

PERFORMANCE OF KENTUCKY BLUEGRASS SEED TREATED WITH METHANOL

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Abstract

Foliar-applied methanol was purported to enhance growth and yield for C3 crop plants in Arizona, possibly by inhibition of photorespiration. In central Oregon, Kentucky bluegrass in plots treated in the spring of 1993 with methanol or glycine showed a statistically significant ($P < 0.05$) reduction in vegetative growth, and a trend for reduced vegetative tillers and seed yield when compared to plants in untreated plots. These results support the hypothesis that methanol may actively alter physiological processes, but suggest an opposite effect than that reported from Arizona.

Introduction

In 1992, Nonamura and Benson (1,4,5,6) reported that foliar-applied methanol increased crop production of C3 plants. Under high light intensity, methanol may have reduced photorespiration, increasing the efficiency of carbon utilization. In the Arizona desert in the summer, methanol in aqueous solution increased crop yield (2,3,4,6). Phytotoxicity was reported between about 15 and 50 percent methanol, depending on plant species; optimal effects were seen for concentrations just below phytotoxic levels (6). Plants appeared to require less water as maturity was shortened (6).

As one of a series of investigations to determine if growth and yield responses might be gained in central Oregon from methanol treatment, we made application to Kentucky bluegrass (*Poa pratensis*) grown for seed production. This species of C3 plant grows optimally during cool temperatures during the fall and spring. Floral induction of vegetative tillers to fertile tillers occurs in the fall. Following winter dormancy (with periodic growth during warmer winter days), tillers mature in the spring, anthesis occurs around the first week of June, seed matures during June, and seed may be harvested during early July. It is uncertain how much effect on crop yield and quality that inhibition of photorespiration might have after anthesis.

The primary factor reported to favor responses to methanol was high light (1,2,3,4,5,6), presumably total daily flux, which is a combination of daylength and solar intensity. Lack of general plant responses to methanol in Arizona in the winter were attributed to less light flux, rather than to reduced temperature (6). Lower limits for effective light intensity were not defined, but the response was seen in the summer rather than in the winter in Arizona (6). Central Oregon encompasses an arid, high altitude (2,500-4,000 ft) area, and daylengths for much of the growing season are longer than Arizona daylengths (Figure 1). At the spring equinox (March 20, 1993) the daylengths in central Oregon begin to exceed

those in Arizona. This period would extend through the fall equinox (September 23, 1993). Thus, pending variation due to cloudiness, total light flux normally would be as high or higher through much of the growing season in central Oregon vs Arizona. However, for many plant species, plant growth during much of the season in central Oregon may be inhibited by cooler temperatures; the relationship between temperature and light flux with respect to methanol-induced growth responses is not known. Further, minutes of daylight as shown in Figure 1 do not directly translate into light flux, as light flux is moderated by cloudiness and perhaps other factors. Typically, for central Oregon, cloudiness is not extensive during the growing season.

Specifically, then, with respect to Kentucky bluegrass, for much of its early growth in the fall, late winter, and early spring, total light flux for Kentucky bluegrass might not be as great as in Arizona, and perhaps not great enough for a response to methanol application. But for growth in the late spring and early summer, total light flux for Kentucky bluegrass would be higher than in Arizona, so methanol application might have significant opportunity to elicit plant responses.

There may two different opportunities for treatment of Kentucky bluegrass: fall and spring. In 1993, we treated only through the spring, on a field which until then had been handled in a commercial manner.

Materials and Methods

No toxicity determinations were made on Kentucky bluegrass. The concentration of methanol was held at 25 percent, as recommended by A. Nonamura as a non-toxic but effective concentration for most crops. Methanol was applied in three replications in a randomized complete block design. Plots were 9 ft wide x 32 ft long. Materials were applied using a CO₂-powered backpack sprayer. Spray was applied at 40 lb/in², 20 gal/ac. The spray boom was held at 18 inches high, and six Teejet 8002VS were spaced at 18 inches along a 9 ft boom.

Treatments were as listed in Table 1. A glycine plus phosphate treatment was included upon the recommendation of A. Nonamura, as a potential alternative to methanol. As methanol was purported to increase plant growth, a minimal nitrogen solution as urea was included to supply needed supplemental nitrogen for such additional growth. This required that a second experimental control treatment (MEM) be added to the list of treatments. Triton X100 was included as a spreader-sticker wetting agent.

