



## AFRS Fruit Update



*Recent research at the  
Appalachian Fruit Research Station  
Kearneysville, WV*

**December 10, 2007**

### **Apogee®- Many Beneficial Effects from One Product**

Apogee® (prohexadione calcium) is a plant growth regulator that was approved for horticultural use in the U.S. in 2000. Dr. Stephen Miller and later Dr. Jay Norelli at AFRS contributed to the development of the program of its use on apples with BASF Corp., Agricultural Products Division along with colleagues at several state experimental stations.



Untreated

Treated

Apogee® acts by blocking the production of the plant's own growth hormones. In the Eastern U.S., growing conditions favor vegetative growth. By reducing the amount of vegetative growth, more energy can be directed into the fruits. Spraying shortly after petal drop and then 2 weeks later is sufficient to reduce total growth by 20%-60%. It degrades in the tree within a few weeks so additional applications may be needed to achieve the desired result. By controlling new shoot growth in apples, Apogee® helps

growers save time and money spent on pruning, and it makes thinning and harvesting easier. A more open canopy can also improve fruit color in red varieties. Because of reduced shoot growth, Apogee® reduces aphid populations on the tree, decreasing the need for one or more pest sprays. Apogee® has shown no effect on return bloom or negative effects on fruit quality following spray treatment. In some tests Apogee® has demonstrated yield increases up to 21% in treated trees.

Another benefit of Apogee® is its ability to suppress the shoot blight phase of fire blight (*Erwinia amylovora*) when applied at 250 mg/L for young trees. Because it takes several days for Apogee to decrease plant susceptibility, optimum effectiveness occurs about 10 days after spraying. If there is a fire blight outbreak ongoing, Apogee may not be effective. Two Apogee sprays significantly reduced the number of fire blight strikes in a year with heavy fire blight infection pressure.



Recent evidence indicates that trees sprayed with Apogee® develop natural chemicals within their tissues that may provide greater resistance to disease and insects.

A potential negative side effect is a significant increase in fruit set and a corresponding decrease in fruit size, requiring an aggressive thinning program. Additionally, Apogee® was shown to cause fruit cracking on Empire and Stayman apples, which led to a label caution statement.

BASF Corporation markets Apogee®.

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### Genetic manipulation to resist fire blight on apple

The work of Dr. Jay Norelli and cooperators on the response of apples to fire blight shows promise in being able to control the disease in the future. Fire blight is a disease caused by the bacterium *Erwinia amylovora* that has been typically controlled by the use of antibiotics. This presents several problems with regard to timing, weather, as well as introducing antibiotics into the environment. Bloom is a critical time for fire blight infection, especially when the flowers are wet and conditions are warm.



When apples are initially exposed to fire blight several apple genes are shut down and some are activated, compared to uninfected trees. It is not known which of these genes are responsible for resistance or susceptibility in this response, but the genes that react to fire blight provide a starting point for identifying 'candidate' resistance genes. This set of several hundred genes were analyzed to identify a few dozen 'candidate' resistance genes. An event

called 'gene silencing' occurs when extra copies of a gene are inserted into cells and results in expression of that gene being shut down. Gene silencing is being used to determine if the 'candidate' resistance genes are actual resistance genes. If a gene associated with the infection process could be 'down regulated' perhaps resistance would be conferred on the cells. Because the target of this resistance is specific, it is expected to be innocuous to other bacteria that may live on apple. A resistance assay was developed to rapidly screen apple transgenic cells for changes in resistance and susceptibility to fire blight after gene silencing. Work is ongoing.

If a rootstock could be transformed to resist fire blight by gene silencing perhaps scions grafted onto it might obtain some immunity by transfer of compounds through the vascular tissue (graft transmissible). This would be useful because the fruit and pollen would not be genetically modified but would reap the benefits of the transformed rootstock. This 'graft transmissibility' has been demonstrated in tobacco & sunflower with various marker genes.



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## Bio-Save® - Post harvest Bio-Control Protection for Fruits and Vegetables

Bio-Save® is a bacterium based product which after application to fruit can protect fruit wounds from infection by decay causing fungi. The bacterium is a non-pathogenic strain of *Pseudomonas syringae* (strain L-59-66) which was developed as biocontrol agent by Dr. Wojciech Janisiewicz and commercialized by EcoScience Corp (Orlando, FL) after large scale testing in various packinghouses and research facilities. In 1995 the EPA registered Bio-Save®.

Application of Bio-Save® followed by a wax coating does not degrade Bio-Save. The level of efficiency is linked to how quickly after harvest the produce is treated with Bio-Save®. It can be applied to fruit as drench or in a wash tank (1 gallon will treat 100 cartons of apples).

Bio-Save® controls *Penicillium expansum* (blue mold) *Mucor piriformis* (mucor rot), and *Botrytis cinerea* (gray mold) on apples and pears. It has also been shown to be effective against *Fusarium* dry rot, and silver scurf on seed potatoes. Another strain of *Pseudomonas syringae*, isolated subsequently by EcoScience Corp., has also been included in formulations of Bio-Save®. Currently, in addition to apples and pears, Bio-Save® has been used on citrus, cherries, potatoes, and sweet potatoes to control variety of postharvest diseases.

Bio-Save® is the only product that is registered for postharvest treatment on sweet potatoes designated for export to Europe.



Increased use of Bio-Save® for control of postharvest decays has been ongoing since its introduction in the mid 90s. Currently, approximately 4 to 8 million cartons of pear and apple, approximately 8 million lugs of cherry, 1 million cartons of citrus, and 3 million sacks of potato are treated with Bio-Save® annually. Bio-Save® is listed by the Organic Materials Review Institute (OMRI) for use in organic production and fruits can be shipped internationally as it has no requirement for maximum limits for pesticide residues (MRL).

This bacterium can also inhibit growth of human pathogens, such as *E. coli* O157:H7, on apple.

The mechanism of biocontrol of this antagonist has not been fully described but competition for limited nutrients and space appears to play the major role. This biocontrol agent has only preventative activity and is not effective against existing infections. In years with high field infection rates, biocontrol will be most effective as a part of an integrated control strategy, which can also include reduced doses (one tenth of the recommended rate) of fungicides, calcium and heat treatments. Good sanitary practices are also very important as the efficacy of these methods decreases with increasing fungal spore loads.

JET Harvest Solutions Co. (Longwood FL) currently markets Bio-Save®.

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