Teaching Methods

Sunny Hollow Orchard: A Decision Case as a Basis for Classroom Discussion

Doug S. Foulk¹ and
Emily E. Hoover²

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SUMMARY. This decision case concerns the need to make management decisions in a commercial apple orchard planted largely with 'Haralson,' a russet-susceptible cultivar. The growers described in this situation had to decide whether applying GA₄₊₇ for russet suppression was appropriate for their operation, given the financial, cultural and pesticide issues that required addressing. The case is intended for use in fruit production or other intermediate to advanced undergraduate horticulture courses and assumes a knowledge of basic perennial-crop production practices. Students assume the role of a decisionmaker in the complicated issue of orchard management.

Department of Horticultural Science, University of Minnesota, St. Paul, MN 55108.

¹Research assistant.

²Associate professor.

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Samantha Green and Toni Anderson had a problem. They had been operating their apple orchard, planted largely with the cultivar Haralson, for 15 years, but it had never given them the production they had expected. Now, in Winter 1995, after the fifth year in a row of declining production, they knew they had to rethink their entire operation in terms of current cultural practices as well as marketing strategies.

Sunny Hollow Orchard consisted of 60 picturesque acres lining a small valley in the Hiawatha region of southeastern Minnesota (Fig. 1). Apple trees lined not only the sloping sides of the hollow, but, out of practicality and aesthetics, the bottom as well. Aesthetics were important, since at the far end of this orchard lay the retail store where Samantha and Toni sold no. 1 fruit, cider, and a selection of baked goods each fall. This meant that, as customers approached the store, they drove next to a section of the orchard and had ample opportunity to decide if they liked the way it looked. Although

Fig. 1. The primary commercial apple-growing areas in Minnesota.

they grew nearly a dozen cultivars for customers to purchase, 50% of the orchard was planted with 'Haralson.'

Samantha, as primary owner and operator of Sunny Hollow Orchard, made all the day-to-day orchard decisions and was responsible for coordinating labor and cultural decisions, like pruning, nutrition, and pest control. Toni, on the other hand, was responsible for financial affairs, such as marketing and bookkeeping. Even though their orchard was on the small side, the operation had been profitable for the 15 years they had owned it, due largely to sales of on-site-produced frozen apple pies, cakes, and crisps to local and Minneapolis-St. Paul grocery stores. Although they used only 20% of their harvest for these bakery products, 40% of their gross revenue came from this source. The reason for this was simple: while they had received \$20.00 per bushel for their no. 1 fruit in the last few years, a single pie sold for \$8.00 and they could produce an average of 12 pies from a bushel of fruit. In addition, the fruit used for the baked goods often were less than perfect and would have fetched as little as \$2.00 per bushel if sold fresh. Yet high-quality fresh fruit was essential to their retail operation—their on-site customers came for the scenery and the fresh, locally grown apples. Furthermore, most of their customers asked for 'Haralson' by name, making it an important part of their fresh-market sales.

Apple growing in Minnesota is concentrated in the southeastern portion of the state, primarily along the bluffs of the Mississippi River (Fig. 1). Compared to major apple-producing states like Washington, California, and New York, Minnesota's apple industry is very small, with 2600 acres in production in 1992. 'Haralson' is the most widely grown cultivar in the state,

Fig. 2. The most widely grown apple cultivars grown in Minnesota (number of trees by variety, 1993).