Table 1. Treatments used in the Kentucky bluegrass methanol trial located at the Central Oregon Agricultural Research Center, Madras, OR, 1993.

| Treatment | Materials used |
|----------------|--|
| Untreated | none |
| MEM | 1 g/1 urea and 0.05 g/1 Triton X100 |
| Methanol + MEM | 25% methanol + MEM |
| Glycine | 1% glycine + 0.1% phosphate + 0.05 g/1 Triton x100 |

The variety of Kentucky bluegrass was 'Adelphi', and management was as per standard commercial practice for the region with respect to fertility, irrigation, weed control, etc. Treatments were applied on May 11, May 26, June 8 (late anthesis) and June 24 (during seed maturity). On July 7, all vegetation above 1 inch was removed from 2 ft² of each plot. Total weight and numbers of fertile tillers were counted. Uncleaned and cleaned seed weight for each sample was determined by standard seed separation methods.

Results

Weather in the spring of 1993 was much cloudier and cooler than normal. These data are not summarized here, but likely accounted for less light flux than normal for this period. The extent to which this may have influenced plant responses is not clear, but could be significant based on Arizona reports (6).

Foliage height differences during May and June were only scanned visually; no measurements were taken, but no differences were noted visually. Also, there was no obvious difference in timing of anthesis, or in crop maturity as the season progressed. Means of data for total dry weight, fertile tiller number, combined seed weight, and cleaned seed weight are shown in Table 2. Statistically significant differences were found only for total dry weight, although means for fertile tiller number and seed weights follow the same trends. For all parameters, however, higher mean values were found for Kentucky bluegrass in the experimental controls (untreated and MEM treated plots) compared to methanol and glycine treatments.

Table 2. Performance data for methanol-treated Kentucky bluegrass at the Central Oregon Agricultural Research Center, 1993

| Treatment | Total Sample Fertile | Uncleaned Seed | | Clean Seed |
|-----------|----------------------|----------------|------------|------------|
| | Dry Weight (g) | Tiller No. | Weight (g) | Weight (g) |
| Untreated | 874 A | 567 | 215 | 21.8 |
| MEM | 821 AB | 429 | 198 | 18.2 |
| Methanol | 713 B | 470 | 181 | 18.2 |
| Glycine | 675 B | 371 | 164 | 11.8 |

For Total Sample Dry Weight, numbers followed by different letters were significantly different ($P < 0.05$) for both the F-Test and Duncan's Multiple Range Test. No significant differences ($P < 0.05$) were found among treatments for fertile tillers or seed weights.

Discussion

The extent to which increased cloudiness in the spring of 1993 may have affected the results above is uncertain, but there were fewer sunny hours in 1993 than in normal seasons. Additionally, the spring was cooler than normal, which extended the season by one to two weeks, but with no net effect on bluegrass yields for the region.

These data support the conclusion that methanol and glycine influenced plant growth and yield, but the data are not as clear or strong as is needed to support strong statistical statements. Whether more replications would have resulted in greater statistical separation among treatments is a question that may be pursued in future trials.

Total sample dry weight was higher for Kentucky bluegrass in untreated and MEM treated plots than in methanol and glycine treated plots. Similarly, there was a trend for higher seed yield in the experimental control treatments. These responses, if verified, are the opposite of those anticipated based on reports from Arizona (1,2,3,4,5,6), where foliar-applied methanol increased plant growth and yields compared to untreated plants. Nevertheless, there at least was the suggestion of plant responses in our data. Any responses are noteworthy, and suggest that such treatments might serve as management or research tools in some manner. It may well be worthwhile to further investigate the response of Kentucky bluegrass in central Oregon to foliar-applied methanol, both for fall and spring application.

References

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Figure 1. Minutes of daylight calculated for Central Oregon (latitude 46) and for northern Arizona (latitude 35) for 1993, based on data from the U.S. Naval Observatory (7). For Kentucky bluegrass, anthesis in central Oregon occurs at about week 23 in typical years, and occurred in week 25 in 1993 due to extended cloudy, cool spring weather in 1993.

