TITLE: TREE PLANTING SITE-SPECIFIC FUMIGANT APPLICATION TO CONTROL ALMOND REPLANT DISEASE

AUTHORS: Robert Coates, Bio. and Agr. Eng. Dept., UC Davis, CA

Mir Shafii, Bio. and Agr. Eng. Dept., UC Davis, CA

Shrini K. Upadhyaya*, Bio. and Agr. Eng. Dept., UC Davis, CA

Greg Browne, USDA, ARS, UC Davis, CA

SUMMARY: The goal of this research was to use recent advances in the global positioning system and computer technology to apply just the right amount of fumigant (0.2 kg/tree) where it is most needed (i.e., in the neighborhood of each tree planting site) to decrease the incidence of replant disease. Since a typical almond orchard has 200 to 350 trees/ha, this site-specific treatment of 0.2 kg/site amounts to an application of 40 to 70 kg/ha of chemicals. This translates to a 58 to 76% reduction in fumigant cost and environmental load, compared to the conventional strip fumigation. This reduction in chemical application is not only beneficial to the environment, it can save a significant amount of money for the farmers. At a typical fumigant cost of approximately $5/kg the savings would range from $490 to $640/ha. Thus it is clear that applying a small amount of soil fumigant to control replant disease makes environmental, ecological, and economical sense. In this study we have retrofitted a shank type fumigant applicator with a High-Performance Global Positioning System (HPGPS) receiver (accuracy in the range of 10 to 20 cm) and developed software necessary to accomplish tree-planting-site-specific application of fumigants.

A TriCal shank type fumigant applicator was retrofitted with a HPGPS based tree planting-site specific fumigant application system. The schematic diagram of the system employed to apply the fumigant in the neighborhood of a future tree planting site is shown in figure 1. The system uses an embedded controller (Tern Inc., Davis, California, USA) which was programmed to read the HP DGPS serial data to determine the position of the tractor shanks (applicator). The controller compares the HP DGPS coordinates with the tree site coordinates and if the shank is within the treatment zone, a solenoid valve is actuated. When the solenoid valve is actuated, fumigant would be applied by the Raven spray controller that meters the correct amount of fumigant based on the ground speed (provided by a speed sensor) and desired application rate (manually entered into the controller by the operator). The Raven controller actuates a fast acting flow control valve to apply the correct amount of fumigant.

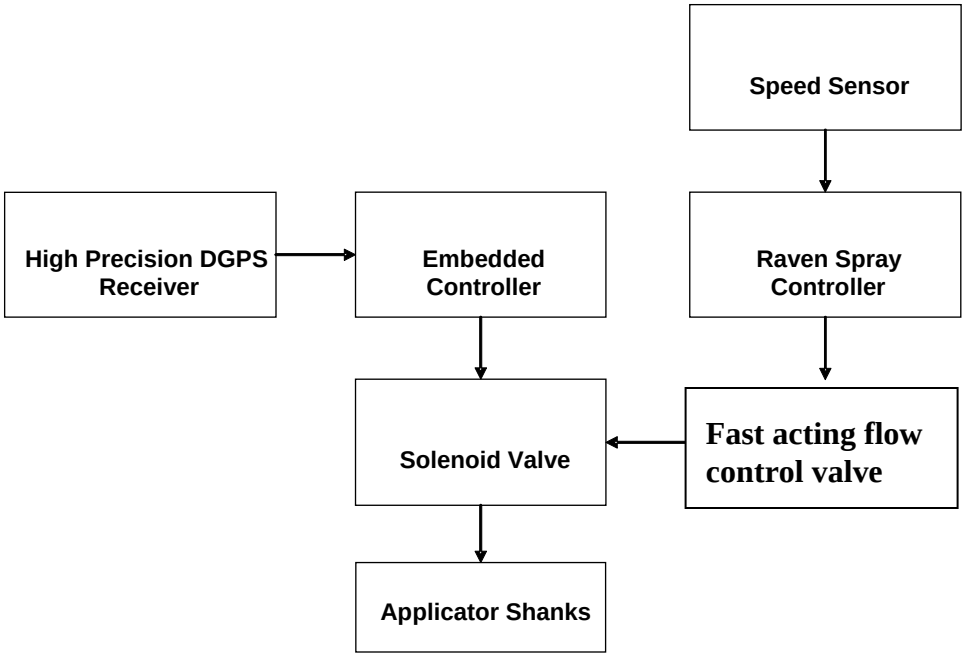

Figure 1. A schematic of the modified tree-planting-site-specific fumigant application system

The system was tested near the UC Davis campus determine its accuracy. The results indicated that the error in position location depended on the vehicle speed and look-ahead value. A look-ahead value of 0.8 s appears to account for the hydraulic system response time. The RMS error was 33.5 cm (13.2 in) when the speed effect was properly accounted for. Although this error is higher than desirable, even at this level of accuracy the amount of fumigant applied can be reduced by nearly 50% thus realizing significant cost and environmental benefits. The system was used in an orchard-replant fumigation trial which tested different combinations of fumigant type, rate, and application method (Paramount Farming - Columbia Ranch, Firebaugh, California, USA). Twelve of 80 subplots used the redesigned tree-planting-site-specific fumigant application system. Each subplot contained 24 trees. New almond trees were subsequently planted in the treated soil. The effect of each treatment on preventing or reducing replant disease is currently being investigated. A modified version of this system is currently being developed to enhance the accuracy. Several trials will be conducted with the newer system this Fall.

ACKNOWLEDGEMENTS: We are grateful to the Almond Board of California for their support of this project. Moreover, we appreciate the support received from TriCal Inc. (Holister, CA) for providing the fumigant applicator, VIPER computer, flow controller and other equipment to develop the tree-planting-site-specific fumigant application system.