 B. Evaluation of CWT at 2 oz/gallon on seeded pepper in Promix.
12. AUO 104 C. Evaluation of CWT at 2 oz/gallon on seeded cucumber in Promix.
13. AUO 104 D. Evaluation of CWT at 2 oz/gallon on seeded marigold in Promix.
14. AUO 104 E. Evaluation of CWT at 2 oz/gallon on seeded zinnia in Promix.
15. AUO 104 F. Evaluation of CWT at 2 oz/gallon on seeded sunflower in Promix.

General methods

In all experiments, the treatments were applied by watering the transplants immediately after transplanting (experiments 1 – 9) or watering the seeds (experiments 10 – 14) immediately after seeding. In the transplant experiments, CWT and the formulation control were reapplied two weeks after transplanting.

For transplants, the growth rate was calculated by taking weekly measurements of the growth index, which is the height X width of each plant in cm. This procedure allows visualizing how growth is affected over time. In addition, at the end of the experiment, plants were destructively sampled to measure root and shoot fresh weight.

With seeded experiments, a single destructive sampling was done to measure fresh weight of shoots, roots, and whole plants. Stem caliper was also measured on some plant types.

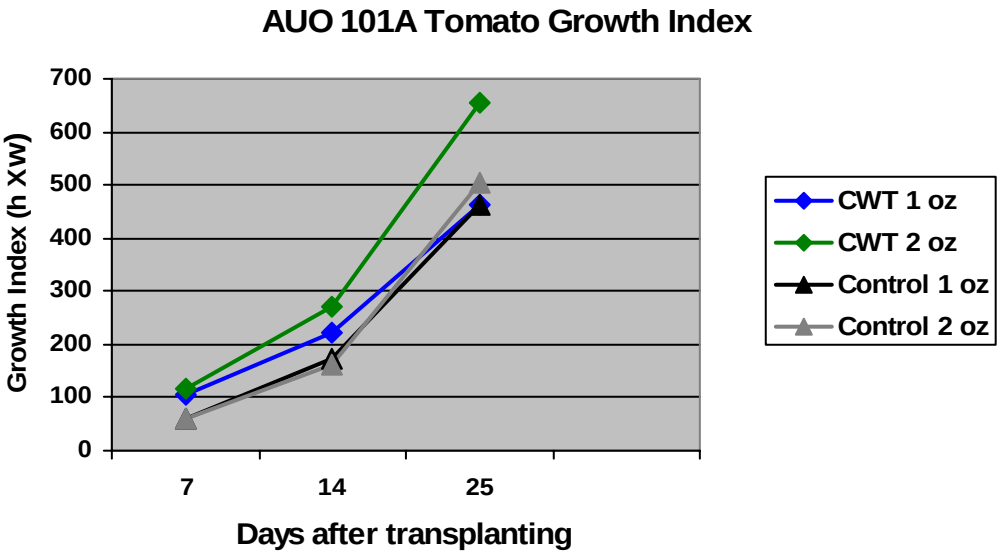
Results

1. Experiment 1

Experiment 1, AUO 101A, Tomato Transplants in Field Soil, Growth Index

	Growth Index (Height x Width) cm		
Treatment	**7 Days**	**14 Days**	**25 Days**
1) Test Product 1 oz/gal	**107.52***	**222.00***	464.60
2) Test Product 2 oz/gal	**117.29***	**272.24***	**656.67***
3) Control 1oz/gal	62.16	173.45	462.83
4) Control 2 oz/gal	62.16	162.39	506.00
$LSD_{0.05}$	16.98	31.67	67.44

* Indicates significant increase from the corresponding rate of control at the 95% probability level. Values are means of 6 replications.



AUO 101A Tomato Final Plant Weight 25 Days after Transplanting

Treatment	Root Wt.(g)	Shoot Wt. (g)
1) Test Product 1 oz/gal	4.03	12.37
2) Test Product 2 oz/gal	**5.38***	**16.08***
3) Control 1oz/gal	4.83	10.15
4) Control 2 oz/gal	4.12	13.03
$LSD_{0.05}$	1.05	2.49

* Indicates significant increase from the corresponding rate of control at the 95% probability level. Values are means of 6 replications.

Photographs of Experiment 1

Figure 1. AUO 101A, Tomato 2 weeks after transplanting. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Figure 2. AUO 101A, Tomato 3 weeks after transplanting. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Figure 3. AUO 101A, Tomato 3 weeks after transplanting. Right = CWT @ 1 oz/gallon; left = formulation control @ 1 oz/gallon.

