Foliar Methanol Application Ineffective in Tomato and Melon Production

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Nonomura and Benson (1992) reported that foliar methanol application dramatically increased the growth, yield, and water-use efficiency of many C₃ crop plants. Field-grown watermelon [*Citrullus lanatus* (Thumb.) Matsum & Nakai] yield increased 36% in response to a single methanol application. Vegetative growth of barley (*Hordeum vulgare* L.), cotton (*Gossypium hirsutum* L.), and tomato (*Lycopersicon esculentum* Mill.) increased 50% within 30 days of methanol treatment. Cabbage (*Brassica oleracea* L. Capitata group) and cotton showed increased turgidity under stressful field conditions, with methanol-treated plants remaining erect and non-treated plants wilting. Concurrently, methanol reduced cotton's irrigation requirement.

Although methanol can be metabolized in the photosynthetic pathway (Nonomura and Benson, 1992), the magnitude of these crop responses was greater than could be explained by its value as a foliar nutrient. Based on the observations that C₄ plants [corn (*Zea mays* L.), sorghum (*Sorghum vulgare* Pers.), and bermudagrass (*Cynodon dactylon* L.)] did not respond to methanol treatment and that significant crop response in C₃ plants required high light intensity, Nonomura and Benson deduced that methanol treatment affected the photorespiratory pathway. Our objective was to determine if foliar methanol application could improve vegetable production under typical California field conditions.

In 1993, seven field trials were conducted: three on processing tomato, three on muskmelon (*Cucumis melo* L.), and one on water-

melon (Table 1). Each trial represented field environment and cultural practices typical of commercial production in its respective area of California. All locations had high light intensity during the growing season. All plots were either drip- or furrow-irrigated and managed to minimize crop stress, with the exception of the Riverside trial. At Riverside, we imposed two irrigation treatments: weekly irrigation based on estimated crop evapotranspiration and weekly irrigation at 70% of that amount.

Starting at early bloom stage, methanol solutions (16% to 35%, v/v) were applied weekly, with CO₂-powered hand sprayers. Nonomura and Benson (1992) reported that phytotoxicity and symptoms of nutrient deficiency occurred after repeated methanol applications. Both were ameliorated by adding glycine, urea, and iron ethylenediamine-tetraacetic acid (EDTA) to the methanol solution. Our standard methanol formulation included 0.1% glycine, 1.0% low-biuret urea, 0.01% iron EDTA, and 0.1% surfactant. The response of methanol-treated plants was compared to those receiving applications of the glycine-urea-iron EDTA-surfactant solution and those not receiving treatment. Spray volume varied from 280 to 480 liters·ha⁻¹ (broadcast basis) among tests. Applications generally were made within 2 h of solar noon; the air ranged from 27 to 41°C during applications.

At each site, we used a randomized complete block with four to six replications. Individual plots ranged from 20 to 59 m². A single destructive harvest was performed for each tomato trial when ≈90% of fruit was red. Muskmelon plots were harvested five to eight times, with fruit picked at full-slip maturity. Watermelons were harvested twice.

Applying methanol did not significantly influence fruit yield of any crop at any site. Mean fruit size and soluble solids concentration also were not affected. There was neither evident vegetative growth response to the methanol application nor advanced crop maturity at any site. At Riverside, a 30% reduction in irrigation volume reduced fruit yield equally in plots treated with methanol and those treated with only the foliar nutrients. Marketable yield of nontreated plots was >78 t·ha⁻¹ (tomato) and >27 t·ha⁻¹ (melon) at all sites, which met or exceeded those typical of commercial production in their respective production areas.

Nonomura and Benson (1992) reported that under high temperature and arid field conditions, foliar methanol applications increase vegetative growth, fruit yield, quality, and water-use efficiency. All C₃ crop plants tested, including tomato and watermelon, responded positively to methanol treatment. According to Nonomura (personal communication), one application was sufficient to improve plant productivity, but multiple applications were required to achieve maximum benefits. Our data do not support these claims. Following Nonomura and Benson's treatment protocol, we found foliar methanol application totally ineffective in enhancing any measure of muskmelon, tomato, or watermelon plant performance under irrigated field conditions representative of the California vegetable industry.

Literature Cited

Nonomura, A.M. and A.A. Benson. 1992. The path of carbon in photosynthesis: Improved crop yields with methanol. Proc. Natl. Acad. Sci. USA 89: 9794-9798.

Table 1. Field location and treatment protocol for foliar methanol application trials in California.

Location	Crop	Methanol concn (% v/v)	No. methanol applications
Davis ²	Tomato	25	3 or 6
Dixon	Tomato	25	3 or 6
Five Points ³	Tomato	25 or 35	3
Holtville 1 ⁴	Muskmelon	20	4
Holtville 2	Muskmelon	20	4
Holtville 3	Muskmelon	20	4
Riverside ⁵	Watermelon	16	4

²Sacramento Valley.

³Central San Joaquin Valley.

⁴Southeastern desert.

⁵Eastern Los Angeles basin.

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