Teaching Methods

The Floratech Dilemma: A Case Study for Potted Plant Production Specialists

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Additional index words. floriculture, crop production, labor, teaching methodology

Summary. This paper presents a case study for use as an active learning tool with students in a floriculture potted plant production class. Students work together in small groups (three to four) to pose answers to a dilemma. With this case study, students quickly learn the names of their colleagues and work together outside-of-class to solve the assignment. Each student role-plays being hired on as a new potted plant production specialist. A memorandum from the Board of Directors is delivered on their first day of work at Floratech, a company specializing in potted plants. Floratech is a finisher company, purchasing plugs (vegetative or seed-propagated crops) from plug producers and rooting stations, and selling their final products to both wholesale and retail markets. Objectives of this case study are to determine 1) the students' fluency in terminology for potted plant production, 2) ideal production time/labor inputs for the Floratech potted crops, and 3) limiting factor(s) preventing each crop from reaching this goal. As the students progress through the course material, they refer to the memorandum for clarification of unknown terms. Unresolved questions are raised during the semester (in the classroom and during laboratory tours) to other players interacting in the memorandum, i.e., Floratech staff (growers, sales people, management), its suppliers (rooting stations, plug producers, distributors, breeders, producers, operations, quality control), and customers (wholesale, retail). This case study was tested with undergraduate students enrolled in HORT 4051, Floriculture Production and Management I (Potted Plants) at the University of Minnesota, St. Paul, during Fall Semester 1999.

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Florist and environmental horticulture crops now rank fifth for farm-gate (wholesale) cash receipts—US $12.1 billion in 1998 (USDA, 1999). The floriculture industry includes cut flowers and greens, flowering potted plants, potted foliage plants, and bedding/garden plants (annuals, biennials, perennials). Farm-gate cash receipts for these floricultural crops increased by 6% to US $3.93 billion in 1998, with the notable increase occurring in bedding/garden plants (Miller, 1999; USDA, 1999). As an added benefit, retail expenditures for all floriculture and environmental horticulture products reached US $54.8 billion (US $203 per capita) in 1998. Potted flowering plants consist of 19.7% of the floriculture market; sales dropped to US $701 million, down 3% for the year. The top states for flowering potted plant production include California (21%), Florida (11%), New York (5.8%), Texas (5.2%), Pennsylvania (5%), and North Carolina (≈5%). Kalanchoe (*Kalanchoe blossfeldiana*) recorded the greatest increase in sales (up 11%), while other unspecified flowering potted plants had a modest gain (up 6%). The number one potted crop, poinsettia (*Euphorbia pulcherrima*), dropped 7% in total value.

Sales of most flowering potted plants are correlated with holidays, although most can be produced year-round (Dole and Wilkins, 1999; Larson, 1980). For instance, poinsettias are sold for Christmas, chrysanthemums (*Chrysanthemum ×morifolium*) primarily for Thanksgiving, easter lilies (*Lilium longiflorum*) for Easter, etc. Since observed local and national holidays persist through the calendar years, the sale of potted flowering plants is likely to continue despite its small market share (≈20%). Many undergraduate curricula throughout the United States also continue to offer potted plant production classes to train grower staff for the industry.

During potted plant classes, students are exposed to the top-selling crops, holiday-specific crop needs, consumer demand, market share and potential, terminology, and crop-specific production schedules. However, students are given few opportunities to entertain a more global, comprehensive vision of opportunities within this arena to allow for change and buildup of practical expertise for industry positions.

The Floratech Dilemma case study was developed to test student's current knowledge and understanding of the complexities of crop production decision-making in the industry, before learning crop-specific production information. Decision cases are interactive learning tools, based on real-life scenarios that enable students to focus on real dilemmas; case studies are based on hypothetical situations. The use of decision cases encourages students to view dilemmas from the inside-out, rather than as external critics (Simmons, et al., 1992). Few case studies or decision cases have been written for horticulture students (Davis, 1992a, 1992b; Foulk and Hoover, 1997; Hoover, 1993; Meyer and Allen, 1994), and fewer yet for floriculture classes (Engeikyoku and Hanakika, 1983; Kuehny and McMahon, 1998). The Floratech Dilemma is the third case study for use by floricultural students.

The strategic advantage of using a case study early in the class enables the instructor, as well as the students, to quickly identify the students' current knowledge base and the areas requiring special focus for the duration of the class. In addition, interactive learning enables the students to learn their colleagues names, work cooperatively in problem solving, embrace diversity of backgrounds and understanding in their colleagues, and to use their particular skills enabling the group to process information for decision-making. Such group activities are continued throughout the duration of the class, giving students a revolving opportunity to re-examine their initial recommendations as their knowledge base increases. The Floratech Dilemma encompasses additional educational facets, demonstrating that successful growers cannot operate in a vacuum and must involve other important players, such as sales, operations, shipping, quality control, marketing, breeding, and propagation staff.