Conclusions and interpretations of Experiment 1.

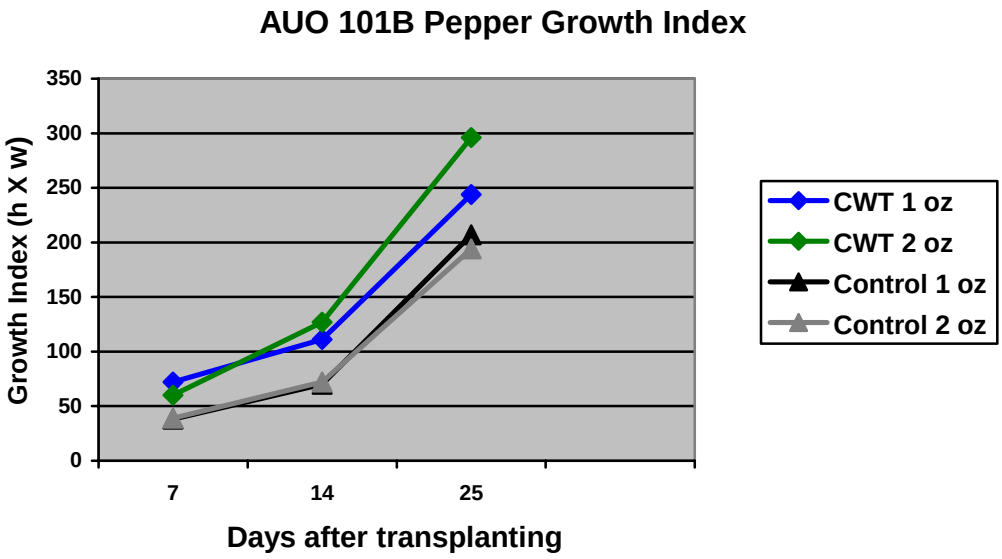
Initial growth promotion was seen with both rates of CWT on tomato transplanted into field soil. However, the rate of growth decreased with time at the 1 oz rate, while growth promotion continued at the 2 oz rate. Root and shoot growth were significantly enhanced, over the control, at 2 oz/gallon but not at 1 oz/gallon.

2. Experiment 2.

Experiment 2, AUO 101B, Pepper Transplants in Field Soil, Growth Index

	Growth Index (Height x Width) cm		
Treatment	**7 Days**	**14 Days**	**25 Days**
1) Test Product 1 oz/gal	**72.00***	**111.21***	**297.83***
2) Test Product 2 oz/gal	**59.89***	**127.79***	**244.67***
3) Control 1oz/gal	37.82	70.64	207.33
4) Control 2 oz/gal	39.00	72.00	194.17
$LSD_{0.05}$	11.31	20.08	43.28

* Indicates significant increase from the corresponding rate of control at the 95% probability level. Values are means of 6 replications.



Pepper Final Plant Weight 25 Days after Transplanting

Treatment	Root Wt. (g)	Shoot Wt (g)
1) Test Product 1 oz/gal	4.08	6.62
2) Test Product 2 oz/gal	**5.38***	**9.52***
3) Control 1oz/gal	3.08	6.75
4) Control 2 oz/gal	2.98	6.58
$LSD_{0.05}$	1.15	1.91

* Indicates significant increase from the corresponding rate of control at the 95% probability level. Values are means of 6 replications.

Photographs of Experiment 2

Figure 4. AUO 101B, Pepper 2 weeks after transplanting. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Figure 5. AUO 101B, Pepper 3 weeks after transplanting. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Figure 6. AUO 101B, Pepper 3 weeks after transplanting. Right = CWT @ 1 oz/gallon; left = formulation control @ 1 oz/gallon.

Conclusions and interpretations of Experiment 2.

