Evaluating Alternative Pest Management Strategies for Organic Apple Production: On-Farm Trial, Adel, Iowa, 2009

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INTRODUCTION

Organic apple production reached 17,626 acres in the U.S. in 2008 (USDA–ERS, 2010). 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, 2010) 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 (11– to 14–yr-old) of each of four 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 2009 spray program included Surround WP applied at 50 lb/acre on May 22 and 30; *Bacillus thuringiensis* (Dipel™, Valent BioSciences Corp., Libertyville, Ill.) on May 3, 22 and 30, July 10, and August 12 and 31 at 1 lb/acre and July 28 at 8 oz/acre; and CYD-X® (Certis USA, LLC, Columbia, MD) was sprayed on July 10 and August 12 at 4 oz/acre, and July 28 and August 31 at 2 oz/acre. Serenade® (Agra Quest, Inc., Davis, CA) was applied at 4 lb/acre on May 3 and 12, at 2 lb/acre on May 22 and June 10, and at 1 lb/acre on June 22. Leaves and fruit (10 each) were sampled for insects and diseases on 10 trees per cultivar on July 31. 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 11, 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 appeared higher in 2009 than in 2008. During the 2009 season, leaves from the 'Enterprise' trees had significantly more cedar apple rust than the other cultivars (86% occurrence in 'Jonafree' compared with an average of 24% in 'Enterprise' and 'Redfree') (Table 1). Codling moth incidence was high during the season, averaging 33% across all cultivars, with no significant differences among cultivars (Table 1). Plum curculio damage averaged 2% during the season, with no significant differences among cultivars.

The percentage of apples with codling moth damage at harvest averaged 25% in 2009, with 'Enterprise' having less damage (13%) than 'Redfree' (42%), and 'Jonafree' intermediate between these two cultivars (20%). Plum curculio damage was higher at harvest, averaging 17% across all cultivars with no significant differences among cultivars, although there was a trend towards lower numbers (8%) in the 'Redfree' cultivar (Table 2). Harvested fruit from 'Enterprise' trees weighed significantly more compared with 'Jonafree' and 'Redfree' apples (225 g compared with an average of 139 g/fruit in the other cultivars) (Table 2). Monitoring will continue in 2010 to determine the effect of organic management on other cultivars.

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Table 1. Leaf and fruit blemishes during growing season-July 16, Wills Family Orchard, Adel, IA, 2009.

Variety	Codling moth damage (%)	Plum curculio damage (%)	Cedar apple rust (%)
Jonafree	30.00	4.00	86.0a
Enterprise	38.00	0.00	14.0c
Redfree	30.00	2.00	34.0b
$LSD_{0.05}$	NS	NS	15.7

Table 2. Apple blemishes and fruit weights at harvest, Wills Family Orchard, Adel, IA, 2009.

Variety	Codling moth damage (%)	Plum curculio damage (%)	Fruit weight (g)
Jonafree	20.00ab	26.67	139.9b
Enterprise	13.33b	16.67	225.4a
Redfree	42.00a	8.00	138.0b
$LSD_{0.05}$	4.44	NS	38.1