Challenges of Controlling Fire Blight

Alan L. Jones

Department of Plant Pathology, Michigan State University, East Lansing, Michigan

Presented at the 44th Annual IDFTA Conference, February 17-21, 2001, Grand Rapids, Michigan.

Michigan apple growers have experienced several severe outbreaks of fire blight during the last decade, particularly in 1991, 1994, 1995, 1997 and 1998. However, the outbreak in southwest Michigan in the 2000 growing season was more severe than anyone can remember. It extended across Berrien and Van Buren Counties into adjacent counties, affecting more growers at one time than any previous epidemic.

Many new apple cultivars and rootstocks are highly susceptible to fire blight. The renovation of old apple orchards replanted with these highly susceptible trees has increased the fire blight problem at a time when streptomycin-resistant *Erwinia amylovora* is making fire blight control nearly impossible for Michigan apple growers. Besides the loss of susceptible cultivars, the loss of resistant cultivars like Delicious due to rootstock blight is compounding the problem and makes control much more difficult, if not impossible.

The Michigan Farm Bureau, on behalf of the Michigan and New York apple industries, spearheaded the drive to raise fire blight research funds and successfully lobbied Congress for funding in both states beginning in October 1996. Excellent research progress is being made on this difficult problem, but more remains to be done.

The following article reviews the fire blight problem in Michigan, how control practices are changing and the direction of some of Michigan's current research efforts.

BLOSSOM BLIGHT CONTROL WITH STREPTOMYCIN

The efficacy of bloom applications of streptomycin for fire blight control in apples was established in numerous orchard trials throughout the United States in the 1950s and 1960s. Streptomycin was registered for fire blight control in 1955, and the practice of using streptomycin at bloom for fire blight control was well established by the late 1960s. Streptomycin continues to be the main control method for fire blight, and no effective alternatives to this antibiotic are currently available.

The effectiveness of streptomycin at bloom for fire blight control is illustrated by data from recent experiments on mature Jonathan apple trees where streptomycin was included as the standard. In 1999 and 2000, there were 292 and 105 strikes per tree on unsprayed trees versus 7 and 5 strikes per tree on the streptomycin-treated trees, respectively (Fig. 1, top). This level of control (over 95%) was obtained with two sprays applied during the bloom period and a third applied as petal fall was near completion.

The fire blight pathogen has developed resistance to streptomycin in at least four counties in western Michigan and in most apple growing regions of western North America. Because of streptomycin resistance, fire blight will be more difficult and costly to treat and epidemics harder to control. In Michigan, tank mixtures of streptomycin with oxytetracycline, both at full rates, are suggested as the preferred control strategy in place of streptomycin alone, particularly for high density orchards.

CONTROLLING SECONDARY SPREAD OF FIRE BLIGHT WITH GROWTH RETARDANTS

Terminal infections by *E. amylovora* after bloom are often severe, particularly in years with wet weather during the first and middle parts of the summer. Wind-driven rain can disseminate the bacteria to succulent leaves damaged from high winds. Hailstorms increase the problem even more by injuring leaves and fruits, thereby aiding infection. The combination of just one or two blossom blight strikes per tree and frequent local storms in early summer can result in severe blight by the end of the summer.

Actigard significantly reduced the incidence of fire blight following natural infections associated with storms at petal fall.

In past years little could be done to prevent secondary spread of fire blight in summer except to use streptomycin immediately after hailstorms or apply it on a regular basis through the summer months. Routine use of streptomycin during the summer was discouraged because this practice resulted in the selection of streptomycin-resistant strains and subsequent loss of fire blight control. The use of shoot growth retardants for reducing the spread of disease to shoots and terminals is a novel approach to fire blight control.

Two growth retardants, Apogee (prohexadione-calcium) and Palisade (trinexapac-ethyl), have been shown to reduce the secondary spread of blight to shoots and terminals. These compounds belong to a family of compounds that inhibit gibberellin biosynthesis (2). In apple, Apogee or Palisade applied during the later part of bloom results in cessation of growth and increased resistance to fire blight infection. Apogee received federal registration for use on apples in May of 2000; Palisade is being evaluated experimentally and may be useful in the future.

Experiments in 1999 and 2000 were carried out on mature Jonathan and Golden Delicious apple trees on M.106 rootstock. The treatments were replicated six times on 2-tree plots with paired trees of the two cultivars. All treatments were applied with a handgun sprayer to runoff. Apogee 27.5%WG was applied once at 12 oz of product per 100 gal (high rate application, 250 ppm) or twice at 6 oz per 100 gal (split-rate application, 125 ppm). In the experiment in 2000, Palisade was included for comparison with Apogee.