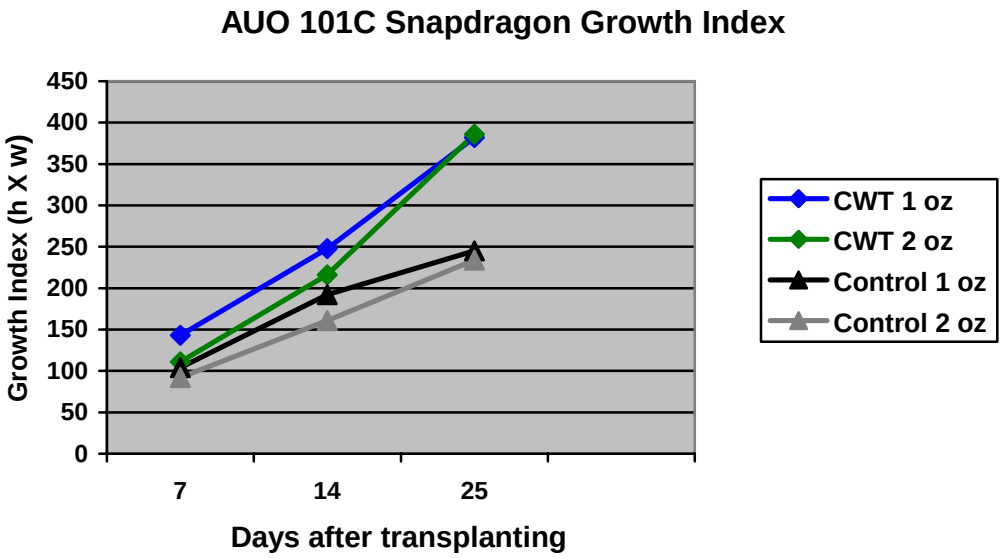
Pepper responded similarly as did tomato in Experiment 1. Initially, both rates of CWT increased growth relative to the formulation control. By 3 weeks after transplanting, growth had slowed with the 1 oz rate. Significant increases in root and shoot weights were obtained with the 2 oz but not the 1 oz rate.

3. Experiment 3

Experiment 3, AUO 101C, Snapdragon Transplants in Promix, Growth Index

Growth Index (Height x Width) cm			
Treatment	**7 Days**	**14 Days**	**25 Days**
1) Test Product 1 oz/gal	**143.00***	**248.64***	**382.50***
2) Test Product 2 oz/gal	111.00	**216.60***	**386.00***
3) Control 1oz/gal	104.60	192.50	245.33
4) Control 2 oz/gal	92.00	161.28	234.33
$LSD_{0.05}$	24.92	44.47	48.56

* Indicates significant increase from the corresponding rate of control at the 95% probability level. Values are means of 6 replications.



Snapdragon Final Plant Weight 25 Days after Transplanting

Treatment	Root Wt. (g)	Shoot Wt (g)	Percent of Surviving Plants
1) Test Product 1 oz/gal	**2.72***	12.78	100
2) Test Product 2 oz/gal	**4.10***	**16.44***	83
3) Control 1oz/gal	1.50	11.60	33
4) Control 2 oz/gal	1.47	11.47	50
$LSD_{0.05}$	1.34	4.27	

* Indicates significant increase from the corresponding rate of control at the 95% probability level. Values are means of 6 replications.

Photographs of Experiment 3

Figure 7. AUO 101C, Snapdragon 3 weeks after transplanting. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Figure 8. AUO 101C, Snapdragon 3 weeks after transplanting. Right = CWT @ 1 oz/gallon; left = formulation control @ 1 oz/gallon.

Conclusions and interpretations of Experiment 3.

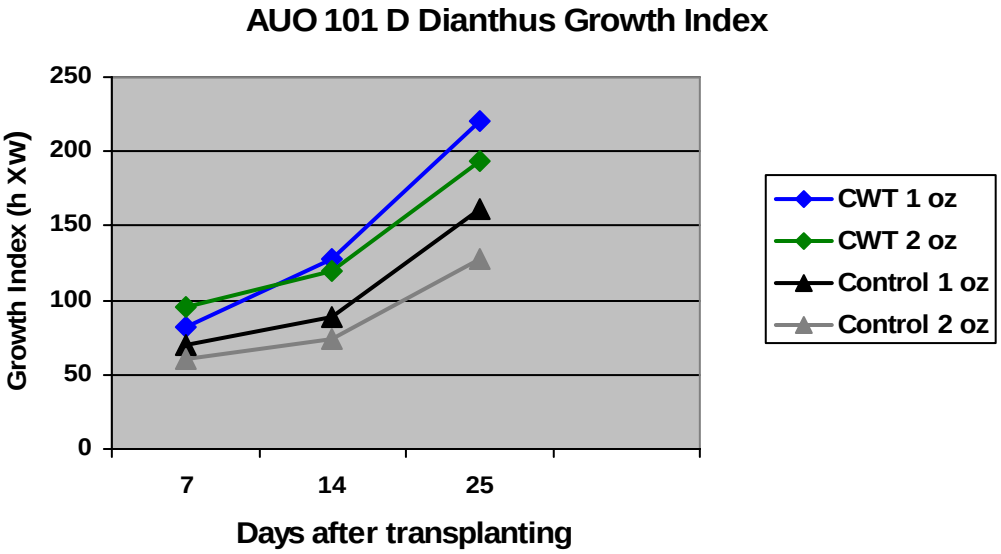
With snapdragon the 1 oz rate promoted growth over the length of the experiment at about the same level as the 2 oz rate. However, analysis of plant weights showed that the 2 oz rate significantly increased root and shoot weights, compared to the control, while the 1 oz rate only increased root growth. In addition, the promotion of root growth by CWT at 2 oz was significantly greater than the root weight of CWT at 1 oz.

