TITLE OF PROJECT: Evaluation of growth regulators for transplant size control and earlier maturity of processing tomato.

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BACKGROUND: Previous work using the triazole paclobutrazol (Bonzi) on processing tomato transplants involved treating the plants with a 5 ppm soil drench at the 2 leaf stage, and subsequently fertilizing heavily (up to 5 times the normal rate) to achieve the desired plant height. This treatment resulted in increased vigor in the field (measures as plant dry and fresh weight), advanced plant development (earlier bloom), advanced fruit maturity and increased yields. However, it is not presently registered on any food crops in North America, so a registration for use on tomato transplants is unlikely.

Work in 2005 included other potential growth regulators with greenhouse registrations (uniconazole- Sumagic; Nova) and food crop registrations (Apogee). This approach was continued in 2006.

METHODS: Transplants of TSH4 (early commercial hybrid - Tomato Solutions) and CC337 (late commercial inbreed - CanGro Foods) were grown in CanGro Foods research greenhouse in Dresden ON. Ten treatments were applied to the transplants according to the following schedule:

1. Untreated
2. Prohexadione Ca (Apogee) @ 250 ppm - 2 applications of 125 ppm 7 days apart
3. Paclobutrazol (Bonzi) @ 5 ppm
4. Myclobutanil (Nova) @ 500 ppm - 4 applications of 125 ppm 5 days apart
5. Uniconazole (Sumagic) @ 5 ppm - applied to tray surface 2-3 days after seeding
6. Uniconazole (Sumagic) @ 5 ppm - applied once @ 2nd true leaf
7. Uniconazole (Sumagic) @ 5 ppm - applied once @ 3rd true leaf
8. Uniconazole (Sumagic) @ 5 ppm - 2 applications of 2.5 ppm 7 days apart
9. Uniconazole (Sumagic) @ 7.5 ppm - 3 applications of 2.5 ppm 7 days apart
10. Uniconazole (Sumagic) @ 10 ppm - 2 applications of 5 ppm 7 days apart

All treatments were applied at 100 ml per tray starting at the 2nd true leaf (approximately 18 days after seeding) unless otherwise stated.

The transplants were fertilized in the greenhouse with solutions of 60-5-65 (prepared using Plant Products 12-2-14 and 14-0-14) and solutions of 150-25-175 (prepared using Plant Products 12-2-24). Fertilizer solutions and water (when necessary) were applied to provide 1 inch of growth per week over a 6 week period. From seedling emergence to the 2nd true leaf stage, all treatments received a prepared solution of 60-5-65, after which the solutions were altered to provide the required growth. The total amount of N, P, and K applied to the various treatments, relative to the control plants is summarized below:

Table 1. Amounts of N, P, and K applied to various growth regulator treatments required to produce a marketable plant. Amounts expressed as a percentage of that applied to control plants. Data courtesy of John Lang, CanGro Foods, Dresden

	Treatment	% of Control		
		N	P205	K20
1.	Control - No treatment	100	100	100
2.	250 ppm Prohexadione Calcium (APOGEE)	140	275	140
3.	5 ppm Paclobutrazol (Bonzi)	200	710	200
4.	500 ppm Myclobutanil (NOVA)	125	245	125
5.	5 ppm Uniconazole (SUMAGIC) (germination)	225	655	225
6.	5 ppm Uniconazole (SUMAGIC) (2^{nd} true leaf)	200	710	200
7.	5 ppm Uniconazole (SUMAGIC) (3^{rd} true leaf)	150	350	150
8.	5 ppm Uniconazole (SUMAGIC) (2.5 ppm x 2)	210	750	210
9.	7.5 ppm Uniconazole (SUMAGIC) (2.5 ppm x 3)	210	750	210
10.	10 ppm Uniconazole (SUMAGIC) (5 ppm x 2)	225	825	225

Transplants were established in the field on 12 May, 2006.

DATA COLLECTION: Plant fresh weights were taken on 4 plants per plot once flowers were present on the most mature treatments, and again every 5-7 days. Flowers counts on 10 plants per plot were taken at 20 and 35 days after transplanting. Plots were harvested (8 plants per plot) when 80% of the fruit appeared mature. Fruit was graded into mature red, green and rots, and expressed as tons/acre as well as a percentage of the total tonnage.

