Quote: . . . fire blight bacteria can move downward inside apparently healthy branches . . . into the rootstock.

Effect of Pruning Out Fire Blight Infections on Incidence of Rootstock Blight

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SHOOT INFECTIONS AND ROOTSTOCK BLIGHT

Fire blight (*Erwinia amylovora*) can kill dwarf apple trees by girdling susceptible rootstocks or interstems, especially M.9 and M.26. We now know that these infections can originate by internal movement of bacteria from infection in the scion and through infected root suckers. In a field experiment, about equal numbers of trees became infected via suckers, and via some other entry path, including internal movement of bacteria within the plant, from blossoms and shoot infections, and direct infection of rootstocks through growth cracks or wounds caused by mechanical, insect or freeze injury.

We have determined in greenhouse experiments that fire blight bacteria can move downward inside apparently healthy branches and the trunk from infections in shoots into the rootstock. Movement of bacteria to the rootstock occurs rapidly. Bacteria were detected in the M.26 rootstock of Empire trees 21 days after inoculation of the shoot tip and 41 days after inoculation in Golden Delicious trees. To determine the effect of growth stage of the tree on the movement of the bacteria through the scion, Empire trees on M.26 were inoculated in the greenhouse at different times during the growing season. Surprisingly, it was found that most internal spread occurred in more mature shoots (10 weeks after bud break) rather than in younger, more vigorously growing shoots. Therefore we think that late-season infections may be particularly dangerous for the rootstock. When several resistant and susceptible scion varieties were inoculated with *E. amylovora* in the field and later tested for movement of bacteria into rootstock, we showed that the bacteria moved into the rootstock from both resistant and susceptible scion varieties. Our preliminary results show that age of the tree may affect susceptibility to rootstock blight.

ECONOMICS OF SHOOT INFECTIONS

It is often recommended that fire blight infections be pruned out of young apple trees during the growing season to prevent rootstock infection. We evaluated how effective pruning was on Empire, Jonamac, and Liberty trees on M.26 rootstock and trees of Empire, Liberty, and Mutsu on M.9 rootstock. Pruning out scion infections 3 weeks after blossom inoculation and then repeatedly during the growing season gave variable results in 3 years of experiments. In 1995 and 1997 pruning had no beneficial effect on eventual death of the rootstock, but in 1996 pruning reduced rootstock death. However, 2 to 3 consecutive years of pruning reduced fruit yield. In comparison to non-inoculated trees, fruit yield on M.9 trees was reduced by 6% on unpruned inoculated trees, but by 62% on pruned inoculated trees (2 years of pruning). On M.26 trees

yields were reduced by 8% on unpruned inoculated trees, but by 79% on pruned inoculated trees (3 years of pruning). Despite these high yield reductions, an economic analysis (conducted with Alison DeMarree, Cornell Cooperative Extension) indicated that pruning out fire blight infections was cost effective. Accumulated net present value (NPV) 20 years after planting for an M.26 planting (272 trees /acre, central leader) without fire blight was $4,684, compared with -$47 for unpruned inoculated trees and $521 for pruned inoculated trees. The improved profitability in the pruned treatment was a result of the reduced tree loss in 1996. The analysis also indicated that replanting, rather than pruning fire blight out of infected trees, may be cost effective if severe fire blight occurred in trees in their 1st or 2nd leaf, but losses from replanting greatly increased for trees in the 3rd, 4th, or 5th leaf. In the trial M.26 trees were in their 3rd, 4th, and 5th leaf in 1995, 1996, and 1997, respectively. For example, if a fire blight epidemic required replanting 50% of the trees in the 2nd year and 3rd year, accumulated NPV was reduced to $3,191 and $2,001, respectively, whereas replanting in the 5th year or 6th year reduced NPV to -$6,360 and -$9,290, respectively.

