

1994

TITLE: USE OF METHANOL AND MYCORRHIZAL COLONIZATION TO ENHANCE POTATO MINITUBER FORMATION IN THREE DIFFERENT GENOTYPES

PROJECT LEADERS: F. B. Reeves, C. Stushnoff, A. Al-Agely

PROJECT JUSTIFICATION: During the past year interest in the use of methanol as a plant growth stimulant has increased (Nonomura and Benson 1992, and Polien 1993). Growth improvement of methanol-treated plants after weekly applications of 10-50% methanol solutions are shown in TABLE 1 (Nonomura and Benson 1992). The authors conclude that plants treated with methanol have increased biomass, reduced water requirements, and improved crop yields. The EPA now considers methanol to be a fertilizer and authorizes the use of methanol for agricultural practices without regulation as a plant growth regulator (Polien 1993). Unfortunately the mechanism(s) by which methanol enhances growth is not understood.

Al-Agely and Reeves (1994, in prep.) found in greenhouse grown tomatoes that methanol foliar application and inoculation of plants with vesicular-arbuscular mycorrhizal fungi (VAM) increased fruit fresh weight by 57.19%, fruit dry weight by 48.39%, root fresh weight by 27.06, and root dry weight by 27.56 when compared with control plants, but had no positive effect on shoot fresh and dry weight (TABLE 2). In tomato plants Al-Agely and Reeves (1994) noted no diseases, aphids or white fly insects on plants treated with methanol. Our speculation is that methanol foliar application could affect insect egg viability and dehydrate fungal mycelium. We expect methanol will improve growth in potato. Methanol application also offers the potential for enhancing minituber yield and quality.

OBJECTIVE The results of foliar methanol application on potato have not been published. Our study has the following objectives: (1) to study the effect of methanol foliar application and mycorrhizal colonization on potato growth and minituber production; (2) to assess pathogen and insect elimination in potato minituber seed propagation; and (3) to evaluate genotypic response in three different potato cultivars.

APPROACH: Potato (*Solanum tuberosum* L.) cv. Chipeta, cv. Russet Nugget, and cv. Ute Russet that were developed by the CSU potato breeding project in the San Luis Valley of Colorado will be used. If approved, the plants will be grown in a potato seed certification greenhouse at CSU under an environment similar to that used by Lommen and Struik (1992) to produce potato minitubers. Treated plants will be sprayed with methanol in 20% concentrations increments up to 60% and will be inoculated with VAM fungi. Control treatments will lack VAM fungi and will be treated with water only or appropriate methanol concentrations. To reduce foliar injury, each methanol application will be combined with a protective (0.05% Triton X-100, 0.2% Urea, and 0.1% Glycine).

Approximately nine months are required for growing potato plants, producing minitubers, culturing mycorrhizal fungi, and testing methanol effects. Three months are required to analyze plant growth and data. Assuming positive results, we may need to modify the experiments and to repeat the experiments to validate the results.

Five replicates will be randomly assigned to each treatment. Foliar application by means of misting with equal volumes of water, methanol, or methanol plus protective will be applied once per week for 12 weeks for potato plants producing minitubers. Foliar application will continue until the entire leaf system is wet and droplets form. The experiments will use a randomized block design. The results will be analyzed using the multivariate analysis of variance. Significance will be at the 95% confidence level.

For the proposed research we have a well equipped chemical laboratory and growth chambers for the basic biological aspects of the study. We have equipment for monitoring leaf water potential and photosynthetic gas exchange.

LITERATURE CITED

- Al-Agely, A. and F. B. Reeves. 1994. Interaction of methanol and VAM inoculation and their effect on tomato plants growth and yield. (in preparation).
- Lommen, W. J. M., and P. C. Struik. 1992. Influence of a single non-destructive harvest on potato plantlets grown for minituber production. *Netherlands J. Agr. Sc.* 40: 21-41.
- 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.
- Polen, N. 1993. Methanol: letting growers master light. *AVG* 41: 28F-28G.

TABLE 1. Growth response of plants to methanol application. Data taken from Nonomura and Benson 1992.

| Plant | Days From Treatment | Percentage Growth Improvement |
|----------------------------|---------------------|-------------------------------|
| <i>Botryococcus</i> (alga) | 10 | 100 |
| Wheat (grain yield) | 60 | 100 |
| Palm | 180 | 70 |
| Eggplant | 30 | 60 |
| Strawberry | 30 | 60 |
| Cotton | 30 | 50 |
| Cabbage, savoy | 60 | 50 |
| Tomato | 30 | 50 |
| Rose | 45 | 40 |
| Melon (fruit yield) | 75 | 36 |

TABLE 2. Change in tomato biomass (in percent) of mycorrhizal (+VAM), non-mycorrhizal (-VAM), methanol treated (M), and methanol plus protective treated (P) plants compared to controls (water application or 0% methanol). Data from Al-Agely and Reeves, 1994.

| METHANOL PERCENTAGES | PERCENTAGES RELATIVE TO CONTROL | | | | PLANT BIOMASS |
|----------------------|---------------------------------|---------|--------|---------|--------------------|
| | +VAM+M | +VAM+MP | -VAM+M | -VAM+MP | |
| 40 | 57.19 | 12.58 | 17.53 | 24.30 | Fruit Fresh Weight |
| 40 | 48.39 | 10.20 | 34.25 | 21.70 | Fruit Dry Weight |
| 20 | 27.06 | 6.20 | 3.24 | 6.89 | Root Fresh Weight |
| 20 | 27.56 | 8.43 | 5.15 | 19.83 | Root Dry Weight |
| 40 | -1.19 | 5.83 | -11.31 | -3.54 | Shoot Fresh Weight |
| 40 | -12.91 | 2.50 | -25.63 | -0.04 | Shoot Dry Weight |

FUNDING REQUEST: Primary expenditure is for a part-time hourly worker that has expertise in growing plants under greenhouse conditions and in dealing with mycorrhizal fungal and their use on specific plants. Additional expenses are for misc. greenhouse supplies, chemicals, and travel.

ONE YEAR BUDGET JUSTIFICATION:

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|--|-----------------|
| Salary for part-time hourly worker (10 hr/WK and \$12.50/hr) | \$6,000.00 |
| Misc. supplies and chemicals | 700.00 |
| Travel | 300.00 |
| Total | <u>7,000.00</u> |