The Floratech Dilemma

A memorandum (Exhibit 1) from the Board of Directors of Floratech is presented to each student on the first day of class. The students are commencing a new job at Floratech, Potted Plant Production Specialist, and this memorandum outlines their first task. Floratech is a finisher company specializing in potted plants. Plugs (vegetative or seed-propagated crops) are purchased from plug producers and rooting stations, which are then grown by Floratech and sold to both the wholesale and retail markets.

A graphical summary of the current potted crops in production at Floratech throughout the year is included with the memorandum (Exhibit 2). This summary portrays the labor input versus production time for each crop. Floratech's crops are depicted by varying sized circles and asterisks, although no legend is provided for interpretation of the graph. The task and guidelines for its accomplishment accompany the memorandum (Exhibit 3). As a means of introducing the crop production specialists to Floratech and the complexities of potted plant production, initial findings and recommendations are to be reported back to the Board of Directors within 1 week. At issue is the following question: "What is the most realistic, cost-effective location on the graph (Exhibit 2) that Floratech should aim to move all of the crops?" Students (crop production specialists) within each group begin their discovery by analyzing the graph and answering the following questions. What is meant by the question? What does a realistic, cost-effective location mean? What are the noticeable trends depicted by the graph? What are the limiting factor(s) that might prevent any/all of the crops from moving to this location? Each group must decide and "sign off" on one location, using diagrams, calculations, and logical reasoning in making the decision. As the memorandum states, a presentation of the initial findings to the Board of Directors is due 1 week later. Both a written summary and oral presentation are required.

Additional class discussion

After the presentations are made, a follow-up session is scheduled for the next period to consider additional questions raised by the in-class discussion and those posed by the Board of Directors (Exhibit 4). It is not envisioned that students will have all of the answers to the questions posed by the end of these initial sessions. Rather, they will constantly refer back to the memorandum and their answers as crop-specific cultural information is presented; each crop on the graph is eventually identified (Exhibit 4). As the production requirements for each potted plant crops are covered, students connect the crop-specific needs (labor and other inputs, crop production time) with factor(s) that control physiological and genetic opportunities (limitations). Students then pose questions to the proper sources (growers, breeders, producers, distributors, etc.) during laboratory tours of the industry for information on how to minimize or alleviate the current production restraints.

Interpretive or teaching note

The Floratech Dilemma describes a typical potted plant production specialist's challenges of working in the industry. The case study can be used to demonstrate student's beginning knowledge base early in the class and the difficulties of decision-making when critical information is lacking. This case study is best suited for floriculture students. However, a diversity of student backgrounds will positively affect the discussions and diversity of opinions. There are no right or wrong answers to most decision cases (Davis, 1992b; Meyer and Allen, 1994).

This case study was used in HORT 4051, Floriculture Production and Management I—Potted Plants, De-

Exhibit 1. Memorandum from the Floratech Board of Directors to each new Potted Plant Production Specialist (role-played by each enrolled student) regarding the first job assignment.

To: New Potted Plant Production Specialist
From: The Board of Directors
Re: Your first assignment

Welcome to your first day on the job as Potted Plant Production Specialist for Floratech Company! We have several crops currently in production for upcoming holiday sales and many more crops entering as the year progresses. You will become familiar with all of these crops.

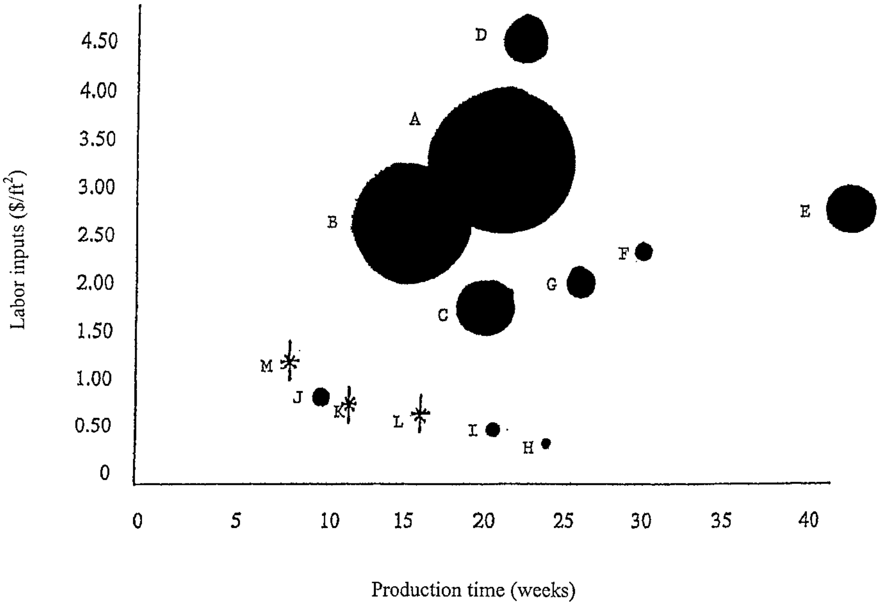
Floratech is a finisher company, specializing in potted plants. It is a family owned and operated company. Floratech sells flowering potted plants on the wholesale (bench run contracts) and retail markets.