To ensure that fire blight would develop in these trials, ten shoots around the outside of each tree were inoculated each year by cutting two leaves per shoot near the tip with scissors dipped into a suspension of *E. amylovora*. Once the pathogen was established, the length of infected tissue and total shoot length were recorded for each inoculated shoot.

In 1999, the growth rate of terminal shoots measured 17 and 31 days after treatment with the high-rate of Apogee was less than that for untreated shoots on check trees (Table 1). The low-rate Apogee treatment reduced the rate of growth on Golden Delicious but not on Jonathan. A severe storm on May 17, 7 days after the initiation of the Apogee treatments, created ideal conditions for blossom and trauma blight on Jonathan but not the more

FIGURE 1

Control of several stages of fire blight in 1999 and 2000 with streptomycin and with Actigard applied weekly (x6) and biweekly (x3). Columns with a common letter are not significantly different from each other.

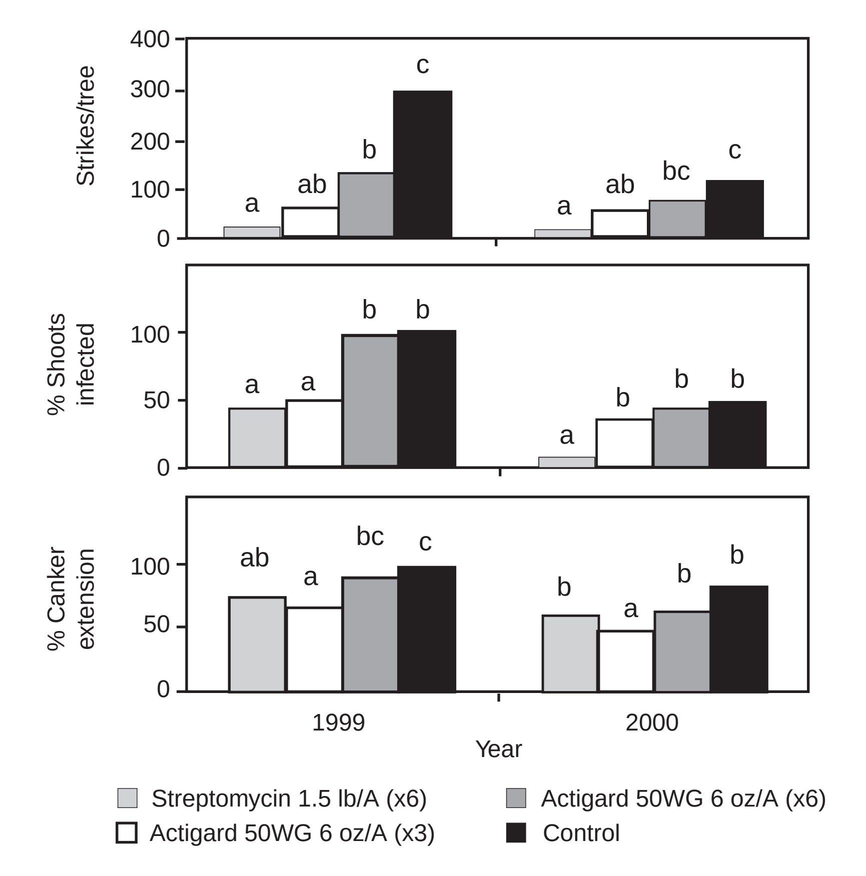


TABLE 1

The effect of Apogee treatments on growth of Jonathan and Golden Delicious apple shoots and on the incidence and severity of fire blight in 1999.

