Evaluating Alternative Pest Management Strategies for Organic Apple Production: On-Farm Trial, Adel, IA–2008

Kathleen Delate, associate professor
Departments of Horticulture and Agronomy
Maury and Mary Wills, Wills Family Orchard, Adel, Iowa

INTRODUCTION

Organic apple production reached 12,772 acres in the U.S. in 2005 (USDA–ERS, 2009). Organic apple growers have requested assistance from universities and research institutes to address key production and postharvest issues for their industry. Concerns for environmental health, food safety and food quality have motivated consumer demand for organic products (O.T.A, 2005; Reganold et al., 2001), and new organic pest and disease management strategies, improved orchard management practices, and marketing incentives, particularly in the European Union have increased supply of organic apples (Weibel, 2001). Key issues for organic fruit growers include selection of cultivars that are traditionally developed (non-genetically modified) in compliance with USDA certified organic regulations (USDA–AMS, 2009) and that meet production area constraints and market demands. Insect pest and disease management, weed control, and plant nutrition are also important issues for organic apple growers (Swezey et al., 2000; Weibel, 2001). Management of apple scab disease requires intensive spray programs in humid regions or the use of scab–resistant cultivars (Delate et al., 2008). Challenges associated with scab–resistant cultivars include poor shipping potential and poor eating quality of certain cultivars.

The role of beneficial insects in providing biological control of fruit crop pests has been reported worldwide, but when these options fail to provide adequate control, least toxic, organic–compliant insecticides are utilized (Swezey et al., 2000). However, non–target effects of some organic–compliant insecticides, such as mortality of beneficial insects and resurgence of secondary pests, are becoming key concerns in organic orchards. The humid regions in the U.S. share many common problems in relation to organic apple production: acceptance and improvement of scab–resistant cultivars, more effective methods for managing specific insect pests, and methods to extend storage life in currently available scab–resistant cultivars. The objective of this on-farm study is to evaluate differences in insect and disease development among scab–resistant cultivars in an organic orchard in Iowa. Cultivar susceptibility to plum curculio (PC), codling moth (CM) and apple diseases under an intensive organic spray program will provide useful information for organic growers.

MATERIALS & METHODS

In the organic orchard located in Adel, Iowa, fruit from ten trees (10– to 13–yr-old) of each of three scab-resistant cultivars, ‘Enterprise’, ‘Jonafree’ and ‘Redfree’ on dwarfing rootstock (M-9) were sampled for insects, diseases and fresh weight at harvest. The entire orchard was treated uniformly, per local organic practices, to avoid creating a refugium for insect pests and diseases in any untreated control blocks. The 2008 insect and disease spray program included Surround WP™ (Engelhard Corp., Iselin, NJ) applied at 50 lb/acre on May 30 and June 7 as well as 74 lb/acre on June 17; *Bacillus thuringiensis* (Dipel™, Valent BioSciences Corp., Libertyville, Ill.) on May 12, 16 and 30 at 2 lb/acre and June 7 and 21,

July 3 and 8, and August 17 at 1 lb/acre, on July 22, 27 and 30, and August 30, at 8 oz/acre; CYD-X® (Certis USA, LLC, Columbia, MD) was sprayed on May 30, June 7 and 21, and July 3 at 4 oz/acre, August 17 at 2 oz/ acre, and August 30 at ½ oz/acre; and Entrust® (Dow AgroSciences, Indianapolis, IN) was sprayed on the following days and rates: May 30 and June 7 at 2 oz/acre, June 21 at 1/8 oz/acre, July 3 at 1 oz/acre, July 22, 27 and 30 at 1/8 oz/acre, and on August 30 at 1/8 oz/acre. Seranade® (Agra Quest, Inc., Davis, CA) was applied against quince rust at 2 lb/50 gal water/acre on May 12 and 16, June 28 and 30 and at 8 oz/acre on July 7. Leaves and fruit (10 each per tree) were sampled for insects and diseases on 10 trees per cultivar on July 16. Harvest data included fresh weight of 20 apples per tree (200 per cultivar) and the percentage of apples damaged from codling moth and plum curculio feeding. Harvest periods over the course of the experiment included 'Redfree' harvested on August 18, and 'Jonafree' and 'Enterprise' on October 16. All data were subjected to analysis of variance and mean separation (Tukey-Kramer HSD test at $p \leq 0.05$; SAS, 2001).