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MINNESOTA EXTENSION SERVICE

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AGRICULTURE

Minnesota Hardiness Zones

Apples for Minnesota

Emily Hoover, David Bedford,
Shirley Munson, and Doug Foulk
Horticulture

<u>Variety</u>	<u>Average Harvest Dates</u>	<u>Fruit Characteristics</u>	<u>Use</u>	<u>Storage</u>	<u>Hardiness Zone</u>
Mantet	August 6-13	Medium to small, round, bright red. Juicy, sweet.	Fresh eating, pie, sauce.	August	all
Oriole	August 7-14	Orange-yellow, striped with red. Very good eating and cooking.	Fresh eating, pie, sauce.	August	all
Duchess (of Oldenburg)	August 9-15	Above medium size, pale yellow skin striped with red. Tart, yellowish flesh, tender, juicy.	Pie, sauce.	Aug.-Sept.	all
State Fair	August 18-24	Medium size, white flesh, round, smooth, bright red, glossy finish. Crisp, juicy, moderately acid.	Fresh eating, pie, sauce.	Aug.-Sept.	all
Paulared	Aug. 25-Sept. 1	Medium size, roundish, oblate, red color, heavy bloom. White flesh, firm, crisp, juicy, sub-acid.	Fresh eating, pie, sauce.	Aug.-Sept.	1, 2
Beacon	August 17-24	Medium size, very attractive red. Sweet, aromatic flavor.	Fresh eating, sauce.	Aug.-Sept.	all
Chesnut Crab	September 3-11	Large crabapple, flesh crisp, firm. Highly flavored.	Fresh eating.	September	all
Wealthy	September 8-16	Medium size, striped red. Somewhat tart in flavor.	Fresh eating, pie, sauce.	Sept.-Oct.	all
Minjon	September 9-17	Below medium size, very attractive red. Flesh often pink, somewhat tart.	Fresh eating, pie, sauce.	Sept.-Oct.	all
Red Baron	September 12-20	Medium size, attractive cherry red. Crisp, juicy, and sweet.	Fresh eating, sauce.	Sept.-Oct.	all
Lakeland	September 17-25	Medium size, solid red color. Pleasant flavor. Slices hold shape when cooked.	Fresh eating, pie, sauce, baking.	Sept.-Oct.	all

<u>Variety</u>	<u>Average Harvest Dates</u>	<u>Fruit Characteristics</u>	<u>Use</u>	<u>Storage</u>	<u>Hardiness Zone</u>
Sweet Sixteen	September 19-27	Medium to large size, colored by stripes and solid wash of rosy red. High sugar, moderately acid, crisp, and fine texture.	Fresh eating, pie, sauce.	Sept.-Oct.	all
McIntosh	September 18-26	Medium size, nearly solid bright red. High quality for eating. Rich flavor, but soft when cooked.	Fresh eating, pie, sauce, baking.	Sept.-Oct.	1, 2
Honeycrisp	Sept. 20-28	Red with mottled yellow background. Extremely crisp and juicy. Excellent, well-balanced, aromatic flavor.	Fresh eating, sauce, pies.	Sept.-Mar.	1, 2, 3
Cortland	Sept. 25-Oct. 3	Medium size, attractive red. White flesh similar to McIntosh. Holds flesh color well in salad. Aromatic flavor.	Fresh eating, pie, sauce, baking, salad.	Sept.-Nov.	1, 2, 3
Northwestern (Greening)	September 30	Very large size, attractive green or yellow.	Pie, sauce.	Oct.-Jan.	1, 2
Redwell	Sept. 29-Oct. 7	Large size, attractive red. Pleasant flavor, mildly acid.	Fresh eating, sauce, baking.	Oct.-Jan.	all
Spartan	Sept. 29-Oct. 5	Medium size, round, deep red. Flesh is white, firm, crisp, and juicy.	Fresh eating, pie, sauce, baking.	Oct.-Jan.	1
Prairie Spy	Sept. 27-Oct. 5	Large size, striped red. Mild flavor, very good for all uses. Slices hold shape when cooked.	Fresh eating, pie, sauce, baking, freezing.	Oct.-Feb.	1, 2, 3
Haralson	Sept. 30-Oct. 8	Medium size, striped red. Very popular, tart, crisp apple for eating and cooking.	Fresh eating, pie, sauce, baking, freezing.	Oct.-March	all
Honeygold	October 9-17	Medium to large size, golden to yellow green. Very crisp and juicy with an excellent, sweet flavor.	Fresh eating, pie, sauce, freezing.	Oct.-Dec.	1, 2
Red Delicious	October 11-20	Medium size, striped to solid red. Flavor sweet, low acid. Not recommended for cooking.	Fresh eating, salad.	Oct.-Feb.	1
Regent	October 9-17	Attractive red-striped apple with well-balanced, excellent flavor. Flesh is crisp and juicy.	Fresh eating, pie, sauce, baking, freezing.	Oct.-March	1
Golden Delicious	October 15	Medium size, attractive yellow. Flavor rich, high quality.	Fresh eating, pie, sauce, baking, salad.	Oct.-Feb.	1
Fireside/ Connell Red	October 8-18	Large size, attractive red. Flavor rich, high quality, sweet. "Connell Red" is a color sport of "Fireside".	Fresh eating, baking, salad.	Oct.-March	1, 2, 3
Keepsake	October 11-19	Small to medium with irregular angular sides, red with scattered white dots. Light yellow, fine-textured flesh, firm and crisp. Store under humid conditions.	Fresh eating; after storage: pie, sauce.	Oct.-April	1, 2, 3