Product and rate/100 gal (number of applications)	Timing	Inoculated shoots[Z] Current growth infected (%)	Inoculated shoots[Z] Control (%)	Blossom and terminal fire blight Strikes/tree on 14 June	Blossom and terminal fire blight Control (%)	Growth rate for shoots (mm/day) at various times after application 17 days	Growth rate for shoots (mm/day) at various times after application 31 days
Jonathan (susceptible variety)							
Apogee 27.5% 12 oz (x1)	10 May	69.6 b[Y]	29.3	22.8 b	53.5	7.2 b	6.3 b
Apogee 27.5% 6 oz (x2)	10, 17 May	92.3 a	9.2	24.8 b	49.9	8.6 a	10.4 a
None	—	98.4 a	—	59.3 a	—	9.0 a	9.4 a
Golden Delicious (less susceptible variety)							
Apogee 27.5% 12 oz (x1)	10 May	25.4 b	50.4	0.5	nd	6.8 c	6.1 c
Apogee 27.5% 6 oz (x2)	10, 17 May	54.3 a	0.0	0.2	nd	8.6 b	8.2 b
None	—	51.2 a	—	1.2	—	9.9 a	10.5 a

[Z]Ten shoots were inoculated on May 27, 1999, with a suspension of *Erwinia amylovora*.
[Y]Means followed by the same letter are not significantly different according to LSD ($P<0.05$).

resistant Golden Delicious. On June 14, significantly fewer strikes per tree were present on Jonathan trees treated with Apogee than on the check trees.

The extension of fire blight in inoculated shoots of the highly susceptible cultivar Jonathan was greater than in shoots of the less susceptible Golden Delicious. On Jonathan and Golden Delicious, the high rate of Apogee reduced the extension of blight in inoculated shoots by 29 and 50% compared to the control, respectively. The half-rate Apogee treatment reduced the extension of blight in inoculated Jonathan shoots by only 9% and was ineffective on Golden Delicious.

When this trial was repeated in 2000 with the addition of Palisade, both Apogee and Palisade reduced the growth of the Jonathan apple trees compared to the untreated control (Table 2). On Golden Delicious, the high rates of Apogee and Palisade were most effective. The addition of ammonium sulfate to Apogee 27.5WG significantly improved growth control over Apogee with Regulaid. When Jonathan shoots were inoculated, Palisade at the high rate gave the best control of fire blight. Apogee applied once at the high rate gave better control of blight on inoculated shoots than two applications at lower rates; the addition of ammonium sulfate improved disease control. On May 30, Apogee and Palisade treated trees had significantly less blossom and terminal blight than the unsprayed check (27% of the terminals on unsprayed trees were infected). The low rate of Apogee applied twice was less effective in controlling blight than the high rate applied once.

INTEGRATING GROWTH RETARDANTS INTO THE FIRE BLIGHT CONTROL PROGRAM

Apogee is the first new compound for fire blight control since the antibiotics and the only compound that we can realistically use to prevent secondary spread of blight. For fire blight control, Apogee should be applied at full bloom to early petal fall and integrated with streptomycin sprays to control blossom blight (Fig. 2). Apogee is **not** a substitute for streptomycin. Ideal timing for Apogee is when the king blooms start to lose their petals. It takes about 2 weeks to see a slowing of vegetative growth. Sprays delayed until normal petal fall will be less effective. Apogee will fit best on vigorous, bearing trees of susceptible cultivars where fire blight is a perennial problem.

New fire blight control chemicals are needed because old control methods with copper formulations can cause fruit russet and resistance to streptomycin, the antibiotic most commonly used for fire blight control, has developed in several states including Michigan. A single, high-rate spray of Apogee significantly increases the resistance of trees to fire blight (3, 7) and enables trees to escape infection during blight-event storms. The effective life of Apogee is on the order of 4 to 6 weeks, depending on tree vigor. In the northeastern United States, one properly timed application of Apogee normally should be sufficient for preventing fire blight spread in the summer but, in areas with a longer growing season, a second application may be needed.

Apogee is not a substitute for streptomycin during bloom for blossom blight control. Streptomycin is needed to prevent blossom infection and to protect shoots until they become resistant within about 2 weeks after a high-rate Apogee treatment. Although Apogee will be used primarily to control shoot blight, the test results reported here indicate a reduction in the severity of blossom blight where Apogee was applied 1 week after a severe infection period which affected both blossoms and shoots.

An interesting result from the 2000

TABLE 2

The effect of Apogee and Palisade treatments on growth of Jonathan and Golden Delicious apple shoots and on the incidence and severity of fire blight in 2000.