An indirect measure of potential biocontrol was observed in this experiment. The snapdragon transplants were obtained from a local commercial greenhouse. Root disease was observed starting at one week after planting. As shown in the table above, 50% of the plants treated with 2 oz of the formulation control died, while 100% treated with 2 oz of CWT survived.

4. Experiment 4

Experiment 4, AUO 101D, Dianthus Transplants in Promix, Growth Index

Growth Index (Height x Width) cm			
Treatment	**7 Days**	**14 Days**	**25 Days**
1) Test Product 1 oz/gal	82.38	**128.38***	**221.50***
2) Test Product 2 oz/gal	**96.70***	**119.97***	**194.67***
3) Control 1oz/gal	70.81	89.21	161.67
4) Control 2 oz/gal	60.05	74.17	128.83
$LSD_{0.05}$	17.16	21.08	29.95



Dianthus Final Plant Weight 25 Days after Transplanting

Treatment	Root Wt. (g)	Shoot Wt (g)
1) Test Product 1 oz/gal	**2.43***	**14.00***
2) Test Product 2 oz/gal	**1.88***	12.85
3) Control 1oz/gal	1.18	11.50
4) Control 2 oz/gal	1.15	9.90
$LSD_{0.05}$	0.63	3.08

* Indicates significant increase from the corresponding rate of control at the 95% probability level. Values are means of 6 replications.

Photographs of Experiment 4

Figure 9. AUO 101D, Dianthus 3 weeks after transplanting. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Figure 10. AUO 101D, Dianthus 3 weeks after transplanting. Right = CWT @ 1 oz/gallon; left = formulation control @ 1 oz/gallon.

Conclusions and interpretations of Experiment 4.

The results of experiment 4 are different from experiments 1 – 3. In experiment 4 with Dianthus, the 1 oz rate of CWT was better than the 2 oz rate, based on growth index and the magnitude of root and shoot growth. Hence, the best rate of CWT may vary somewhat among plant types.

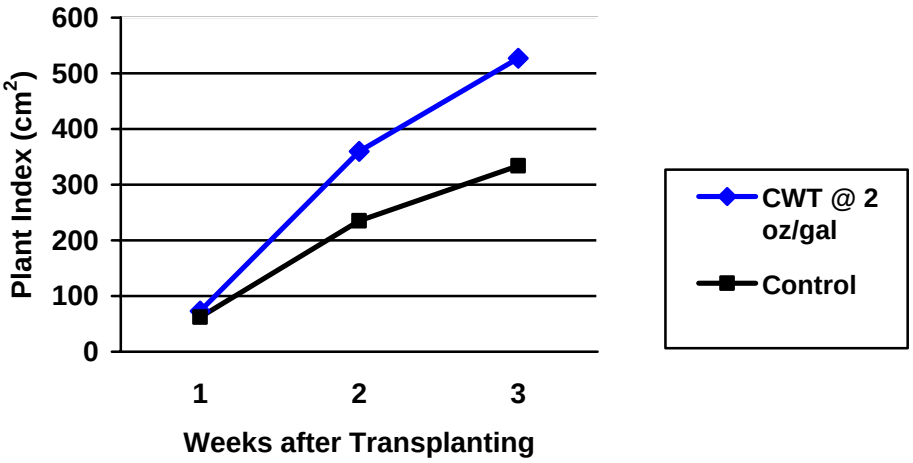
Experiment 5

Experiment 5, AUO 102A, Tomato Transplants in Promix, Growth Index and Plant Weights.