comprising 31% of all bearing trees in 1993 (Fig. 2). 'Haralson' has long been a mainstay in commercial apple production in the upper midwestern United States because it is winter-hardy, produces flavorful fruit that stores well and is excellent for pies, and possesses an easily-trained compact tree habit (Fig. 3).

'Haralson' has some flaws, however, one of which is a susceptibility to russetting. Apple russetting is a physiological disorder that appears as a rough, but finely textured, corky netting on the surface of the fruit (Fig. 4). This netting may cover only a small portion of an individual fruit or the entire surface. Russetting reduces the aesthetic quality of an apple, for which it is graded less favorably at packout, resulting in decreased grower profits. In addition, russeted fruit experience greater moisture loss at room temperature, potentially reducing storability under common handling and sales conditions.

The 'Haralson' trees in Samantha and Toni's operation produced a high number of russeted fruit nearly every year. In an average year, at least 60% of their 'Haralson' crop was russeted—up to half of them, or 30% of the total 'Haralson' harvest, so badly that the apples cracked, rotted, and dropped prematurely. Samantha and Toni estimated that only about 10% of their 'Haralson' fruit could be sold as no. 1; the rest of the usable 'Haralson's' went into their baked goods. In addition, several trees in the lower third of the

hollow, especially the 'Haralson' trees, had been declining over the last 10 years, and some had died. Although average yield for a mature 'Haralson' planting in their region was about 800 bushels/acre, they had never produced more than about 600 bushels/acre, and, in the last 2 years, that figure had dropped to 400 bushels/acre. These dying trees not only were reducing in total yield but were unsightly for the customers who visited the orchard. On the other hand, a few other cultivars they grew were still thriving and producing high-quality fruit. Samantha had observed that the same 'Haralson' trees that exhibited the worst russetting were also those experiencing decline problems; she had always wondered what the cause of the russetting and decline was, thinking that perhaps an as-yet unknown disease or insect was at fault.

Facts on 'Haralson' russetting

At a seminar held for the Minnesota Apple Grower's Association, Samantha learned that moisture, in one form or another, seems to be the single necessary precondition for the development of russetting in 'Haralson' and other susceptible apple cultivars. For example, conditions of high humidity, frequent rain, or even dew during the first 30 to 40 days after bloom all may suffice as the necessary first event in russet development. Other antagonistic factors apparently do not

cause russetting without this initial precondition. The exact role water plays in the initiation of russetting is not yet certain and may not be limited to a single effect. Wetness may cause developing fruit to form a thin cuticle, may diffuse into epidermal cells through cuticular cracks, causing cell rupture and death, or both, or may act in other ways as well. Given the above conditions—the presence of a susceptible cultivar and an environment containing abundant moisture during the first 30 days after anthesis—the following environmental factors, also within the first 30 days after anthesis, may further promote russet formation:

- High night temperatures (15 to 20 °C).
- High levels of available nitrogen.
- Fruit exposure to direct sun.
- Sprays toxic to cells (Pesticides mentioned in peer-reviewed literature as causing russetting that are currently registered for use on apples include dodine, chlorpyrifos, and diazinon. A popular theory is that, given wetness levels conducive to russet development, nearly any spray chemical, or even water alone, may aggravate russet. Emulsifiable concentrate materials have been reported to aggravate most, while copper is reported to cause injury regardless of weather conditions.)
- Frost or near-freezing temperatures.

Two factors have also been reported to reduce incidence of russet:

- High phosphorous levels.
- Shading of developing fruitlets.

During the course of the seminar, Univ. of Minnesota researchers described a study they were working on. They reported that Provide, an agricultural growth regulator, decreased the incidence of russetting in 'Haralson' apples by as much as 25% in a severe year and resulted in up to 25% more apples per tree at a 10% heavier fruit weight (Foulk, 1996). Furthermore, the active ingredient in Provide is a naturally occurring compound in apples with no known effects when ingested by animals. To Samantha, this all sounded promising for use in her operation.