Product and rate/100 gal	Timing	Strikes per tree: Blossom blight 30-May	Strikes per tree: Blossom and terminal blight 30-May	Inoculated shoots infected (%)	Terminal growth rate for 30 day (inches/day)	Amount of growth in 30 days (inches)
Jonathan						
Apogee 27.5DF 12 oz + Regulaid 4 fl oz + Ammonium sulfate 12 oz	8-May	3.2cz	6.6b	32.0bc	0.12	3.7b
Apogee 27.5DF 6 oz + Regulaid 4 fl oz	8, 15 May	15.0ab	23.2ab	69.2a	0.18	5.3b
Apogee 27.5DF 6 oz + Regulaid 4 fl oz + Ammonium sulfate 6 oz	8, 15 May	12.8abc	18.6ab	37.9b	0.12	3.6b
Palisade 1EC 0.6 qt	8-May	4.4bc	8.2b	10.0c	0.11	4.2b
Palisade 1EC 0.4 qt + Regulaid 4 fl oz	8-May	4.0bc	6.2b	24.0bc	0.11	4.7b
Unsprayed (check)	—	16.8a	27.8a	70.0a	0.28	8.3a
Golden Delicious						
Apogee 27.5DF 12 oz + Regulaid 4 fl oz + Ammonium sulfate 12 oz	8-May	4.2b		14.0cd	0.10	2.9d
Apogee 27.5DF 6 oz + Regulaid 4 fl oz	8, 15 May	24.6a		63.5a	0.17	5.1c
Apogee 27.5DF 6 oz + Regulaid 4 fl oz + Ammonium sulfate 6 oz	8, 15 May	18.2ab		27.5bc	0.14	4.1cd
Palisade 1EC 0.6 qt	8-May	11.4ab		4.0d	0.11	3.4d
Palisade 1EC 0.4 qt + Regulaid 4 fl oz	8-May	4.4b		16.0cd	0.17	6.9b
Unsprayed (check)	—	10.0ab		44.1ab	0.30	8.9a

[Z]Means within a column followed by the same letter are not significantly different according to LSD (P< 0.05).

study with growth regulators was the discovery that Palisade, a second compound for inhibiting gibberellin synthesis, also controls apple tree growth and suppresses the secondary spread of fire blight. Although more research needs to be done with this compound, it eventually could play the same role as Apogee in fire blight control programs.

PREVENTING ROOTSTOCK BLIGHT

Rootstock blight in high density orchards on M.26 and M.7 rootstocks was a major contributor to the losses suffered during recent fire blight epidemics. Rootstock blight occurs when bacteria move systemically from strikes in the top of a tree, down through healthy parts of the tree, and into the susceptible rootstocks. Infected trees may not be noticed until their foliage turns prematurely red in early fall before harvest. Losses as high as 65 to 85% of the trees have been demonstrated experimentally and were observed in commercial orchards following the epidemic of 2000. The loss of trees of resistant cultivars like Delicious due to rootstock blight greatly compounds the fire blight problem. The following experiment illustrates the severity of this problem and how it can be controlled with fire blight resistant rootstocks.

Trees of Red Fuji and Jonagored on several rootstocks and Gala on M.26 rootstock were established in a replicated planting on the Botany and Plant Pathology Research farm in East Lansing in May of 1996. Geneva 30 (G.30) was included as a resistant rootstock. B.9, M.7, M.9, and M.26 were the other rootstocks included in this study (Table 3). On May 27, 1999, all the trees were inoculated by injecting a suspension of *E. amylovora* into the terminal of the central leader of each tree. The rootstocks were examined on July 15 and again on October 1 for symptoms of fire blight.

The scions of all trees became infected with fire blight following inoculation. About 6 weeks after inoculation several trees exhibited bleeding from the rootstock below the bud union characteristic of systemic infection by the fire blight pathogen. The incidence of rootstock blight was high for Gala and Red Fuji trees on M.26 and for Jonagored on M.9 (Table 3). The incidence of rootstock infection increased with time and in October at least two rootstocks under each scion cultivar were infected except those on B.9 and G.30. In October, many of the trees with infected rootstocks exhibited red discoloration of the foliage while leaves of the other trees were normal.

Infection of susceptible rootstocks following internal movement of bacteria from minor fire blight infections in the scion can cause devastating losses of trees in young orchards. Gala trees grafted on M.26 rootstock were particularly susceptible. In our test, up to 65% of the trees developed rootstock blight in a single season. Rootstock blight was also a significant problem on trees propagated on M.9 and M.7 rootstocks. Although B.9 is considered fire blight susceptible (6), none of the trees propagated on B.9 died from rootstock blight. Blight-resistant rootstocks, as illustrated by the G.30 rootstock in this experiment, are an excellent solution to the rootstock blight problem. This experiment illustrates the value of resistant rootstocks and the need for work on new fire blight resistant rootstocks.

