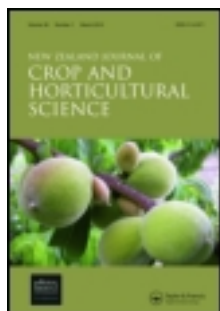


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New Zealand Journal of Crop and Horticultural Science

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/tnzc20>

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Available online: 22 Mar 2010

To cite this article: R. N. Rowe, D. J. Farr & B. A. J. Richards (1994): Effects of foliar and root applications of methanol or ethanol on the growth of tomato plants (*Lycopersicon esculentum* Mill), New Zealand Journal of Crop and Horticultural Science, 22:3, 335-337

To link to this article: <http://dx.doi.org/10.1080/01140671.1994.9513842>

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Short communication

Effects of foliar and root applications of methanol or ethanol on the growth of tomato plants (*Lycopersicon esculentum* Mill)

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Abstract Young tomato plants were treated with foliar sprays and root applications of aqueous solutions of methanol and ethanol. Concentrations ranged from 5 to 20% v/v. Root applications caused severe plant damage. In contrast foliar sprays resulted in significant growth stimulation. Both alcohols increased leaf and stem fresh and dry weights with the maximum increases at the highest concentrations tested. Methanol produced a greater increase in stem length and stem fresh and dry weights than ethanol. There was no significant difference between the alcohols in terms of leaf weights or leaf number.

Keywords tomato; *Lycopersicon esculentum*; methanol; ethanol; photorespiration; ethylene

INTRODUCTION

Nonomura & Benson (1992) showed that foliar applications of methanol on a range of C3 plants increased growth rate and harvest yield. Three applications of 10% methanol increased growth rate and yield of tomatoes without any symptoms of phytotoxicity to leaves. Nonomura & Benson's (1992) data supported the hypothesis that the increase in growth was because of an inhibition of photosynthate loss as a result of photo-respiration. Ethanol has also been shown to have effects in plant tissues, often associated with ethylene activity (Heins

1980; Saltveit 1989; Wu et al. 1990; Mencarelli 1991) and on stomatal resistance by its effect on removing leaf resin (Meinzner et al. 1990).

The experiment reported here was designed to confirm the effects of foliar-applied methanol as shown by Nonomura & Benson, and to ascertain whether root application of methanol would cause any growth effects. Ethanol treatments were applied to study if alcohols other than methanol, produce similar growth responses.

METHODS

Seedlings of the tomato (*Lycopersicon esculentum* Mill.) cultivar 'Moneymaker', germinated in a standard sand-bark seedling medium, were transplanted into 1.8 litre planter bags containing growing medium (80% composted bark and 20% washed crushed rock dust (<5 mm particle size)). Nutrients were provided by 2000 g/m³ "Osmocote Plus" (3–4 month, 15–4.8–10.8 N.P.K.) plus dolomite lime (4000 g/m³). The medium pH was 5.95.

On 19 July 1993, 2 weeks after transplanting when seedlings had reached the four true leaf stage, the first methanol and ethanol treatments were applied to roots or shoots. Further foliar applications were made on 27 July and 5 August at 0, 5, 10, 15, and 20% (v/v) without surfactant. Foliar applications were made with a hand-held sprayer to run-off stage ensuring that no solution entered the growing medium. For root applications 100 ml of the solutions was poured onto the growing medium.

Plants were harvested on 16 August and measurements made of fresh and dry weights of leaves and stems, leaf number, and stem length. Analysis of variance (using Minitab 8.2) was undertaken, on foliar-treated plants only, as a 2 × 5 factorial with four single plant replicates in a randomised block design. In addition, *t*-tests were made between pairs of pooled treatment means (Table 2).

RESULTS

Root applications of 5% ethanol and methanol severely reduced shoot growth, whereas concentrations of 10% or more killed the seedlings. Initial symptoms of wilting were seen within 1 h of treatment. Because of the highly phytotoxic effects of soil applications, soil treatments were not further analysed.

Foliar applications of both alcohols significantly increased fresh and dry weights of leaves and stems (Table 1). The only increases occurred with 15 and 20% methanol and ethanol. Stem fresh and dry weights increased by 22 and 31% respectively and leaf fresh and dry weights by 19 and 17% respectively. No phytotoxic effects were observed on any foliar-treated plants, even at the highest alcohol concentrations.