	Plant Index (height X width in cm)			"Harvest" data 3 WAT		
Treatment	1 WAT[1]	2 WAT	3 WAT	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
1. CWT @ 2 oz/gallon	73.0	**359.6***	**527.1***	**21.7***	**11.2***	**32.9***
2. Formulation control @ 2 oz/gallon	61.6	234.5	334.0	14.0	5.9	19.9
$LSD_{(0.05)}$	16.4	57.1	70.1	3.7	2.7	5.8
$LSD_{(0.10)}$	13.5	46.5	57.0	3.0	2.2	4.7

[1] WAT = weeks after transplanting.

* Indicates significant increase compared to the control at the 95% probability level.



Conclusions and interpretations of Experiment 5.

CWT induced consistent growth enhancement during the experiment, and 3 weeks after transplanting, the weights of roots, shoots, and whole plants treated with CWT were significantly greater than those treated with the formulation control.

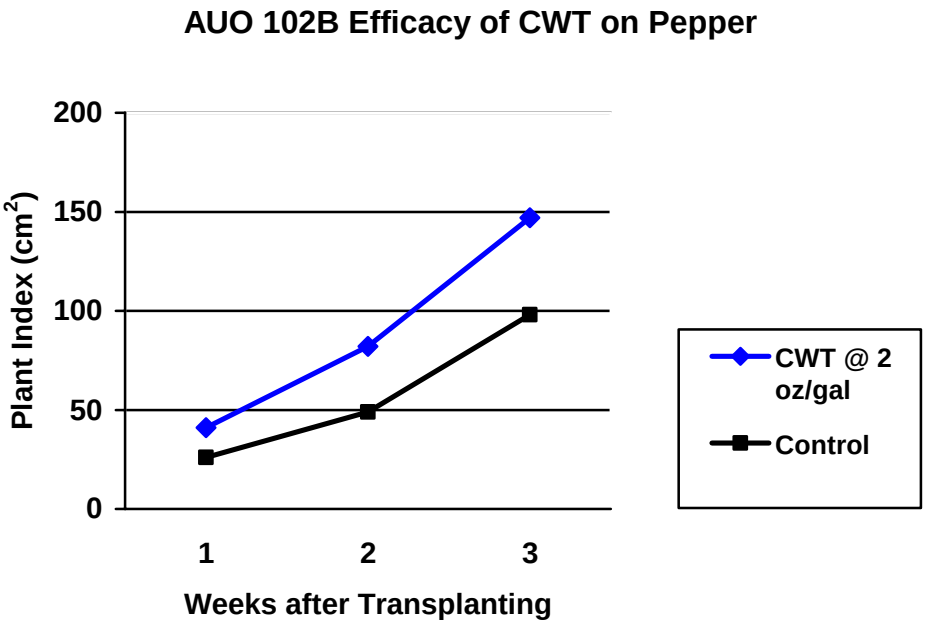
In this experiment, Promix soilless mix is typical of mixes used in the horticultural industry for greenhouse production of vegetables. Hence, in such operations, CWT would be expected to benefit production as it did when applied to transplants in field soil in experiments 1 and 2.

Experiment 6

Experiment 6, AUO 102B, Pepper Transplants in Promix, Growth Index and Plant Weights.

	Plant Index (height X width in cm)			"Harvest" data 3 WAT		
Treatment	1 WAT[1]	2 WAT	3 WAT	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
1. CWT @ 2 oz/gallon	**40.8***	**82.0***	**146.6***	**6.5***	**4.8***	**11.3***
2. Formulation control @ 2 oz/gallon	26.0	48.9	97.5	4.1	1.6	5.8
$LSD_{(0.05)}$	8.4	10.3	19.4	1.3	0.6	1.8
$LSD_{(0.10)}$	6.9	8.8	15.9	1.1	0.5	1.5

[1] WAT = weeks after transplanting.
* Indicates significant increase compared to the control at the 95% probability level.



Conclusions and interpretations of Experiment 6.