FIGURE 2

Integration of Apogee with streptomycin during the bloom period for fire blight control. Streptomycin is used for the control of blossom blight while Apogee controls vegetative growth which inhibits secondary spread of fire blight from infected spurs to the new shoots.

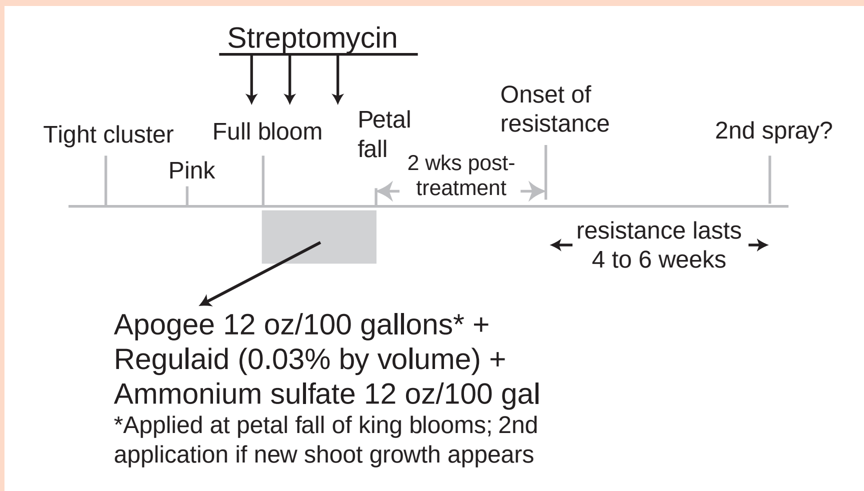


TABLE 3

Frequency of trees with rootstock infection following inoculation of the scions of 3-year-old trees with the fire blight pathogen ***Erwinia amylovora***.

		Trees with rootstock blight			
		July 15, 1999		October 1, 1999	
Scion/rootstock^{Z}	Trees (no.)	Number	Percent	Number	Percent
Red Fuji/Geneva 30	29	0	0.0	0	0.0
/M.7	29	0	0.0	2	6.9
/M.26	29	7	24.1	13	44.8
Jonagored/Geneva 30	28	0	0.0	0	0.0
/B.9	28	0	0.0	0	0.0
/M.7	27	0	0.0	2	7.4
/M.9	29	4	13.8	5	17.2
/M.26	29	0	0.0	4	13.8
Ultrared Gala/M.26	26	13	50.0	17	65.4

^{Z}Trees planted on May 6, 1996. Inoculated with fire blight on May 27, 1999.

FUTURE RESEARCH—BOOSTING APPLE'S NATURAL RESISTANCE

A new method for boosting the natural resistance of apple trees to fire blight with a commercial compound (Actigard) that closely resembles common aspirin has been under development at Michigan State for 2 years (4). It is opening up an exciting new approach to the control of several plant diseases including fire blight. Actigard was recently registered as a disease control product on tobacco and some vegetable crops; registration on apples is not expected for 2 to 3 years.

Two Actigard (acibenzolar-S-methyl, CGA-245704) treatment schedules were compared to a standard streptomycin treatment in a block of 28-year-old Jonathan apple trees. Treatments were replicated three times in 1999 and four times in 2000. Actigard 50WG at 2 oz per 100 gal of spray was applied on weekly and biweekly schedules; both schedules were initiated at pink. Streptomycin was applied twice in bloom and weekly thereafter at 8 oz per 100 gal of spray. Trees were sprayed to runoff with a handgun.

A severe storm with rain and high winds on May 17, 1999, was associated with an outbreak of trauma blight. Total strikes per tree from the trauma blight infection period were counted on June 1 and 2. An outbreak of trauma blight also occurred early in the 2000 trial. In addition to rating natural infections, the efficacy of Actigard was evaluated each year by inoculating 25 shoots per tree by cutting two immature leaves per shoot near the growing tip with scissors dipped in a suspension of *E. amylovora*. Inoculated shoots were evaluated for infection and the percent of shoot growth that was infected was calculated by dividing lesion length by shoot length.

In studies on Jonathan apple trees in 1999 and 2000, Actigard significantly reduced the incidence of fire blight following natural infections associated with storms at petal fall (both blossom blight and trauma blight) (Fig. 1, top). Actigard applied twice before and twice after the storms (weekly schedule) significantly reduced the incidence of infection compared to the control, but disease incidence was not reduced significantly when Actigard was applied only once before and once after the storms (biweekly schedule). Interestingly, streptomycin was the most effective treatment.

