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EFFECT OF METHANOL AS A GROWTH PROMOTER FOR TOMATO PRODUCTION

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Abstract

An experiment was conducted to study the effects of methanol on the growth and productivity of tomato (*Lycopersicon esculentum* Mill.) in a sandy soil during 1996 and 1997. Plants were transplanted in the field and sprayed with methanol to run off at 5,10,15 and 20% concentrations at two different intervals starting from the first week followed by a second application after two weeks. MeOH showed no significant effects on plant height, number of branches and leaf area and plant productivity in total yield, fruit mass, fruit volume and total soluble solids. Since methanol had similar or adverse effect on tomato growth and productivity, it should not be recommended as a growth promoter.

Introduction

Recently, interest has focussed on the effect of methanol on yield increase of different C_3 species. Exogenous application of methanol solution in arid land environment increased the yield (Nonumura & Benson, 1992). Several studies showed more than 100% improvement in growth which raised hopes of increased yields and farm income as a result of using these treatments, however, some data presented lacked statistical analysis.

The mode of action of methanol as a growth promoter is believed to alleviate CO_2 deficiency. It has also been suggested that it may inhibit photorespiration, consequently it provides a potential to reduce water requirements and to improve crop yields (Nonomura & Benson, 1992). Nishio *et al.*, (1993) indicated that in hydroponically grown spinach, CO_2 gas exchange was unchanged after 2 hrs, but was stimulated by about 20% 3 h after applying 20% methanol and this stimulation was continued for 2 weeks up to 33%. Methanol may also be assimilated in a sugar phosphate pathway in some C_3 species like *Aspergillus niger* (Maldonado *et al.*, 1993). Methanol is a single carbon alcohol that is lipid-soluble and passively traverses bilipid membranes affecting rapid incorporation in cells (Salisbury & Ross, 1992). It is synthesized into serine and methionine and it is oxidized to CO_2 in C_3 plants. Increased CO_2 fixation does not appear to be a major response to methanol foliar application (Cossins, 1964). Simmot (1993) was able to assess methanol residues in crop plants treated with aqueous methanol fertilizer using gas chromatographic analysis.

Several studies indicated a demand from commercial growers and researchers for information regarding this product. Molin (1993) reported that methanol was classified by EPA (Environmental Protection Agency) as a foliar fertilizer, thereby allowing its use without further regulatory action.

The purpose of this study was to determine the effect of aqueous application of methanol on plant growth and productivity of tomato under the United Arab Emirates conditions.

Materials and Methods

Tomato (*Lycopersicon esculentum* Mill.) was grown in a sandy soil (Typic torri-padmments, with pH 8.7 containing 5% clay, 3% silt and 92% sand) at the Faculty of Agricultural Sciences Farm in Al-Oha (Lat. 24°15-, Long. 55° 45- and Alt. 306.1 m above sea level) during the growing season of 1996/1997. A split plot design was adopted with four methanol concentrations of 5,10,15 and 20% with control as the main plots and period of their application as a sub plot. Each treatment consisted of two lines with 30 plants in each line. Plants were established in speeding trays in the green-house on Sept. 15, 1996. The temperature was maintained at average of 20°C. The seedlings were transplanted to the field on Oct. 10, 1996 around drip irrigation lines that were 150 cm apart and were grown at a distance of 40 cm apart. The plot area was 0.2 ha. Fertilizers (4000 kg/ha organic matter and 200 kg/ha superphosphate) was incorporated into the seedbed prior to planting. A complete fertilizer of 120 kg of nitrogen, 80 kg of phosphorus and 200 kg/ha of potassium was applied at different intervals throughout the plant life starting at 15 days after planting. Drip irrigation (4L/hr) daily for the first month and then it was adjusted to 2L/hr for the rest of the growing season. Methanol at concentrations of 5,10,15 and 20% was applied after 21 days from transplanting followed by second application after 3 weeks interval. The exogenous application was made till run off in full sunlight to permit plants to undergo stress. Triton at concentration of 1% was used as a surfactant with all treatments. pH was adjusted to 6.5-7. Pesticides were used to control pests as necessary.

Data taken at one month interval from date of transplanting included: plant height, number of branches, leaf area, average weight (volumes) of fruits expressed as weight of 20 fruits, total weight of the fruit in addition to total soluble solids (T.S.S.).