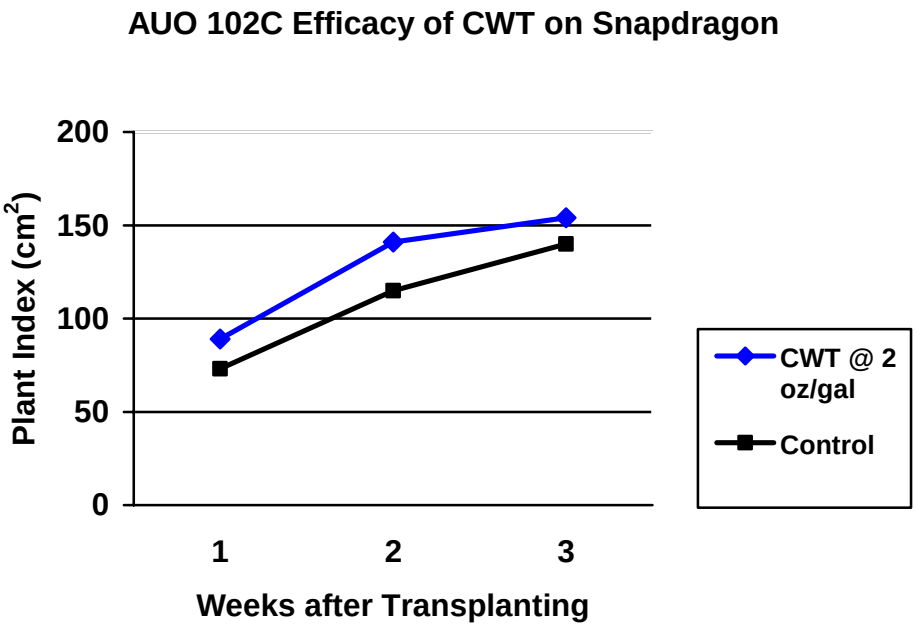
On pepper transplanted into Promix, CWT caused strong and consistent growth enhancement. One point that is unique to pepper is the magnitude of the root growth promotion. Note that on pepper (experiment 6) that CWT induced more than a 4-fold increase in root mass compared to the control, while on tomato (experiment 5), CWT induced about a 2-fold increase in root mass. This difference could be interpreted to result from the slow rate of pepper root development vs. the fast rate of tomato root growth. Hence, then a plant root system grows slower, CWT may have a more pronounced beneficial effect.

Experiment 7

Experiment 7, AUO 102C, Snapdragon Transplants in Promix, Growth Index and Plant Weights.

	Plant Index (height X width in cm)			"Harvest" data 3 WAT		
Treatment	1 WAT[1]	2 WAT	3 WAT	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
1. CWT @ 2 oz/gallon	**88.5***	**141.2***	154.3	**18.7+**	**9.5***	**28.3***
2. Formulation control @ 2 oz/gallon	73.2	114.6	140.1	15.6	6.4	22.0
$LSD_{(0.05)}$	13.2	16.6	20.0	3.2	2.1	4.3
$LSD_{(0.10)}$	10.7	13.4	17.0	2.6	1.7	3.5

[1] WAT = weeks after transplanting.
* Indicates significant increase compared to the control at the 95% probability level.
+ Indicates significant increase compared to the control at the 90% probability level.



Conclusions and interpretations of Experiment 7.

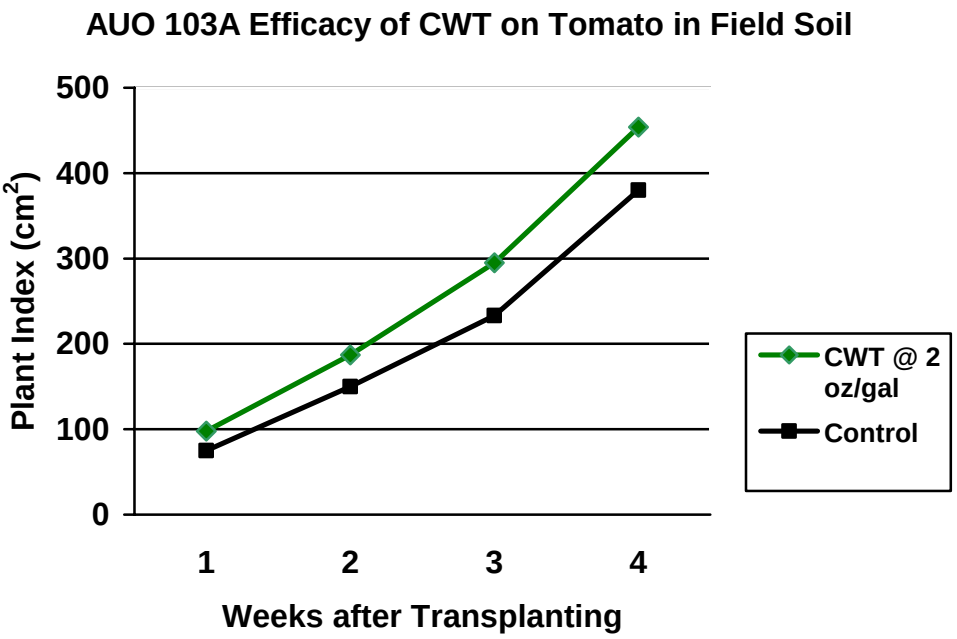
CWT at 2 oz/gallon again increased growth of snapdragon transplants in Promix. However, the magnitude of growth promotion was less than on tomato or pepper. There was no significant increase in plant index at 3 weeks after transplanting. While root weight was greater at the 95% probability level, shoot weight was greater only at the 90% level.