Actigard applied weekly three times before inoculation and three times after inoculation significantly reduced the percent of inoculated shoots with fire blight infections in 1999, but not in 2000 (Fig. 1, middle). In both years the extension of fire blight in infected shoots treated weekly with Actigard was less than that observed in the control (Fig. 1, bottom). Here again, biweekly applications of Actigard did not reduce fire blight in the inoculated shoots compared to the control (Fig. 1, middle and bottom). Streptomycin applied twice in bloom and weekly thereafter also reduced the percentage of shoots with fire blight in both years, but it affected only lesion expansion in 1999.

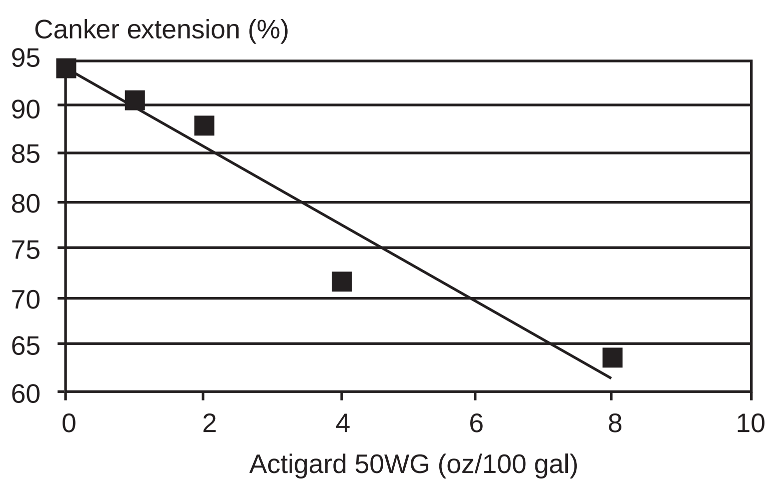
Although these experiments clearly demonstrate that Actigard can boost the natural resistance of apple trees to fire blight, control was no better and often poorer than with streptomycin. Control may improve with higher rates of Actigard. To test the rate-effect of Actigard on fire blight control, Fuji trees were sprayed on weekly schedules with increasing concentrations of Actigard 50WG (0 to 8 oz per 100 gal of spray) and then the shoots were inoculated with fire blight bacteria. The distance that the fire blight cankers advanced from the point of inoculation was directly related to the application rate (Fig. 3). The highest rate tested (8 oz/100 gal) was the most effective, significantly more effective than the 2 oz rate used in the Jonathan trial described above. It remains to be determined if higher rates of Actigard will be as effective for blight control as streptomycin.

Actigard exhibited excellent activity against fire blight under very favorable blight conditions in the East Lansing area of Michigan during 1999 and 2000. Actigard only recently was reported to have activity against fire blight (1, 5), but further research is needed to define application rates and frequency for this compound. The weekly spray schedule was more effective than the biweekly schedule, suggesting that Actigard will need to be applied frequently for best results. Unlike streptomycin which is typically applied during the bloom period, Actigard treatments were started at pink. Early treatments are probably needed to allow sufficient time for induction of the plant's natural defense mechanisms against infection by the fire blight pathogen.

As noted earlier, Actigard brings about control by modifying the plant's natural resistance. Understanding the physiological and molecular basis of how Actigard boosts the resistance of apple to fire blight could lead to other fire blight management strategies in the future. For example, a gene has been isolated from apple by Michigan State scientists that switches several of the tree's defenses into action when it is attacked by fire blight. This is the same gene that is stimulated by spraying apple trees with Actigard. The goal of current research is to enhance the gene and place it back into apple with the expectation that this will result in fire blight-resistant apple trees.

FIGURE 3

Relationship of the extension of fire blight cankers in 1-year-old Fuji apple shoots to the rate of Actigard applied weekly beginning 8 days before inoculation.



REFERENCES

Brisset, M.-N., S. Cesbron, S.V. Thomson and J.-P. Paulin. 2000. Acibenzolar-S-methyl induces the accumulation of defense-related enzymes in apple and protects from fire blight. Eur. J. Plant Pathol. 106:529-536.

Evans, J.R., R.R. Evans, C.L. Regusci and W. Rademacher. 1999. Mode of action, metabolism, and uptake of BAS 125W, prohexadione-calcium. HortScience 34:1200-1201.

