PNEUMATIC SOIL EXCAVATION AND ITS EFFECT ON WOUNDING AND CROWN GALL INFECTION

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ABSTRACT

Crown gall disease is an increasing problem in walnut orchards planted on Paradox rootstock. Many growers are successfully treating galls by surgical removal and painting with Gallex. Safely and efficiently removing soil without wounding the crown and roots is important in preventing new crown gall infections and reducing treatment costs. Pneumatic soil excavation offers an alternative method to hydraulic or hand excavation using shovels and trowels. Treatment can occur immediately after soil removal unlike hydraulic excavation where the soil and tree need to dry first. Only a few air jet wounds confined to outer bark removal were found in 1998 when soil was pneumatically excavated under dry conditions. No crown gall developed on air wounds or intentional cambium wounds over a period of one year. There was no evidence of reinoculation under these conditions. In 1999, only two superficial air jet wounds were found when excavating under moister soil conditions and higher pressure; it took one minute per tree to expose the lower crown and upper roots. Soil should be at field capacity for optimum results suggesting that spring would be good timing to expose galls using air jet excavation. Pneumatic soil excavation offers a fast and safe technique from a wounding perspective for exposing crown galls.

OBJECTIVES

To test pneumatic soil excavation of walnut crowns and roots for efficiency, wounding and subsequent crown gall infection.

PROCEDURES

The study site, a walnut rootstock plot, was selected because of the presence of crown gall from previous evaluations for this disease. All six rootstocks were found to have crown gall to varying degrees. The three rootstocks used in this study appeared to have a high susceptibility. However, treatment trees were selected that had no known crown gall infections so as not to interfere with interpretation of new crown gall infections from wounds.

Four single tree replicates of three rootstocks: 1) clonal Paradox , 2) *Juglans californica* (Southern California black), and 3) *Juglans microcarpa* (Texas black) were treated using a completely randomized design. Treatments were:

1) Expose lower crown and upper roots using super sonic air jet soil excavation and refill.
2) Expose lower crown and upper roots using super sonic air jet soil excavation, apply one chisel wound three inches below ground level, 3/8 inch deep into cambium, perpendicular to the root surface on the north side and refill.
3) Unexposed check.

On October 15, 1998, 24 trees were excavated using 90 psi at 150 cfm, 3/4 inch diameter hose with a mach two nozzle. The soil was dry. After excavation, trees were examined for air jet wounds and the presence of existing crown gall. Trees in treatment two were wounded as previously described before soil was refilled. All existing galls and air jet wounds were noted as to location and many were photographed before refilling soil.

On November 19, 1999, 24 trees were reexcavated and the eight check trees excavated using 90 psi at 330 cfm, 1.25 inch diameter hose with a mach two nozzle. The soil was moist in the upper two inches and it was raining during excavation. Trees were examined for gall development on wounds in treatment two or from 1998 air jet wounds on November 22, 1999. Root and crown areas were also examined for any new air jet wounds. Excavation sites were refilled.

RESULTS AND DISCUSSION

In 1998 using less pressurized air and under dry soil conditions, it took approximately 6.5 minutes per tree to pneumatically excavate 24 trees. It took one minute per tree to excavate 36 trees in 1999 with higher air flow rate and moister soil conditions although still not the optimal field capacity. It is possible that excavation time could be reduced further under ideal soil conditions and clear weather.

After super sonic air jet soil excavation in 1998, 67 percent of the trees in the expose and refill treatment and 50 percent in the expose, wound and refill treatment had existing crown galls. Seventeen percent of the unexposed check trees had crown gall when exposed in 1999. All rootstocks were similarly infected. The previous crown gall evaluation was in 1997 after flooding left scour holes around each tree. Apparently the scour holes did not expose enough of the lower crown compared to pneumatic excavation to adequately evaluate crown gall infection.

Air jet wounds were observed in 1998 on five trees, mainly on roots rather than on the crown area. The wounds were small and confined to bark removal. In contrast, only two superficial air jet wounds were observed in 1999 when soil was removed under better soil conditions. No galls had formed on any 1998 air jet wounds when exposed again in 1999. Additionally, No galls were found on wounds made in 1998 in treatment two. Without gall formation, no statistical analysis was performed. Since there were no galls on the chisel wounds into the cambium, we can speculate that crown gall bacterial populations were low at this site. Under these conditions, there was no evidence of reinoculation of crown gall. There is no assurance that there would be no gall formation under heavy bacterial populations. From a wounding perspective, pneumatic excavation offers a soil removal technique that appears to be relatively safe.

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