RESULTS & DISCUSSION

Disease and insect pressure were extremely low in 2008 due to favorable weather and a rigorous spray program. Leaves from the 'Jonafree' trees had significantly more cedar apple rust than the other varieties (3% occurrence compared with an average of <1% in the other varieties) (Table 1). Plum curculio and codling moth incidence was also low during the season, averaging 0.03 stings/fruit across all cultivars (Table 1). 'Jonafree' fruit had significantly more occurrences of cedar apple rust at harvest than the other varieties, but incidence was less than 2% compared with an average of 0.3% among the other varieties). The percentage of apples with codling moth damage only reached 2.8% in 2008, with no significant differences among cultivars, one of the lowest recorded CM damage rates in the orchard history. Plum curculio damage was also low at harvest, averaging 2.6% across all cultivars with no significant differences (Table 2). Harvested fruit from 'Enterprise' trees weighed significantly more compared with 'Jonafree' and 'Redfree' apples (182 g) compared with an average of 121 g/fruit in the other cultivars (Table 2). Monitoring will continue in 2009 to determine the effect of organic management on other cultivars.

REFERENCES

Delate, K., J. T.S. Walker, R. Volz, J. Johnston, A. White, V. Bus, R. Turnbull, D. Rogers, L. Cole, N. How, S. Guernsey, and A. McKern. 2008. Organic apple systems: Constraints and opportunities for producers in local and global markets. HortScience 43(1):6–11.

O.T.A. (Organic Trade Association). 2005. OTA Newsletter. Organic Trade Association, Greenfield, MA.

Reganold, J.P., J.D. Glover, P.K. Andrews, and H.R. Hinman. 2001. Sustainability of three apple production systems. Nature 410:926–930.

Swezey, S.L., P. Vossen, J. Caprile, and W. Bentley. 2000. Organic apple production manual. Publication 3403. University of California; Santa Cruz, CA

USDA-AMS (U.S. Department of Agriculture–Agriculture Marketing Service). 2009. National Organic Program. Final Rule: 7 CFR Part 205. USDA-AMS, Washington, D.C http://www.ams.usda.gov/nop.

USDA-ERS (U.S. Department of Agriculture – Economic Research Service). 2009. Organic Production in the U.S. USDA-ERS, Washington, D.C. <www.ers.usda.gov/data/Organic/>.

Weibel, F.P. 2001. Organic fruit production in Switzerland: research and development to resolve cultural, management, and marketing problems. Amer. J. Alternative Agr. 16:191–195.

ACKNOWLDEGEMENTS
We would like to thank the Leopold Center for Sustainable Agriculture for their support of this project. Thanks also go to Daniel Wills for his help on production and data collection and Vivian Bernau for her help with the report.

Table 1. Leaf and fruit blemishes during growing season, Wills Family Orchard, Adel, IA, 2008.

Variety	Cedar apple rust (blemishes/leaf)	Fruit (stings/fruit)
Jonafree	2.69a	0.06
Enterprise	0.18c	0.02
Redfree	0.84b	0.02
$LSD_{0.05}$	0.66	NS

Table 2. Apple blemishes and fruit weight at harvest, Wills Family Orchard, Adel, IA, 2008.

Variety	Cedar apple rust (%)	Codling moth damage (%)	Plum curculio damage (%)	Fruit weight (g)
Jonafree	1.56a	3.3	3.3	112.7c
Enterprise	0.60b	1.0	3.3	182.3a
Redfree	0.00c	4.0	1.2	128.4b
$LSD_{0.05}$	0.60	NS	NS	53.0