We have hired you as the potted plant production specialist due to your keen insight and novel approaches to floricultural crops. Exhibit 2 is a graphical summary of the major and minor crops grown here at Floratech that portrays the total production time and labor inputs for the various crops. The total production time is the summation of the number of weeks required by propagation/rooting stations, prefinishers, and finishers (such as Floratech) to bring each crop to the marketable stage. Floratech's production time is significantly shorter than the total production time. Both inputs represent significant costs to Floratech as each increases. This cost must be passed on to our customers. In the ever-competitive, worldwide floriculture market we need to keep costs down as much as possible. We are interested in developing innovative ways to do this.

Exhibit 2. Graphical summary of total production time (from propagation to harvest) and labor inputs ($\$1.00/ft^2$ = $\$10.76/m^2$) for current potted crops.

Instructor's notes

Students refer to this graph to answer the question posed by the memorandum from the Floratech Board of Directors (Exhibit 1). The Floratech crops depicted on the graph are identified below. Floratech does not grow all of the possible potted crops available. The circles represent established crops, with increasing size denoting sales volume but not necessarily production space, while the stars denote new crops with exciting potential; A = vegetatively propagated (veg.) poinsettia (*Euphorbia pulcherrima*); B = veg. chrysanthemum (*Dendranthema* ×*grandiflora*); C = veg. hibiscus (*Hibiscus rosa-sinensis*); D = veg. easter lily (*Lilium longiflorum*); E = seed-propagated (seed) cyclamen (*Cyclamen persicum*); F = seed primrose (*Primula malacoides, P. obconica, P. vulgaris*); G = seed eustoma (*Eustoma grandiflora*); H = seed or veg. crossandra (*Crossandra infundibuliformis*); I = veg. rose (*Rosa hybrida*); J = seed or veg. flowering maple (*Abutilon* ×*hybridum*); K = seed ornamental pepper (*Capsicum annuum*), non-pungent types; L = seed pentas (*Pentas lanceolata*); M = seed crape myrtle (*Lagerstroemia indica*).



partment of Horticultural Science, University of Minnesota during the Fall 1999 semester. Twenty students were enrolled in HORT 4051 who were juniors and seniors in Floriculture and Nursery Management. Students noted several assumptions they made during their deliberations of the Floratech Dilemma, such as 1) crop production must meet, but not exceed, customer demand; 2) labor and other production costs would not cause the market price to exceed that of alternative products; 3) quality crop products resulted from the depicted labor inputs; and 4) the size of the circles (Exhibit 2) represented the production area (square feet) and sales of each crop. Such assumptions led to discussions of how crop production levels are determined at Floratech and the impact forecasting and sales projections have on the quantity of crops produced. Students inquired whether any production overage occurred for insurance against crop losses (10% on average). As a result, student's intrigue with professional growing increased when they realized that production quotas are the result of interactions with participants in the marketing chain (breeder/producer, distributor, propagator, pre-finisher companies) and the sales force (forecasting, estimated market demands, customer orders).

Exhibit 3. The task and guidelines portion of the Floratech memorandum for use by students to answer the question from the Board of Directors.

The task

In your first year as production specialist, your primary task is to learn the business and carefully study each of these crops. In your interactions with all of the Floratech staff (growers, sales people, management), its suppliers (rooting stations, plug producers, distributors, breeders, producers, operations, quality control), and customers (wholesale—bench run, retail) you need to find answers to the following question. Please report back to the Board of Directors within 1 week with your initial findings and recommendations.

• What is the most realistic, cost-effective location on the graph (Exhibit 2) that Floratech should aim to move all of the crops?

In your discussion group, you may come up with three different locations. By the end of the discussion, your group must decide on one location. Each of you must sign off on this location. Be able to explain and defend your answer. In your discussions, listen carefully to your colleagues' ideas. Don't change your mind for the best location without a logical reason to do so.