Results and Discussion

Sources of **variation:** Concentration rates had significant effects ($p = < .05$) on all studied traits except the total soluble solids (Table 1). These results indicated that methanol concentrations represent major sources of variations for the growth and productivity of tomatoes. However, application frequencies of methanol to tomato plants had no significant effects on yield and plant height. Number of branches, leaf area, fruit mass, volume and T.S.S. were significantly affected by the type of application. The interaction between concentration rates and frequencies of application was not significant for yield, plant height and number of branches but had a significant effect on leaf area, fruit mass, fruit volume and T.S.S.

Plant growth: Plant height reached its maximum (114cm) in 5% MeOH treatment after two applications (Table 2). The lowest plant height was obtained when MeOH was used at 15%. However, mean heights were not significantly different among all treatments. No differences were found for number of branches. Average number of branch-

Table 1. Analysis of variance showing comparison of one and two applications of Methanol on tomato plants.

Variables Source of Variation	Yield	Plant Height	No. of branches	Leaf Area	Fruit mass(g)	Fruit Volume(cm^3)	T.S.S.
Conc.(A)	*	*	*	*	*	*	NS
Error 1 (df)	15	15	15	15	15	15	15
Application B	NS	NS	*	*	*	*	*
Interaction AB	NS	NS	NS	*	*	*	*
Error 2(df)	15	15	15	15	15	15	15

* p = < 05

es was about 12 branches/plant. Although there was a trend of increased leaf area with increasing application time, especially at concentrations of 5,15,20% of methanol but treatments were not statistically different. These findings are in agreement with the results reported by Esensee *et al.*, (1995)

Fruit growth: None of the treatments showed an increase in yield compared to the control (Table 2). Moreover, all treatments showed a reduction in yield as compared to the control. The difference however was not statistically significant except with one application of methanol at 15% that adversely affected yield. With regards to fruit mass (expressed as kg/plant), the data indicated that methanol at 15% with two applications and at 20% whether with one or two applications resulted in significantly higher fruit mass than methanol at 5% or 10% with one application. The highest value of fruit

Table 2. Effect of different concentrations of methanol and application frequency on growth and fruit quality of tomato during 1996/1997.

Treatment	Fre-quency	Plant Height	Number of branches	Leaf Area	Fruit Yield (kg/ha)	Fruit Mass	Fruit Volumes (cm^3)	T.S.S
5% MeOH	1	114.0a	12.9a	488.1a	70.3ab	95.3b	97.8	4.8
	2	91.1ab	13.2a	538.4a	72.8ab	104.7ab	108.8	4.7
10%MeOH	1	80.6ab	11.1a	584.3a	61.0ab	91.0b	92.5	5.1
	2	90.7ab	11.9a	513.8a	65.8ab	102.5ab	106.8	5.0
15%MeOH	1	86.4ab	10.8a	518.8a	56.6b	92.0b	95.8	4.9
	2	85.6ab	12.7a	536.7a	70.5ab	123.0a	127.8	5.0
20%MeOH	1	92.1ab	12.0a	488.6a	74.2ab	118.0a	122.3	5.2
	2	87.2ab	13.1a	537.8a	67.1ab	118.5a	122.3	4.8
Control		97.8ab	12.9a	525.8a	78.5a	106.2ab	110.3	4.8

= Mean separation within columns by Duncan's multiple range at * p = < 05 mass was obtained with methanol at 15%(two applications). This value, however, was not statistically different from the control (Table 2). All other methanol treatments did not cause any significant change in fruit mass when compared with the control. Furthermore, the trend of fruit volume values was similar to that of fruit mass. No significant effect was observed for total soluble solids. This trend indicates that MeOH has a deleterious effect on tomato productivity.

In most instances, the methanol treated plants were similar or worse than the controls. Nonomura & Benson (1992) indicated that phytotoxicity should be anticipated. In the present study, plant growth appeared not to have been impaired by methanol. Finally the enhanced inconsistency of a promotive response to methanol raised a question on the efficacy of methanol treatment on tomato growth under arid conditions as also reported by Barnes & Houghton (1994), Mc Griffin *et al.*, (1994), Funderberg *et al.*, (1994), Hartz *et al.*, (1994), Nelson *et al.*, (1994) and Esensee *et al.*, (1995). This study provided evidence that methanol was not effective on tomato growth. Thus the data raises doubts about the possibility of using methanol to alleviate stress impacts under arid conditions, especially yield and growth.

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