SHOOT BLIGHT

Shoot blight can be an extremely damaging phase of fire blight. Unfortunately, its biology is not well understood and it is difficult to control. In general, shoot blight is more likely to occur in orchards with blossom blight or a previous history of fire blight, after hail or high wind thunderstorms, or when insect vectors with sucking or piercing mouth parts are present in the orchard. Numerous experiments and field observations have indicated the importance of wounds as avenues for entry of fire blight bacteria. Types of injuries vary from small insect punctures and stem abrasions to large wounds caused by severe wind, hail, or frost.

The following are recommendations for the control of shoot blight:

- Fertilization programs should be designed to:
  1) discourage late vegetative shoot growth
  2) provide proper balance of the major nutrients and especially avoid an excess of nitrogen.
- Pruning out infected shoots to limit the spread of shoot blight is of doubtful benefit on large trees but is recommended on young small trees, particularly those on M.9 or M.26 rootstocks or interstems. To effectively limit damage, strikes should be pruned out as soon as they appear throughout the terminal growth period; begin checking for symptoms about 90 to 100 degree days (base 55˚F) after an expected infection event such as rain during bloom or a summer hailstorm. During periods of active lesion extension, pruning cuts should be made 6-12 inches or more below visible lesions, because large numbers of bacteria are present in tissues that do not yet appear to be symptomatic.
- An application of streptomycin (Agristrep 17WP 1/2 lb/100 gal dilute basis) is strongly recommended following a hailstorm in fire blight-affected orchards. This application may be critical if even moderate amounts of blight were present before the storm. Sprays should be complete within 24 hr after the start of hail. Growers in the U.S. should be aware that on apple streptomycin can be applied until 50 days before harvest.
- To reduce the chance of developing resistance to streptomycin, the routine use of streptomycin to control the spread of shoot infections is **not** recommended.
- Should blight develop, it is also important to maintain control of insects with piercing-sucking mouth parts (aphids, leafhoppers) in order to reduce further spread.
- Summer prune during dry weather, especially in orchards with a previous history of fire blight or when fire blight is present in nearby blocks. Caution is needed especially for

susceptible varieties (Crispin, Fuji, Gala, Gingergold, Idared, and others). Summer pruning should be avoided entirely in orchards that are severely affected with fire blight.
- The grass sod or cover crop should be well mowed early in the season and then allowed to grow in midsummer to check tree growth.

The above points are based upon recommendations found in Cornell Cooperative Extension *Pest Management Recommendations for Commercial Tree-Fruit Production* and van der Zwet, T. and S.V. Beer. 1995. *Fire Blight—Its Nature, Prevention, and Control: A Practical Guide to Integrated Disease Management*. U.S. Department of Agriculture. Agriculture Information Bulletin No. 631, 97 pp. Copies of a revised edition of the latter publication should be available July 1999 from the Government Printing Office on the web at: www.access.gpo.gov, phone: 1-202-512-1800, fax: 1-202-512-2250, or by mail: Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954.

SHOOT BLIGHT CONTROL

Rapidly growing, succulent apple shoots are more susceptible to fire blight infection than are slow- or non-growing shoots. Prohexadione calcium (formulated as BAS 125 or Apogee, BASF Corporation) is a plant growth regulator that reduces the vegetative growth of apple trees. Recently, Apogee has been shown not only to suppress apple shoot growth but also to reduce the incidence of shoot blight infections and suppress the extension of lesions. In tests we conducted in New York last year, treatment of Idared trees with Apogee resulted in less shoot growth and an 86% reduction in the severity of shoot blight. The effect of Apogee on fire blight severity was far greater than that of streptomycin, which resulted in a 39% reduction in disease severity.

Although Apogee is not yet registered for fire blight control in New York, it has great potential as a tool to control the shoot blight phase of fire blight in the future. However, due to its growth effects, its use in orchards will need to be integrated into other orchard practices. Application will need to be timed carefully to have the desired, but not excessive, growth reduction effects. Interaction with thinning sprays will need to be evaluated. In addition, the effect of treating young trees (less than 4 years old) on yield will need to be evaluated.