Guidelines

Begin your arguments by answering the following questions:

• What does a "realistic, cost-effective location" mean?
• What are the noticeable trends depicted by the graph?
• What are the limiting factor(s) that prevent any/all of the crops from moving to this location?

1. You are encouraged to use charts, diagrams, tables, graphs, equations, calculations, and logical reasoning in making your decision.
2. Clearly state your choice of the best location. Your one-page, typed summary for the group (due one week from today in lecture) should include the arguments and mathematics that support your decision. The summary should also explain how your charts, diagrams, tables, graphs, equations, calculations, and logical reasoning relate to the factors you considered and led your group to your choice.
3. Hand your written presentation in to the instructor with all of the group member's signatures.
4. In addition to the written presentation, your group will give an oral presentation of approximately five minutes to the rest of the class. This oral presentation will summarize your arguments and explain the reasons for your decisions.

Exhibit 4. Follow-up items to consider after class presentations of their answers to the question posed in the memorandum from the Floratech Board of Directors.

Followup items

Consider the following questions based on the classroom presentations.

- What information/data will you need to analyze in your first year to make your decision?
- Which criteria were used most often to determine the location?
- Can you name the crops depicted on the graph?
- What do the circle sizes represent?
- What directions will you give to the Floratech suppliers for continued crop improvement?
- Construct a list of proposed changes for the Floratech growers to implement during the next year to move crop production towards the most realistic, cost-effective location.

Students' answers for the realistic, cost-effective location ranged from 10 to 22 weeks and were at the midpoint [$2.25/ft² ($24.21/m²)] for labor costs, depending on the issues and trends they perceived for Floratech production. Their responses were supported by mathematical justifications (trends, linear relationships, descriptive statistics), assumption(s) about the circle/star sizes (crop production space allocations, market share, variable associated costs), potential labor reducing measures, analysis of the cultivar choices (for crops with high labor costs or long production times), and limiting factors that prevent shifting crops toward the cost-effective location (need for enhanced breeding, lack of fast-cropping). The wide difference of opinions for the ideal production time generated discussion, prompting delineation in the next class period of industry standards for potted plant production (16 to 18 weeks, maximum finishing time), aesthetic ratios, and production inputs (factors of plant growth, cultivars, genetic traits) that contributed to the data for the graphical illustration (Ball, 1985; Dole and Wilkins, 1999; Larson, 1980).

Other questions and discussion points that surfaced can be illustrated using results from one student group. This group chose the intersection of US $2.50/ft² ($26.90/m²) and 15 weeks production time as the most realistic, cost-effective location, which was occupied by crop B (Exhibit 2). Students assumed circle sizes represented production volumes (number of units produced) for each major crop. Minor crops were denoted as smaller circles or stars. Crop A was the closest to the chosen location (crop B) and would require the least amount of labor and production time changes to move it towards the ideal location. They posed questions focusing on crops A and B to understand why these two crops differed from each other, e.g., was crop A associated with a holiday during the winter months (which caused an increased production time) whereas crop B was produced year-round? Crops A and B were compared with crops D and E to determine how crop production could be modified to bring these closer to the crop B location. If the low production costs for crop B were not solely due to its inherent genetic makeup, the breeding programs for crops C–G would need to focus on creating significantly earlier and less labor-intensive cultivars. The importance of crops B and A readily affected the students' interpretations for crops H–M (Exhibit 2). No group chose the low labor costs and production times for crops H–M as the most cost-effective location. Students felt that these minor crops might potentially expand in production area if the market could be increased, while maintaining the crop locations on the graph.

One trend became apparent to the students, namely that with every increase in production time there was a corresponding increase in cost/ft². The students projected that the crop data points would almost fit a linear regression equation. Participants could not determine, based on the information provided by Floratech, the production time and costs associated with finishing each crop. This information was supplied later in the class during production lectures for each specific crop. Students also queried growers during laboratory tours to determine the production time for propagators, prefinishers, and finishers.

In making their decisions, the students noted potentially limiting factors preventing any crop (Exhibit 2) from moving toward their selected realistic, cost-effective location. The factors included genetic restraints preventing significantly earlier flowering (crops E, F, and G, Exhibit 2) and difficulty in reducing labor inputs for forcing crops on schedule (crop D). Other questions surfaced, e.g., if a crop is produced for holiday sales, what effect would earlier flowering have on the year-round production schedule and bench-space availability for all other crops? What other cost factors are not depicted by the graph that impact production, e.g., overhead, heating, etc.? Would higher heating bills eliminate the outlying crops from production? What is the weekly labor cost/ft² for each crop or the crops with a higher profit margin? During subsequent lectures, answers to these questions were presented to complement crop-specific production information.

