Biologically intensive pest management: Iowa apple growers take the next step toward sustainability

Abstract: Iowa growers have made strides in decreasing chemical use in their apple production. However, demands of the marketplace and regulatory agencies mean that growers need to investigate ways to further reduce pesticide use, potentially through biologically intensive pest management.

Background

Apples are the Iowa horticultural crop with the most intensive pesticide use. According to a 1996 survey of 300 Midwest growers, including Iowans, the average apple grower makes 20 applications of synthetic chemical pesticides per season to control insects and diseases.

While integrated pest management tactics have increased efficiency for apple growers, pressure to make deeper cuts in pesticide use is growing. In addition, pests and diseases are becoming resistant to many pesticides. Yet apple growers are still expected to produce blemish-free apples for sales. Growers are being challenged to do the same with less, providing excellent pest control yielding a perfect product while using fewer pesticides.

Biologically intensive pest control may replace or reduce the need for chemical pesticides by defeating pests in other ways, for example through genetic resistance to diseases and the release of pheromones to disrupt insect mating. A team of Iowa State University research and extension specialists worked with Iowa apple producers to test some promising biologically intensive pest control tactics.

Project objectives were to:

- Compare winter hardiness and fruit yields, quality, and consumer acceptability of 13 cultivars of scab-resistant apples to standard, scab-susceptible varieties.
- Evaluate efficacy of the following tactics: a) an insect growth regulator for codling moth control, b) a disease-warning system for sooty blotch/flyspeck control, c) fruit bagging for sooty blotch/flyspeck control, and d) a postharvest chlorine dip for eradication of sooty blotch/flyspeck symptoms.
- Estimate the cost and return from each of the tactics in Objectives 1 and 2 shown above.
- Help 10 percent of Iowa apple growers gain hands-on experience with biologically intensive methods in cooperative field trials.
- Through an intensive education and demonstration program, and help 75 percent of Iowa growers to increase their understanding of biologically intensive pest-management methods; so that 30 percent of growers indicate increased willingness to try these methods by the end of the project.
- Educate at least 200 Iowa citizens about disease-resistant apple cultivars through taste tests at farmers markets.

Approach and methods

Researchers decided to focus on three of the worst pest scourges in Iowa orchards: apple...
scab, codling moth, and the sooty-blotch/fly-speck disease complex. At the ISU Horticulture Farm near Ames, the research team evaluated yield and fruit quality of 13 new apple cultivars that are genetically immune to scab.

Two tactics were tested against the blemishing diseases sooty blotch and flyspeck, which are caused by fungi that attack the surface of apples. One method used weather information to help decide when, and if, to spray fungicides. Cooperating commercial apple growers around Iowa tried out the sooty blotch/fly-speck warning system in their own orchards. Dipping fruit in a weak solution of chlorine bleach after harvest to clean off the sooty blotch and flyspeck fungi was another method tested to stem the disfiguring diseases.

Insect growth regulators (IGRs) were substituted for conventional insecticides to achieve codling moth control. IGRs cause codling moths to molt at the wrong time—a fatal error for those insects.

Results and discussion

In the two-pronged attack on sooty blotch and flyspeck, both practices showed promise. In three years of trials at the ISU Horticulture Farm, the weather-based warning system that told growers when to spray fungicides saved one to four sprays per season compared to standard practices, with no added fruit damage. The bleach dip method worked so well that almost all of the fungal blotches and specks came off, raising the market value of the apples.

In commercial orchards, the sooty blotch/fly-speck warning system was successful in most cases but exhibited several failures compared to the university trials. Risk factors for the warning system were identified to make it more reliable for growers.

The evidence about the value of using IGRs to control codling moth was inconclusive. In three years of tests at the ISU Horticulture Farm only minimal populations of the codling moth were insufficient to evaluate the new strategy.

The researchers conducted taste panels of apple consumers at ISU and at the Des Moines Farmers Market to judge the consumer acceptance of the scab-resistant cultivars. They compared the flavor, texture, and eye appeal of these cultivars to varieties commonly sold in supermarkets. Several of the scab-immune varieties did as well or better in these consumer-preference tests than standards such as Red Delicious, Gala, Jonathan, and Fuji. The test varieties also yielded well.

Conclusions

Disease-resistant apple cultivars suitable for commercial production in Iowa were identified. Redfree, Goldrush, and Liberty were highly rated on quality and yield evaluations. (Both Redfree and Liberty apples are grown organically in Iowa.) Liberty had an added advantage because its resistance to disease is very broad, including fire blight and cedar-apple rust as well as scab. Because of its long growing season, Goldrush should be planted only in the southern half of Iowa.

The warning system for sooty blotch and fly-speck was shown to be a viable tactic for controlling these diseases in Iowa, with the support of related management practices. Among them were use of dwarf or semi-dwarf trees, thorough annual pruning, proper thinning of fruit loads, dilution (rather than concentration) of spray, mowing of brambles, and prompt response to the second-cover fungicide spray advisory which is based on weather information gathered in the orchard.
Remotely estimated weather data can be substituted for on-site weather measurements to make the sooty blotch/flyspeck warning system more convenient to operate. The remote estimation system will operate more efficiently when a model is developed to calibrate its wetness estimates to conditions beneath a tree canopy.

Postharvest dip treatments in dilute, buffered chlorine bleach reduced severity of sooty blotch and flyspeck symptoms by up to 89 percent and raised the USDA market grade of apples. Chlorine concentration appeared to be more important than treatment time in 1999 trials.

**Potential impact of results**

The project yielded favorable results in these areas:

a) Increased planting of disease-resistant apple cultivars in Iowa orchards. The field and laboratory results showed that certain disease-resistant cultivars survive reliably, yield well, and are highly rated by consumers.

b) Adoption of a weather-based warning system, and associated cultural practices, for management of sooty blotch and flyspeck in Iowa orchards. Project results showed that this system could operate reliably and save one to four fungicide sprays per season in Iowa. The variable results in on-farm demonstrations indicated the need to refine recommendations for growers, and then generated suggested management practices to make adoption easier. The most difficult recommendation to follow calls for diluted rather than concentrate-volume spraying.

c) Application of remote-estimated weather data to pest-warning systems. Data from these tests have the potential to jump-start grower adoption of many weather-based IPM systems, e.g., for insects (degree-day systems), diseases, etc., because the data are easily accessible and convenient.

d) Incorporation of postharvest dip treatments into management of sooty blotch, flyspeck and E. coli on apples. Market grade of fresh apples can be improved dramatically by postharvest dip treatments in dilute chlorine bleach. The dip process also shows excellent potential to reduce E. coli on apples and is an affordable technology for the small-scale apple growers typical in Iowa.

**Education and outreach**

The take-home messages from the research were summarized for apple growers in a 13-minute videotape, “New ideas in integrated pest management for apple growers,” which was prepared at the end of the project. Three hundred copies were produced and distributed free of charge to growers in the Midwest. (Copies of the videotape are available from Mark Gleason.)

Three refereed journal articles are in progress. An ISU Extension publication on growing apples with minimal use of pesticides will be available before the start of the 2001 growing season. Two grower information pamphlets distributed at field days covered treatments for the sooty blotch/flyspeck diseases.