Sumagic Sprays for Height Control of Greenhouse Grown Tomato and Pepper Transplants

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Introduction

For years, there have been no plant growth regulators (PGRs) labeled for use on vegetable transplants. Recently, a supplemental label for Sumagic (Uniconazole; Valent Biosciences, Libertyville, IL) has been released to allow foliar sprays on some vegetable transplants (tomato, pepper, eggplant, tomatillo, ground cherry, and pepino). The new label is rather restrictive, however. The maximum total allowed application is 10 $mg \cdot L^{-1}$ at 2 L per 100 m^2. This means one 10 $mg \cdot L^{-1}$ spray, two 5 $mg \cdot L^{-1}$, or four 2.5 $mg \cdot L^{-1}$ sprays and so on are allowed. The last spray must be no later than 2 weeks after the 2-4 leaf stage (approximately 4 weeks after sowing). PGRs like Sumagic are gibberellin biosynthesis inhibitors which suppress plant height by inhibiting internode elongation. There are other means of controlling height of transplants that have been successfully used including negative DIF (difference between day and night temperatures), brushing, and light quality manipulation (Duman and Duzyaman, 2003; Garner and bjorkman, 1997; Li, et al., 2000; Rideout and Overstreet, 2003). However mechanical height control techniques require specialized equipment and/or manual labor which can significantly add to production costs. PGR sprays can be applied with any standard sprayer and require little time to execute. Sumagic is a particularly active PGR so very small concentrations are needed for efficacy. Sumagic and other PRGs have been shown to effectively control height of both pepper (*Capsicum annuum*)and tomato (*Lycopersicum esculentum*) seedlings when applied as sprays, drenches, or seed soaks (Brigard, et al., 2006; Davis et al., 1990; Latimer, 1992; Pasian and Bennett, 2001). The current study is designed to elucidate the size control efficacy that can be achieved with Sumagic sprays on pepper and tomato transplants using procedures allowed by the new label.

Materials and methods

Seeds of three tomato and pepper varieties were sown on 29 May 2009 in Sunshine LA4 peat-lite substrate (Sun Gro Horticulture, Vancouver, BC, Canada). Tomato 'Early Girl', 'Big Boy', and 'Champion II' are indeterminate varieties typically produced for retail sales to home gardeners. Pepper 'Hungarian Yellow Wax', 'Big Bertha', and 'Better Belle' are also typically produced for the home garden. The seeds were sown directly into the final 36 count cells. This '6-pack' size is common for retail pepper and tomato transplants. Plants were grown in fan and pad cooled greenhouse in Lexington, KY. Plants received plain water for the first week after sowing, and then constant liquid feed at 50 $mg \cdot L^{-1}$ 15-5-15 CalMag (The Scotts Company, LLC, Maryville, OH) for the one week then 100 $mg \cdot L^{-1}$ 15-5-15 CalMag for the remainder of the experiment. Sumagic sprays were applied at concentrations of 0, 2.5, 5, or 10 $mg \cdot L^{-1}$ Sumagic at 14, 21, and/or 28 days after sowing. Plant heights were recorded when the transplants were at a market ready stage six weeks after sowing (10 July). Market readiness was defined as 50% of plants having 7-8 true leaves expanded.

Results and discussion

Sumagic is highly effective for height suppression of both pepper and tomato seedlings. All plants that received a sumagic spray were shorter than the untreated controls at the market ready stage (Table 1).

Tomato plants were 18 to 52% shorter than the untreated controls. Pepper seedlings treated with sumagic ranged from 6 to 71% shorter than the untreated control plants. In the ornamental plant market 25-35% height suppression is considered ideal to produce plants with aesthetically pleasing form that will likely resume normal growth in a timely manner (Hamrick, 2003). Plants more than 35% shorter than untreated plants may appear stunted and it may take a considerable amount of time for normal internode elongation to resume.

TOMATOES. The three tomato cultivars showed very similar responses to Sumagic. Each concentration of sumagic produced plants of similar size at the market ready stage. 'Champion II' seedlings sprayed with 2.5, 5, and 10 $mg \cdot L^{-1}$ sumagic 14 days after sowing were 20, 19, and 20 cm tall, respectively, compared to the control plants at 33 cm tall in other words, approximately 40% shorter than the control plants. However, those treated with the higher concentrations would probably take longer to resume normal growth. In the interest of chemical use efficiency and prevention of post planting complications it would be best for growers to use the lowest effective sumagic concentration. Additional applications can be made one to three weeks after the initial spray if additional height control is needed. For example 'Big Boy' tomato seedlings sprayed with 2.5 $mg \cdot L^{-1}$ Sumagic 14 days after sowing were 33% shorter than the untreated control compared to 35% and 52% shorter when additional sprays of 2.5 $mg \cdot L^{-1}$ Sumagic were applied 21 days or 21 and 28 days after sowing, respectively. Sumagic has not been tested on enough tomato varieties to be sure that they will all react similarly. As with any new PGR program, onsite testing of small portions of the crop is recommended before full scale implementation.

