Controlling Shoot Blight with 'Apogee'

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A new growth regulator named Apogee, which controls excessive shoot growth and reduces the need for summer pruning, may have an additional valuable use in controlling shoot fire blight infections of both young and mature apple and pear trees. This should help reduce the risk growers face when planting new varieties and dwarfing rootstocks that are extremely susceptible to shoot blight and rootstock blight.

Infection of vegetative apple shoots with fire blight (*Erwinia amylovora*) can cause devastating losses to apple and pear growers following hail storms, severe wind storms, or when blossom fire blight is not controlled. Shoot blight is especially dangerous with many of the most popular new apple varieties (Gala, Gingergold, Fuji, and Pink Lady) and with the dwarfing M.9 and M.26 rootstocks. A recent example occurred in May 1998 when a severe wind storm hit the Grand Rapids area of Michigan. Several hundred acres of trees were blown down but the epidemic of shoot fire blight that followed killed 2000 acres of trees (Phil Schwalier, personal communication). Many of the losses were with dwarf, high-density orchards. A similar storm hit New York State on Labor Day 1998, and significant fire blight outbreaks followed, especially in nursery trees that were still growing vigorously at that time.

Vigorously growing shoots are much more susceptible to infection with fire blight than shoots that have ceased growth. This has led pear growers in New York to maintain orchards in a low state of vigor to try to avoid vigorous shoot growth and thus fire blight epidemics. Thus, it seems reasonable that chemical growth regulators that control vegetative shoot growth, such as Apogee, would make the shoots less susceptible to fire blight.

Apogee (Prohexadione-Calcium) is a new growth regulator being developed by BASF Corporation for use on apples and pears. It will be registered for use in the 2000 season. Its primary horticultural benefit is a reduction of shoot growth. Apogee inhibits the synthesis of the growth promoting plant hormones, gibberellins, thus reducing shoot growth. In trials at Geneva with McIntosh in 1997, 1998, and 1999, shoot growth was reduced from 18 inches average shoot length to ten inches average shoot length or about a 40 percent reduction (Table 1). This reduced the need for summer pruning to get good color on McIntosh. In our trial we did not summer prune the trees and there was an increase in red color of fruit from 38 to 55 percent. Apogee will be marketed as a chemical method of reducing the need for summer pruning on vigorous cultivars. A secondary horticultural effect is that Apogee increases fruit set. In many cases this is an unwanted side effect since we usually need to reduce cropload to achieve proper fruit size. Thus, Apogee treated trees generally have slightly smaller fruit size unless they are thinned aggressively.

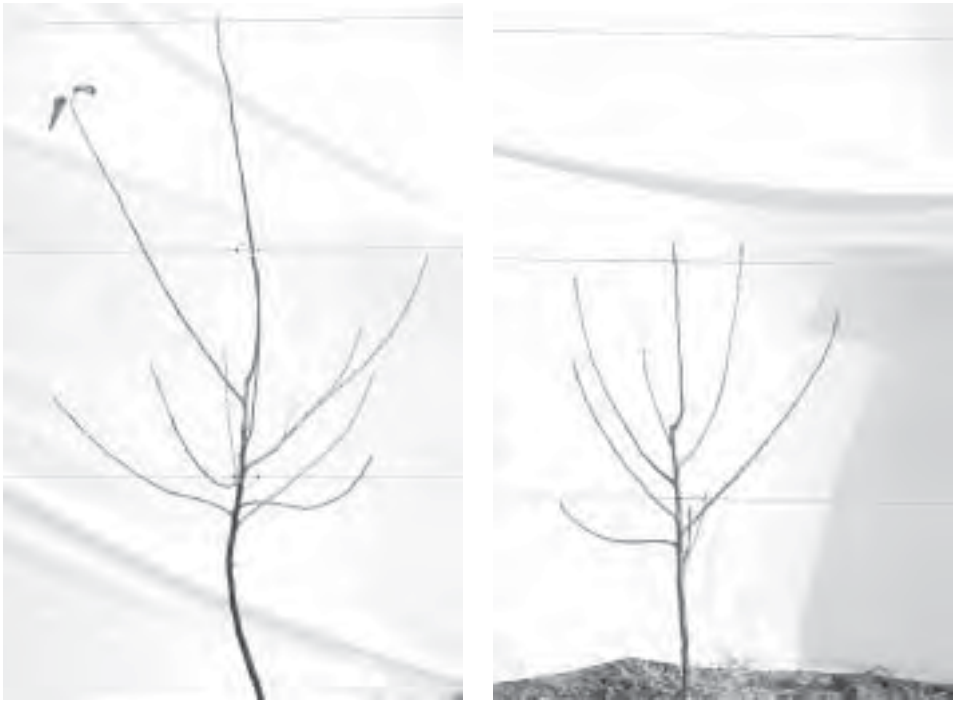
We have also shown experimentally that Apogee limits fire blight development in apple shoots. Several recent reports confirm that Apogee reduces the secondary spread of fire blight to vegetative shoots by controlling shoot growth (Breth et al., 1998; Yoder et al., 1999). Trials conducted during 1995 at Kearneysville with a single application of Apogee at 250 ppm or two applications at 125 ppm reduced shoot growth and resulted in 40-58 percent reduction in number of fire blight strikes per tree (Yoder et al., 1999). Trials in Michigan with Jonathan (susceptible variety) and Golden Delicious (moderately resistant variety) showed 30 and 50 percent control of shoot blight respectively, in Apogee treated trees, compared to untreated trees. Recent work by Jones et al. (1999) showed that Apogee can be used with streptomycin to achieve good control of both blossom and shoot blight. In their trial, streptomycin was used