No comparisons were possible to determine whether students' grades improved significantly with the use of this case study versus traditional information delivery, since the examinations for each year are unique and the same questions are never repeated. Final grades for the class averaged 83% with 50% of the students receiving a B for the course and 25% receiving an A grade. The higher class average could at least be partially attributable to the use of this case study. It should be noted, however, that two additional case studies were also used with the students later in the semester.

Students reacted positively to the Floratech Dilemma case study, particularly as it developed throughout the semester, tying conceptually peripheral factors together with the science and art of growing. The participants were eager to work together in problem-solving situations more than they were to read supplemental lecture material from the text or other sources. Students quickly discerned that the case study offered more practical training for their future careers than memorization of production requirements for each crop. This produced students with additional skills and greater familiarity with market factors than would otherwise be the case in traditional classroom information delivery. Industry representatives were also impressed with the caliber of students from this class, particularly after answering the student's questions during laboratory tours. By the end of the school year, more than 20% of the students were hired as industry growers.

In summary, the use of a case study such as the Floratech Dilemma yielded positive results from the students, creating a more interactive educational setting. This developed the student's problem-solving skills to complement the knowledge derived from traditional production class education.

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Cultivar Trial Setup: A Case Study for Potted Plant Production Specialists

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ADDITIONAL INDEX WORDS. *Cyclamen*, **floriculture,** ***Primula*****, teaching methodology**

SUMMARY. A case study is presented for use as an active learning tool for students in a floriculture potted plant production class. This is the second case study developed for Floratech, a potted plant finisher. Students work together in small groups to solve the proposed problems; each student role-plays as a Potted Plant Production Specialist. A memorandum from the Board of Directors is delivered in their first month on the job at Floratech. Objectives of this case study are to determine the students' fluency in terminology and crop-specific cultural requirements for potted plant production of cyclamen (*Cyclamen persicum*) and primrose (*Primula* sp.) as well as their ability to setup a scientifically rigorous and unbiased cultivar trial for Floratech personnel and selected customers. Students research the latest commercial catalogs to determine which species, series, and cultivars are available, as well as their relative merits, prior to choosing the appropriate cultivars to include in the trial. The trial setup has a space limitation of 2,000 ft^2 (186 m^2). This case study was tested with 20 undergraduate students during Fall Semester 1999. The case study demonstrated the students' fluency with terminology and crop-specific cultural requirements for both crops. Their ability to set up a scientifically rigorous trial varied widely, often with an inadequate sampling of cultivars and excessive replications (56 ± 37 cyclamen to 132 ± 65 primrose). A mean ± SD of 4 ± 1 cyclamen and 7 ± 3 primrose series were chosen. The number of cultivars varied from 6 ± 2 cyclamen to 9 ± 4 primrose and the number of distributors was similar for the crops. Trial design and additional questions raised by the case study were discussed in class and applied in a cultivar trial in the lab. Unanswered questions were used as learning opportunities during class tours with local growers.

Almost half (49.1%) of large floriculture greenhouse operations in the U.S. (≥$100,000 wholesale) produce flowering potted plants (USDA, 1999). After bedding/garden plants, flowering potted plants constitute the second largest segment of the floricultural industry with 19.7% of sales in 1998. While popular potted plant crops remain in annual production cycles, each year new cultivars and series are commercialized. A series is hereby defined as a group of cultivars within a crop that were bred and released to the market by a commercial breeder company. Each cultivar within a series shares one or more phenotypic traits (e.g., plant height, flowering time, flower type, etc.) that characterize the series. The cultivars in a series might, in some instances, share a common female parent, but would differ from each other by flower, fruit, or foliage colors. For example, alstroemeria (*Alstroemeria* ×*hybrida)* 'Jazze Rose Frost', 'Jazze Deep Rose', and 'Jazze Purple Rose' are three cultivars within the Jazze series (PanAmerican Seed Co., 1999). Each cultivar differs from the others within the series by flower color. Potted plant growers conduct cultivar trials to determine which new series perform as good as or better than the industry standards in production.

Students need experience in this area to gain practical experience for industry positions. One important classroom and/or laboratory exercise for undergraduate students enrolled in a potted plant production class is to learn the basics of cultivar trialing. Of particular interest are the objectives of the trial, choice of cultivars and suppliers, consumer demand, crop market share, crop scheduling, and the important components of an unbiased trial that will provide scientific validity.

The cultivar trial setup case study was developed to test the students' comprehension of experimental design, trialing, and decision-making in the industry, after learning about crop-spe-

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