EXPERIMENTAL DESIGN AND DATA ANALYSIS:

The experiment was established as a 2 x 6 factorial in a randomized complete block design with 4 replications. Factor 1 was cultivar and factor 2 was growth regulator treatments. A plot consisted of 1 bed (2 rows), 26" (8.0 m) in length. Transplants were established 45 cm apart in double rows which were spaced 45 cm apart. A protected LSD was used to separate treatments with significant differences. Means followed by the same letter within a column do not differ significantly (P = 0.05).

RESULTS AND DISCUSSION:

Up to 8 times the phosphorous, and 2 times the nitrogen and potash were required to produce transplants of marketable size when 10 ppm uniconazole was applied at the 2 leaf stage, when compared to untreated transplants (Table 1). All treatments required additional fertilizer relative to untreated transplants.

While plant heights differed significantly from the control in some treatments, all product/rate combinations increased top weights, root weights, total plant weights and stem diameters (Table 2). Total plant weight and stem diameter was the greatest when uniconazole was applied 3 times at a rate of 2.5 ppm; this treatment also required one of the highest rates of

fertilizer (Table 2). Applying uniconazole at germination resulted in greater transplant weight and stem diameter compared to applications at the 2nd and 3rd true leaf respectively (Table 2). Multiple applications of uniconazole were no better at improving the plant characteristics (plant weight, stem diameter) of tomato transplants when compared to single 5 ppm application at the 2nd true leaf stage. Apogee and Nova at the rates used were not as effective as the uniconazole treatments.

All uniconazole and the paclobutrazol treatments increased seedling fresh weights up to 25 days after transplanting. Early treatments of 5 ppm uniconazole were as effective at increasing plant growth in the field as were high rates of uniconazole (Table 3). The most effective rates/timings of uniconazole were similar to 5ppm paclobutrazol applied at the 2 leaf stage. The growth rates of Nova and Apogee treated plants did not differ from untreated plants. Similar trends were found in the rate of flower development, which was determined up to 40 days after transplanting (Table 4).

While total yields did not differ significantly amoung treatments, high rates of uniconazole increased red yields (Table 5). The percent ripe fruit tended to be higher with uniconazole treated plants, but these differences were not significant. All responses reported here were also found in an identical field trial conducted at the CanGro Foods research farm.

While uniconazole appears to be a good alternative to paclobutrazol in terms of growth control in the greenhouse and plant establishment in the field, there are still concerns about slight distortions in the growth of uniconazole treated seedlings. All plants treated with uniconazole had a more horizontal leaf orientation and crooked stems, which increased as the rate on uniconazole increased. This made if more difficult to remove the plants from the tray when transplanting, and gave the plants the appearance that they had been handled improperly in the greenhouse. More work is proposed, which will investigate lower multiple applications of uniconazole in an attempt to further reduce these growth distortions..

The application of Nova and Apogee was not as effective at increasing transplant weight and plant growth in the field, and their use will be discontinued.

Table 2. **Effect of Topaz (propiconazole) on tomato plug plants. Measurements made 42 days after seeding. Data courtesy of John Lang, CanGro Foods, Dresden.**

Treatments	Top Weight (g/plant)	Root Weight (g/plant)	Total Weight (g/plant)	Extended Leaf Height (cm)	Stem Diameter (mm)
1. Untreated	1.07 d	0.30 d	1.37 d	17.61 c	2.51 d
2. Apogee @ 250 ppm	1.55 c	0.45 c	1.99 c	18.45 b	3.04 c
3. Bonzi @ 5 ppm	1.84 b	0.78 a	2.62 ab	17.65 c	3.49 b
4. Nova @ 500 ppm	1.56 c	0.43 c	1.99 c	20.64 a	3.00 c
5. Sumagic @ 5 ppm (germ)	1.99 a	0.67 b	2.60 ab	17.26 c	3.64 a
6. Sumagic @ 5 ppm 2nd	1.81 b	0.75 ab	2.56 ab	16.70 d	3.46 b
7. Sumagic @ 5 ppm 3rd	1.45 c	0.57 c	2.02 c	16.28 d	3.07 c
8. Sumagic @ 5 ppm (2.5 x 2)	1.77 b	0.73 ab	2.50 b	17.19 c	3.39 b
9. Sumagic @ 7.5 ppm (2.5 x 3)	1.93 ab	0.80 a	2.73 a	17.35 c	3.55 ab
10. Sumagic @ 10 ppm (5 x 2)	1.79 b	0.74 ab	2.53 b	16.53 d	3.39 b
F Significance	Sig.	Sig.	Sig.	Sig.	Sig.
LSD	0.09	0.03	0.15	0.51	0.13

Table 3. Tomato plant fresh weight in response to growth regular treatment at various times after transplanting.