TABLE 1

Effect of Apogee on tree growth of 20 year old 'McIntosh/M.9' apple trees. (1997)

Treatment[z]	Apogee Application Rate (mg a.i./l)	Application Dates[z]	Total Shoot Growth (cm)	Cropload (fruit number/cm² TCA)	Fruit Size (g)	Fruit Red Color (%)
Untreated Control	—	—	45 a	0.83 a	136 a	38 b
Two Applications	125	1,2	25 b	0.89 a	129 ab	50 a
Single Application	250	1	26 b	1.08 a	122 b	58 a

[z]1= June 4, 2= June 13.



These GingerGold trees are at the end of the first year. The tree on the left was untreated and the tree on the right was treated with Apogee in July.

TABLE 2

Effect of Apogee on tree growth and fire blight infection of inoculated 'Gingergold/M.9' apple trees in their first year (1999).

Treatment[z]	Apogee Application Rate (mg a.i. / l)	Applications[y]	Central Leader Growth after Treatment Date (cm)	Total Shoot Growth after Treatment Date (cm)	Disease Severity (%)[x]
Untreated Control	—	—	26.5 a	109.0 a	34.4 a
Multiple Low Doses	62.5	1,2,3,4	9.2 b	51.1 b	2.2 b
Standard Dose 2 times	125	1,3	9.5 b	32.7 b	0.6 b
Single High Dose	250	1	7.7 b	28.8 b	4.6 b

[z] All spray treatments were tanked mixed with the surfactant "Kinetic" (0.63 ml / l)

[y] 1= July 12, 2= July 19, 3= July 26 and 4= Aug. 2

[x] Shoots were inoculated on August 6. Disease severity (% of shoot length infected with fire blight) was recorded on Oct 27.

to prevent blossom blight infection, was followed by Apogee at petal fall to control shoot blight. In addition to controlling shoot growth and fire blight, Apogee has also shown pronounced effects on the incidence of apple scab in experiments in Europe (Rademacher et al., 1999). This effect is apparently not due to any fungicidal or bactericidal effects of Apogee, but to the induction of natural defense compounds.

Use Of Apogee On Young Trees

Apogee has no effect on blossom blight infection and will not protect young trees from infection during bloom. However, removal of blossoms in the first and second year is a suitable management strategy for control of blossom blight. Apogee's use on young trees will be limited to summer shoot blight control. With young apple trees the dilemma in developing a use strategy for Apogee is that although Apogee may limit fire blight susceptibility, it may also limit tree canopy development, which is counter to the horticultural goal of rapidly filling the space to get a return on the investment. With mature trees, Apogee must be applied at petal fall or soon after to have a major effect on shoot growth, but with young trees, such an early application timing will cause too much growth inhibition. Therefore, later timings are probably more suitable.

In 1999, we began an experiment to determine if a use strategy for Apogee could be developed whereby significant fire blight protection could be achieved without sacrificing tree growth or yield. Our first year results were very promising. On first year GingerGold/M.9 trees Apogee provided excellent fire blight protection when applied in early August (Table 2). However, it also caused more growth reduction than optimal from a horticultural perspective. The economic effect of the growth reduction from Apogee may yet prove to be positive if the untreated trees die or have to be pruned severely to save them. A possible strategy for growers to use on young trees that are at risk of fire blight would be to wait until much of the current season's shoot growth is developed before treating with Apogee in early July. This will then provide significant fire blight protection from devastating late-season shoot blight infections caused by hail storms or wind storms. Further work is needed on even lower rates and other timings than those used in this study to determine if lower rates will allow better tree growth while still providing fire blight protection.