Fernando, W.G.D. and A.L. Jones. 1998. Field evaluation of BAS 125W for fire blight management in 1997. Fungicide and Nematicide Tests 53:5.

Maxson, K. L. 2000. Resistance against *Erwinia amylovora* induced in apple trees by acibenzolar-S-methyl. M.S. Thesis. Department of Botany and Plant Pathology, Michigan State University, East Lansing. 55 pages.

Thomson, S. V., S.C. Gouk and J.P. Paulin. 1999. Efficacy of Bion (Actigard) to control fire blight in pear and apple orchards in USA, New Zealand and France. Acta Hort. 489:589595.

van der Zwet, T. and S.V. Beer. 1999. Fire blight—Its Nature, Prevention, and Control: A Practical Guide to Integrated Disease Management. U.S. Department of Agriculture, Agriculture Information Bulletin No. 631. 91 pp.

Yoder, K.S., S.S. Miller and R.E. Byers. 1999. Suppression of fire blight in apple shoots by prohexadione-calcium following experimental and natural inoculation. HortScience 34:1202-1204.

This research is supported in part by the Michigan Apple Research Committee and the USDA/CSREES Special Grant.

DR. GREG LANG
OUTSTANDING EDUCATOR OF THE YEAR

Dr. Greg Lang received the Outstanding Educator of the Year award at the February 2001 annual meeting of IDFTA. He is an Ohio native raised in Georgia, educated in horticultural science at University of Georgia and in pomology and plant physiology at the University of California-Davis.

Dr. Lang has served as Assistant/Associate Professor of pomology at Louisiana State University, Associate Professor of stone fruit physiology and genetics at Washington State University and presently is Professor of pomology at Michigan State University.

At WSU, he was program leader in cherry research (horticulture, physiology, and breeding), during which time he became involved in IDFTA, particularly emphasizing research on new dwarfing sweet cherry rootstocks, adaptation of cherries to high density training systems, and sweet cherry cropping physiology and growth regulation.

At WSU, he fostered a broad, collegial, "team" approach to cherry research, with numerous collaborations among outstanding graduate students and regional, national and international scientists, resulting in his authoring or co-authoring more than 50 scientific and grower-oriented cherry research papers from 1995-2001. Among Dr. Lang's collaborations, those with Bill Howell at WSU-Prosser to document the pollen-borne virus sensitivity of many new cherry rootstocks have had a clear and immediate impact on cherry growers and nurseries at the forefront of these new plant materials.

Building upon such predecessors as Ed Proebsting and Tom Toyama, Dr. Lang's WSU program also released three new sweet cherry varieties (Tieton, Columbia, and Liberty Bell), a plum variety (Autumnsweet), and two apricot varieties, and began documentation of pollenizer compatibilities and graft incompatibilities of earlier new varieties (such as Chelan) and their performance on new rootstocks.

His WSU research group also discovered the first gene for resistance to cherry powdery mildew and, in collaboration with Dr. Jim Flore of MSU, became the first to design and apply whole-canopy photosynthetic measurements to Pacific Northwest orchard research problems.

Dr. Lang has served as Cherry Working Group Chair-Elect of the International Society for Horticultural Science and co-convener of the 4th International Symposium on Cherry Production, as well as an invited speaker internationally (North America, Europe, Australia, New Zealand, and Chile) on cherry research and production.

At MSU, he is continuing similar areas of research interest, particularly in sweet and tart cherry growth, development, rootstocks, and cropping physiology.

He has been a strong supporter of the IDFTA educational mission and has been an energetic proponent of dwarfing cherry rootstocks at IDFTA conferences and tours.

DR. JAMES FLORE
OUTSTANDING RESEARCHER OF THE YEAR

Dr. James Flore received the Outstanding Researcher of the Year award at the February 2001 annual meeting of IDFTA. Dr. Flore, a native of Benton Harbor, Michigan, earned bachelor's, master's and Ph.D. degrees from MSU. He is known for his work in the environmental and physiology and pathology in fruit crops and the study of photosynthesis in fruit trees. He has done research on cherry cracking and he has evaluated ways to decrease chemical inputs. He is considered one of the movers in MSU's GREEN initiative to reduce growers' dependence on chemicals and to add value to crops that are grown. As an educator and researcher, he has supported the goals of IDFTA to keep growers informed of the latest developments in fruit tree management.