Methanol treatments stimulated significantly greater mean leaf and stem fresh weights and mean stem dry weight compared to the control (Table 2). Stem length was also increased though this was not quite significant at the 95% confidence level. Mean values for all parameters measured on ethanol-treated plants fall intermediate between controls

and methanol-treated plants, but are not significantly different from either control or methanol treatments (Table 2).

DISCUSSION

The methanol growth stimulation data, although not of the same magnitude, agrees with that of Nonomura & Benson (1992). This may have been because no wetting agent or nitrogen supplementation was used in our experiment. However, in contrast to their results, we did not find any phytotoxic effect of either alcohol when applied to the leaves at a concentration of 20%. Over the duration of the experiment three foliar applications, about a week apart, stimulated total shoot fresh and dry weights by c. 20% at the highest concentration. Stem fresh and dry weights increased by 22 and 31% respectively whereas increases in leaf fresh and dry weights were 19 and 17%. This indicates some effect of alcohol on carbohydrate partitioning between leaf and stem.

Our data show that overall ethanol was slightly less effective than methanol in stimulating growth.

Table 1 Pooled effects of foliar-applied alcohols (methanol and ethanol) on mean fresh and dry weights of tomato plants.

% alcohol (v/v)	Mean fresh weights (g)			Mean dry weights (g)		
	Leaf	Stem	Total	Leaf	Stem	Total
0	26.96	10.38	37.34	2.22	0.58	2.80
5	28.78	12.34	41.11	2.23	0.69	2.92
10	28.53	10.84	39.36	2.32	0.65	2.97
15	31.75	12.11	43.86	2.67	0.76	3.43
20	32.18	12.73	44.90	2.60	0.76	3.35
LSD _{0.05}	3.35	1.56	4.56	0.36	0.11	0.45

Table 2 Effects of type of alcohol (pooled concentrations) on mean stem length and fresh and dry weights of tomato plants. Means with similar letters following are not significantly different by *t*-tests with *P* = 0.05. (NS = not significant.)

Alcohol	Fresh weight (g)			Dry weight (g)			Stem length (cm)
	Leaf	Stem	Total	Leaf	Stem	Total	
Control (<i>n</i> = 8)	26.96 a	10.38 a	37.34 a	2.22	0.58 a	2.80	19.56 a
Methanol (<i>n</i> = 16)	31.04 b	12.60 b	43.64 b	2.53	0.74 b	3.27	22.22 b
Ethanol (<i>n</i> = 16)	29.57 ab	11.41 ab	40.98 ab	2.38	0.69 b	3.07	21.30 ab
Significance	<i>P</i> = 0.05	<i>P</i> = 0.05	<i>P</i> = 0.05	NS	<i>P</i> = 0.05	NS	<i>P</i> = 0.05

Nonomura & Benson (1992) proposed that the increase in growth caused by methanol is the result of the inhibition of photorespiration. This hypothesis however needs to be tested further as other mechanisms may be involved.

Whatever the mechanism, use of methanol and possibly ethanol, to increase growth rate may provide significant benefits, if this shoot growth rate is also reflected in yield, on a range of agriculturally important C3 crop plants. Further work is in progress to explore these possibilities.

REFERENCES

- Heins, R. D. 1980: Inhibition of ethylene synthesis and senescence in Carnation by ethanol. *Journal of the American Society of Horticultural Science* 105(1): 141–144.
- Mencarelli, F.; Hugo, L. 1991: Control of flower and bract abscission of Bouganvillea branches by ethanol solutions. *Agricoltura mediterranea* 121: 282–286.
- Meinzer, F. C.; Wisdom, C. S.; Gonzalez-Coloma, A.; Rundel, P. W.; Schultz, L. M. 1990: Effects of leaf resin on stomatal behaviour and gas exchange of *Larrea tridentata* (D.C.) Cov. *Functional ecology* 4(4): 579–584.
- Nonomura, A. M.; Benson, A. A. 1992: The path of carbon in photosynthesis: improved crop yields with methanol. *Proceedings of the National Academy of Sciences USA* 89: 9794–9798.
- Saltveit, M. E. 1989: Effect of alcohols and their interaction with ethylene on the ripening of epidermal pericarp discs of Tomato fruit. *Plant physiology* 90: 167–174.
- Wu, M. J.; Zacarias, L.; Saltveit, M.; Reid, M. S. 1990: Effect of alcohols on Carnation senescence. *Proceedings of the XXIII International Horticultural Congress, Firenze* 2: Abstract 3402.