Experiment 8

Experiment 8, AUO 103A, Tomato Transplants in Field Soil, Plant Weights and Stem Caliper.

Treatment	Caliper (mm)	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
1. CWT @ 2 oz/gallon	**5.19***	20.02	**17.01***	**37.03***
2. Formulation control	4.80	18.99	10.34	29.33
$LSD_{(0.05)}$	0.28	2.05	2.83	3.46

* Indicates significant increase compared to the control at the 95% probability level. Data are means of 6 replications per treatment.



Conclusions and interpretations of Experiment 8.

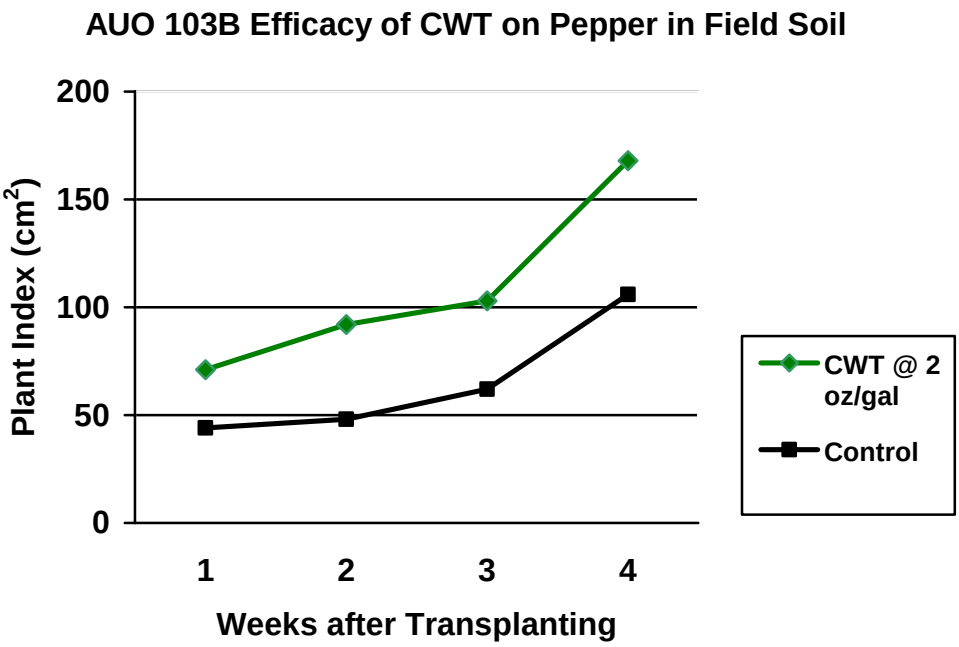
The results of experiment 1 repeated here in a different field soil, as CWT at 2 oz/gallon again significantly increased plant growth compared to the control. It is interesting that significant root mass increase was noted (Table above) although shoot weight was not different. Hence, roots were preferentially stimulated, which would be expected under field conditions to result in healthier plants that are better able to tolerate soilborne diseases. Stem caliper was also significantly increased by CWT. This is a measure of overall strength of the plant.

Experiment 9

Experiment 9, AUO 103B, Pepper Transplants in Field Soil, Plant Weights and Stem Caliper.

Treatment	Caliper (mm)	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
1. CWT @ 2 oz/gallon	**4.51***	**7.08***	**6.26***	**13.34***
2. Formulation control	3.39	4.60	3.58	8.18
$LSD_{(0.05)}$	0.44	1.14	1.62	2.57

* Indicates significant increase compared to the control at the 95% probability level. Data are means of 6 replications per treatment.



Photographs of Experiment 9

Figure 11. AUO 103B, Pepper 4 weeks after transplanting into field soil. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Figure 12. AUO 103B, Pepper 4 weeks after transplanting into field soil. Right = CWT @ 2 oz/gallon; left = formulation control @ 2 oz/gallon.

Conclusions and interpretations of Experiment 9.