Shoot Blight Control In Older Trees

With mature trees, in general, Apogee must be applied at petal fall or soon after to have a major effect on shoot growth. The chemical will begin to affect shoot growth about ten days after application, and the duration of the effect depends on dose and tree vigor. A low dose controls growth for only about three to four weeks, while a high dose may provide season- long control in New York. Our suggested application strategy on mature trees is to apply two sprays, with the first spray at petal fall when shoot growth is about two to three inches long. A second application would come about two to three weeks later. On weaker-growing cultivars only one or two applications may be required while on vigorous soils and vigorous cultivars three applications may be needed.

During 1998 and 1999, the efficacy of Apogee against infection of shoots by fire blight was evaluated on 'Idared' trees in a research orchard at Geneva. In 1998, Apogee (250 ppm) was applied twice (2.5-5 in and 6-8 in of new shoot growth) followed by inoculation two weeks later. Following the treatments, 20 growing tips of current season shoots from each tree were inoculated with fire blight bacteria. Six weeks after inoculation the lengths of necrotic infection and total length of the shoot, including the infected length, was

measured. The Apogee treated trees that showed only 8.4 percent of current shoot length was infected compared with 60 percent in untreated trees (Table 3).

In 1999, two sprays of Apogee at two concentrations (125 and 250 ppm) were applied five days after petal fall and again two weeks later to mature Idared trees. In separate treatments, Apogee was applied at 250 ppm a week before inoculation and ten days after inoculation to determine if there was any post-infection curative effect. Shoots were again inoculated as in 1998, and lesion length as a percentage of total shoot length was measured six weeks later. Empire trees were also inoculated as an untreated moderately resistant check. In 1999, the best Apogee treatment showed 36 percent of shoot length infection compared to 89 percent in the untreated Idared trees (Table 4). Control of shoot blight was not significantly different at lower or higher concentrations if Apogee was applied before infection. If Apogee was applied ten days after infection, there was less control than when applied before infection. Early application of Apogee, prior to the development of fire blight, appears to be critical for optimal control of shoot blight.

White arrows indicate trees that are untreated and black arrows indicate Apogee treated tops.

Summary

Apogee will likely prove to be very useful in the control of shoot blight on susceptible varieties and with susceptible rootstocks. Although blossom blight is often controllable with bactericide sprays, summer shoot blight and rootstock blight are often not controlled well with bactericides. Apogee offers an improved control method for shoot blight on both mature trees and on young apple trees of highly susceptible cultivars. In addition, induction of defenses and compatibility with other disease control agents makes Apogee a prime candidate for the integrated management of fire blight of apple. The primary horticultural benefit of Apogee is reducing shoot growth in vigorous trees. It may also have a secondary benefit of improving spray coverage because of more open canopies. In addition, treated orchards may require fewer gallons of spray per acre, which will reduce the amount of other chemicals used.

TABLE 3

Effect of Apogee on shoot blight control in mature 'Idared/M.7' trees. Geneva , NY, 1998.

Treatment/Product	Rate/50L	Time of Application[1]	% Blighted Shoot Length[2]
Untreated inoculated control			59.6 ab
Untreated non inoculated control			0.0 d
Empire (inoculated)			38.2 c
Agrimycin 17	29.5 g	3	36.6 c
Apogee	45.5 g	1,2	8.4 d
Apogee non inoculated	45.5g	1,2	0.0 d

[1] 1 = 2.5-5 in of current shoot growth, 2 = 6-8 in of current shoot growth, 3 = 24 h before inoculation.

[2] Treatments followed by the same letter did not differ significantly (P=0.01) as determined by Waller grouping.

TABLE 4

Effect of Apogee and other treatments on shoot blight control in 'Idared/M.7' trees. Geneva , NY, 1999.

Treatment	Rate/50L	Surfactants (rate/50L)	Time of application[1]	% blighted shoot length[2]	% russeted fruit[2]	% russeted fruit surface[2]
Untreated control				89.7 a	0.2 c	1.0 bc
Empire (inoculated)				7.2 g		
Pace 17	14.7 g	Regulaid 15 ml	4,5	35.2 f	0.3 c	0.5 c
Agrimycin 17	14.7 g	Regulaid 15 ml	4,5	39.9 ef	0.0 c	0.0 c
Apogee	22.4 g	Kinetic 31 ml	1,2	47.2 cdef	0.3 c	0.7 bc
Apogee	44.8 g	Kinetic 31 ml	1,2	47.5 bcdef	0.0 c	0.0 c
Apogee	44.8 g	Kinetic 31 ml	3	35.9 f	0.5 c	0.5 c
Apogee	44.8 g	Kinetic 31 ml	6	60.0 bc	0.2 c	1.0 bc

[1] 1 = Petal fall + 5 days (May 21), 2 = 2 weeks after #1 (June 4), 3 = 1 week before inoculation (11 June), 4 = 24 h before inoculation (16 June), 5 = 24 h after inoculation (18 June), 6 = 10 days after inoculation.

[2] Treatments followed by the same letter do not differ significantly (P>0.05).

References

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