Treatments	Fresh Weight (g) 19 Days	Fresh Weight (g) 25 Days	Fresh Weight (g) 33 Days
Cultivar			
TSH4	24.6 a	80.2 a	296.8 a
C337	17.8 b	51.1 b	187.4 b
Growth Regulator			
1. Untreated	10.9 a	32.0 c	130.4
2. Apogee @ 250 ppm	14.1 ab	34.0 c	144.4
3. Bonzi @ 5 ppm	30.0 d	83.3 a	329.2
4. Nova @ 500 ppm	14.6 ab	45.0 bc	201.0
5. Sumagic @ 5 ppm (germ)	25.1 cd	81.2 a	309.7
6. Sumagic @ 5 ppm 2nd	26.4 cd	80.3 a	302.2
7. Sumagic @ 5 ppm 3rd	19.0 bc	56.1 b	226.4
8. Sumagic @ 5 ppm (2.5 x 2)	20.7 bcd	72.2 a	245.0
9. Sumagic @ 7.5 ppm (2.5 x 3)	23.6 cd	85.7 a	294.4
10. Sumagic @ 10 ppm (5 x 2)	27.3 d	87.2 a	238.5
F Significance			
Cultivar	0.0004	0.0089	0.0163
Regulator	0.0001	0.0001	N.S.
Interaction: cultivar* regulator	0.046	0.024	N.S.

Table 4. Tomato plant flower counts in response to growth regular treatment at various times after transplanting.

Treatments	Flowers per Plant 25 Days	Flowers per Plant 33 Days	Flowers per Plant 40 Days
Cultivar			
TSH4	6 a	15 a	47 a
C337	0 b	4 b	30 b
Growth Regulator			
1. Untreated	0 a	1 c	18 c
2. Apogee @ 250 ppm	0 a	5 c	22 c
3. Bonzi @ 5 ppm	3 bc	12 ab	49 a
4. Nova @ 500 ppm	0 a	3 c	33 b
5. Sumagic @ 5 ppm (germ)	9 d	15 a	47 a
6. Sumagic @ 5 ppm 2nd	2 b	12 ab	47 a
7. Sumagic @ 5 ppm 3rd	2 b	6 bc	24 bc
8. Sumagic @ 5 ppm (2.5 x 2)	6 cd	15 a	46 a
9. Sumagic @ 7.5 ppm (2.5 x 3)	6 cd	12 ab	47 a
10. Sumagic @ 10 ppm (5 x 2)	6 cd	13 a	50 a
F Significance			
Cultivar	0.0002	0.0007	0.0301
Regulator	0.0001	0.0001	0.0001
Interaction: cultivar* regulator	0.0001	0.0023	0.0155

Table 5. Yield in response to growth regular treatment

Treatments	Total Yield (t/acre)	Red Yield (t/acre)	Green Yield (t/acre)	Percent Ripe
Cultivar				
TSH4	47.5	43.6	2.9	91.0
C337	49.3	45.4	3.0	91.7
Growth Regulator				
1. Untreated	43.0	39.0 c	3.8	90.1 a-d
2. Apogee @ 250 ppm	47.1	40.9 c	5.6	86.4 d
3. Bonzi @ 5 ppm	46.1	41.2 c	2.5	88.5 cd
4. Nova @ 500 ppm	47.6	43.8 abc	3.3	91.8 abc
5. Sumagic @ 5 ppm (germ)	49.6	46.5 abc	2.2	93.1 ab
6. Sumagic @ 5 ppm 2nd	49.3	44.1 abc	3.3	89.8 cd
7. Sumagic @ 5 ppm 3rd	51.4	48.7 ab	2.5	94.0 a
8. Sumagic @ 5 ppm (2.5 x 2)	44.7	42.3 bc	1.7	93.8 ab
9. Sumagic @ 7.5 ppm (2.5 x 3)	52.7	49.1 ab	2.4	92.2 abc
10. Sumagic @ 10 ppm (5 x 2)	52.6	49.6 a	2.5	93.6 ab
F Significance				
Cultivar	N.S.	N.S.	N.S.	N.S.
Regulator	N.S.	0.0381	N.S.	0.0395
Interaction: cultivar* regulator	N.S.	N.S.	N.S.	N.S.