The results of this repeat experiment on pepper were similar to the results on tomato in experiment 8. Here on pepper, CWT continued to promote plant growth for the 4 weeks of the experiment. All growth parameters and stem caliper were significantly higher with CWT. As seen in earlier experiments on pepper, the relative magnitude of the root growth increase was noteworthy. Here root mass was almost doubled. As can be seen in the photographs, the height of pepper was also increased, and the CWT-treated plants had flower buds at 4 weeks after transplanting.

Experiment 10

Experiment 10. AUO 104 A, Seeded Tomato, 19 days after planting.

Treatment	Caliper (mm)	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
CWT Product	**1.97***	**0.58***	**0.31+**	**0.89***
Control	1.86	0.46	0.27	0.73
$LSD_{(0.05)}$	0.08	0.08	0.05	0.11
$LSD_{(0.10)}$	0.07	0.07	0.04	0.09

* Significant increase from control at 95% probability.
+ Significant increase from control at 90% probability.

Conclusions and interpretations of Experiment 10.

Experiments 1 – 9 were all done using transplants. In experiments 10 – 15, we evaluated the effect on seedling development, partly because seedlings are good indicators for potential problems with formulations. Sometimes treatments that either have no effect or promote growth of transplants can deleteriously affect seedlings.

In experiment 10, CWT-treated tomato seedlings had significant increases in all parameters except root weight at 95% probability. Root weight was increased at the 90% probability level.

Experiment 11. AUO 104 B, Pepper, 22 days after planting.

Treatment	**Shoot Wt. (g)**	**Root Wt. (g)**	**Total Wt. (g)**
CWT Product	0.29	**0.17***	**0.46***
Control	0.25	0.12	0.37
$LSD_{(0.05)}$	0.06	0.03	0.09
$LSD_{(0.10)}$	0.05	0.03	0.07

Conclusions and interpretations of Experiment 11.

Pepper grows much more slowly than tomato. The experiment was sampled at 22 days after planting, which is very early. No deleterious effects were noted with CWT. In fact, root growth at this very early stage of development was significantly promoted by CWT.

Experiment 12. AUO 104 C, Cucumber, 14 days after planting.

Treatment	**Caliper (mm)**	**Shoot Wt. (g)**	**Root Wt. (g)**	**Total Wt. (g)**
CWT Product	**2.10***	**0.68***	**0.38***	**1.05***
Control	1.85	0.47	0.26	0.73
$LSD_{(0.05)}$	0.19	0.07	0.06	0.11
$LSD_{(0.05)}$	0.16	0.06	0.05	0.10

* Significant increase from control at 95% probability.

Conclusions and interpretations of Experiment 12.

Cucumber represents the opposite end of the spectrum from pepper, as it is an extremely fast growing seedling. Note that the root weight of the control was the same for 14-day-old cucumber as it was in experiment 10 for 19-day-old tomato. All parameters measured were significantly increased for cucumber by CWT.

Experiment 13. AUO 104 D, Marigold, 21 days after planting.

Treatment	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
CWT Product	**0.99***	0.62	**1.61***
Control	0.68	0.64	1.32
$LSD_{(0.05)}$	0.16	0.08	0.22

* Significant increase from control at 95% probability.

Conclusions and interpretations of Experiment 13.

Marigold is a difficult plant to demonstrate growth promotion with biologicals. Root growth was not affected by CWT, while shoot weight was significantly increased.

Experiment 14. AUO 104 E, Zinnia, 21 days after planting.

Treatment	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
CWT Product	0.79	**0.94***	**1.73***
Control	0.78	0.68	1.46
$LSD_{(0.05)}$	0.09	0.15	0.20
$LSD_{(0.10)}$	0.08	0.13	0.17

* Significant increase from control at 95% probability.

Conclusions and interpretations of Experiment 14.

On zinnia, CWT significantly increased root weight but not shoot weight. As noted previously, such preferential enhancement of root growth is highly beneficial for plant health.

Experiment 15. AUO 104 F, Sunflower, 18 days after planting.

Treatment	Caliper (mm)	Shoot Wt. (g)	Root Wt. (g)	Total Wt. (g)
CWT Product	2.16	**0.79+**	**0.54***	**1.32***
Control	2.11	0.72	0.46	1.18
$LSD_{(0.05)}$	0.11	0.08	0.07	0.12
$LSD_{(0.10)}$	0.09	0.06	0.06	0.10

* Significant increase from control at 95% probability.
+ Significant increase from control at 90% probability.

Conclusions and interpretations of Experiment 15.

On sunflower seedlings, CWT promoted root growth more than shoot growth, as it did on zinnia.