However, she also found that Provide was expensive and, when applied at the recommended rate, cost about \$76.00 per acre per application in 1995, including application costs. Because

Fig. 4. Russeted 'Haralson' apples.

Provide required four applications per season, the actual annual cost totaled about \$304.00 per acre. To complicate matters further, Provide was best applied on its own, without even a wetting agent, so that one could not reduce the actual per-acre expense of application by tank-mixing it with insecticides or fungicides. Provide wasn't foolproof either: University researchers reported that, in a year in which russet was not severe, Provide had not reduced the incidence of russetting. Dependence on a severe russet year for beneficial results was a problem because a grower had to make the decision at the bloom stage whether to begin the four Provide applications, well before knowing if russetting would be a problem that year. Provide's effect, however, in increasing the number and size of the fruit seemed to occur even in a year when russet was not a problem.

The decision

When Samantha told Toni what she had learned, they knew they needed to reevaluate their operation and form a plan of action. Financially, would it make sense to apply Provide each spring? Or was Provide just a Band-Aid solution for a more serious problem? Samantha and Toni knew that much of their orchard was on a less-than-perfect site, but had not yet attempted to determine how strongly the site was linked to their tree problems. An additional consideration stemmed from their awareness that their customers had concerns about the use of pesticides. If they did decide to apply this growth regulator, would it become the next target for antipesticide organizations? They had to look at the bigger picture as well. Considering that 'Haralson' had such problems with russetting and that there was, as yet, nothing that cured the problem entirely, should they keep their 'Haralson' trees at all, even though it was the cultivar their customers asked for by name? Russetting aside, 'Haralson' had the potential to be one of their most cost-effective cultivars since it required less training and pruning than most others, was hardy and long-lived, and possessed no other extreme susceptibilities to diseases or disorders. If, however, 'Haralson' was the wrong cultivar for their site, what then should they do? Should they top-work the trees with

another cultivar or tear out the existing 'Haralson' trees and replace them? Top-working was costly and time-consuming, but could potentially get the trees more quickly back into production, while removing trees entailed letting the site lie fallow for 3 years and waiting another 4 to 7 years after that for the replacement trees to produce a significant crop. No matter what they did in the long run, how could they approach the problem of tree decline in the short term so that their site remained desirable to customers? With thoughts of the decline problem, another issue arose: even if they were profitable now, what adjustments would they need to make to stay profitable in the long run? Toni and Samantha decided they needed to walk through their orchard to observe the situation carefully and to discuss their long-term goals and strategies.

Interpretive or teaching note

The Sunny Hollow Orchard case can be used to illustrate the decisionmaking processes involved in operating a commercial crop-production enterprise encompassing such issues as cultural and environmental factors, financial viability, and pesticide concerns. This case is suitable for intermediate to advanced horticultural crop production courses including, but not limited to, those in commercial fruit production. The case exposes students to a real-life situation and provides them with the opportunity to face a complex situation not uncommon for producers in the horticultural industry.

As per Hoover and Stanford (1995), the questions used by the instructor to stimulate discussion should be focused on the issues and should not be clinical or "what do you think?" types of questions. It is through answering issues-oriented questions that provides students with the framework for problem solving. As part of a more global approach to teaching a decision case like Sunny Hollow Orchard, an instructor may want to discuss with students the importance of issues analysis and how this process is essential to problem solving in the situations they will encounter in their own area of interest. Suggested issues-oriented questions for this specific case include the following:

- What is Samantha and Toni's primary objective in this situation?
- Are any of their other objectives too important to ignore in making a decision? If so, what are they?
- What factors, cultural and environmental, may have led to the development of their current situation?
- Is the use of a plant growth regulator a pesticide issue? Why or why not?
- How important are perfect apples to Samantha and Toni's operation? Perfect trees?
- What additional information could Samantha and Toni use to make a more informed decision?
- What short-term decisions should they make?
- What long-term decisions should they make?

As with most decision cases, students should be given the case well in advance of discussion so that the case can be read and analyzed before class. There is no simple right or wrong answer to this decision case, as is normally the situation in a real-life operation. By having students read, consider, and discuss the issues involved, they will be encouraged to analyze and prioritize the many complex factors that must be considered in a commercial crop production enterprise.

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