DOSE RESPONSE OF *AGROBACTERIUM TUMEFACIENS* TO SOIL FUMIGANTS

James S. Gerik and Dong Wang
USDA/ARS San Joaquin Valley Agricultural Sciences Center, Parlier, CA

Introduction. Cut flower growers in California have routinely used methyl bromide with and without chloropicrin for pre-plant soil fumigation for the control of soilborne pathogens and weeds. Recent research to identify alternatives to methyl bromide for flower growers has involved combinations of 1,3-dichloropropene, chloropicrin, and metam sodium. Recently other emerging alternative chemicals have been proposed as replacements for methyl bromide; one of these is acrolein (2-propenal; Baker Petrolite Inc. Bakersfield, CA). Acrolein has been formulated and registered for use as an aquatic herbicide in irrigation systems. It also is used to control microorganisms and bacteria in oil wells, liquid hydrocarbon fuels, cooling-water towers and water treatment ponds. Here we report the efficacy of acrolein compared to other soil fumigants to control *Agrobacterium tumefaciens* in soil.

Materials and Methods. Soil was collected from commercial aster and solidago fields in San Diego County, CA where the crops were expressing severe symptoms of crown gall. The soil was well mixed and sieved to remove clods. Fifty cm3 of the soil was added to RL C4 cone-tainer cells (16cm x 2.5cm; Stuewe & Sons, Inc., Corvallis, OR) plugged at the bottom with glass wool. Each cell was fitted on the top of a second cell also filled with soil. Chemicals were diluted in de-ionized water and added to the cell in a total volume of 20ml to simulate a field chemigation. Chemical concentrations ranged from a field equivalent rate of 0 to 5600 kg·ha-1. Chemicals tested included acrolein, metam sodium, an EC formulation of chloropicrin, and a mixture containing 61% 1,3dichloropropene 33% chloropicrin and 6% surfactant (InLine). The cells were sealed with a neoprene stopper immediately after application and allowed to sit at room temperature for 1 week after which the soil in the upper tube was collected and mixed. This soil was assayed for populations of *A. tumefaciens* by dilution plating on selective D-1M medium. The population of *A. tumefaciens* in the treated soil was related to the chemical dose by the following model: $Y = Y_0 + a / 1 + e^{((X - X_0) \cdot b)}$, where Y is the population and X is the log of the chemical dose. LC50 and LC90 values were computed from the predictive values of the regression.

Results and Discussion. The acrolein, metam sodium, and InLine treatments did fit the model; even though the R^2 values were low, they were significant ($P < 0.05$). Metam sodium had the lowest LC_{50}, but acrolein had the lowest LC_{90} and

the largest slope at the inflection point of the curve indicating greater susceptibility of the pathogen to this treatment. The susceptibility of the pathogen to Inline was found to be quite low. The data for the chloropicrin treatment did not fit the model and this treatment is no longer considered here. The conclusion from this study is that acrolein could be a feasible treatment to control crown gall; the feasibility will depend on the cost of the treatment.

Acknowledgements: The authors wish to thank Patricia Mungur and Amanda Crump for technical assistance. This research was funded in part from grants from Baker Petrolite INC, and the California Cut Flower Foundation.

Estimated parameters for nonlinear regression of *Agrobacterium tumefaciens* populations in soil treated with acrolein, metam sodium or InLine.

Chemical	b^a	R^2	LC_{50} (kg·ha^{-1})	LC_{90} (kg·ha^{-1})
Acrolein	45.3	0.57	468	525
Metam sodium	3.8	0.48	185	770
InLine	3.0	0.26	1037	3512

[a] Slope at the inflection point of the logistic curve.