PEPPERS. The three pepper cultivars were all highly responsive to sumagic applications (Table 1). With a single sumagic spray at 2.5 $mg \cdot L^{-1}$ applied 21 days after sowing 'Hungarian Yellow Wax' pepper plants, 'Big Bertha' pepper plants, and 'Better Belle' pepper plants were 41, 41, and 29% shorter than the untreated controls of the respective variety. Higher spray rates caused stunting. 'Hungarian Yellow Wax' plants, 'Big Bertha' plants, 'Better Belle' and plants sprayed with 10 $mg \cdot L^{-1}$ Sumagic at any time averaged 48, 52, and 48% shorter than the untreated control plants, respectively. The photo in Figure 1 shows the appearance of 'Better Belle' peppers following sprays of 0, 2.5, 5, or 10 $mg \cdot L^{-1}$ Sumagic 14 days after sowing. Those treated with 10 $mg \cdot L^{-1}$ Sumagic were severely stunted (58% shorter than the control plants) and would not be marketable. Given this high sensitivity, growers will need to use extreme caution when applying Sumagic to pepper seedlings. In most cases negative DIF or other non-chemical height control measures should be sufficient to produce marketable pepper transplants (Hamrick, 2003; Li, et al., 2000).

POST TRASPLANT CONCERNS**.** There is clearly a risk of undesirable side effects of PGR application to fruiting crops, namely delayed fruit set, reduced fruit size, or yield in addition to PGR residue in the fruits. Maginitsky, et al. (2003) found that there was no detectable Sumagic in tomato or cucumber fruits following seed soak applications. Wang and Gregg (1990) found that Uniconazole applications two weeks after sowing led to a reduction in fruit number but an increase in fruit size. Zandastra, et al. (2003) reported no reduction in yield of fruit size following Sumagic sprays on tomato transplants. In fact this study reported a reduction in time from planting to fruit set. Clearly more research is needed

to further elucidate the effect of PGR applications on field performance of tomato and pepper transplants.

Conclusions

Sumagic is a viable tool to control excessive stem elongation in pepper and tomato transplants. Sumagic can be applied without special equipment and with minimal labor making this an economical choice for growers. In addition the product is not expensive and the effective concentrations are very low which will keep chemical costs to a minimum as well. However, growers must be very cautious in implementing a Sumagic height control program. With these low concentrations growers must have the ability to accurately calculate and precisely measure the volume of chemical required for the spray solution. With proper attention to detail, Sumagic will help growers to produce highly marketable, top quality tomato and pepper transplants.

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Table 1. Average heights of tomato 'Early Girl', 'Big Boy', and 'Champion II' and pepper 'Hungarian yellow wax', Big Bertha', and 'Better Belle' at the market ready stage (7-8 expanded leaves) following foliar sprays of Sumagic (uniconazole) at 0, 2.5, 5, or 10 mg·L^{-1} applied 14, 21, and/or 28 days after sowing.

Sumagic concentration (mg·L^{-1})	Spray day(s) (Days after sowing)	Height (cm) at market ready stage (42 days after sowing)					
		Tomato			Pepper		
		'Early Girl'	'Big Boy'	'Champion II'	'Hungarian Yellow Wax'	'Big Bertha'	'Better Belle'
0	14	29.4 a[z]	33.8 a	32.6 a	22.2 a	21.4 a	19.2 a
2.5	14	20.7 def	22.8 cdef	20.0 ef	20.9 a	16.5 b	14.3b
2.5	21	20.0 defg	21.7 efgh	22.6 d	13.0 bcd	12.7 de	13.7 bc
2.5	28	24.1 bc	27.4 b	26.5 b	14.8 b	16.8 b	13.5 bc
2.5	14, 21	17.9 g	21.8 efgh	17.4 gh	14.0 bc	10.3 fgh	9.8 ef
2.5	14, 28	18.8 fg	22.1 defg	17.9 fgh	11.2 cde	14.2 cd	12.8 bc
2.5	21, 28	21.4 de	19.6 gh	21.7 de	10.6 de	11.5 ef	11.2 de
2.5	14, 21, 28	19.4 efg	16.3 i	16.9 h	9.5 ef	8.3 ij	11.2 de
5	14	20.2 defg	21.7 efgh	19.4 efg	15.8 b	11.2 efg	12.2cd
5	21	21.9 cde	23.4 cde	23.7 cd	15.3 b	13.5 d	13.6 bc
5	28	22.0 cd	24.6 cd	22.8 d	15.0 b	15.5 bc	10.6 de
5	14, 21	18.8 fg	20.8 efgh	16.9 h	9.9 e	7.1 jk	9.9 ef
5	14, 28	18.9 fg	19.3 h	25.4 bc	7.0 f	8.0 j	8.6 fg
5	21, 28	21.9 cd	20.0 fgh	18.4 fgh	10.3 de	9.6 hi	9.8 ef
10	14	18.4 fg	20.0 fgh	20.0 ef	9.9 e	6.1 k	8.1 g
10	21	19.6 defg	22.6 cdef	23.4 cd	11.7 cde	9.7 ghi	10.5 e
10	28	25.8 b	25.2 bc	26.1b	13.3 bcd	15.3 bc	11.2 de
Significance		***	***	***	***	***	***

[z]Within-column means followed by different letters are significantly different by Waller-Duncan K-ratio *t* Test at $P \leq 0.05$.

***Significant at $P \leq 0.001$

Figure 1. From left to right, 'Better Belle' pepper plants treated with Sumagic sprays at 0, 2.5, 5, and 10 mg·L^{-1} Sumagic applied 14 days after sowing. Photo was taken six weeks after sowing.