Teaching Methods

Marketing Genetically Modified Organism Carnations by Future Floral Designers: Student-designed Policy Formulation

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SUMMARY. Genetically modified organism (GMO) crops provide new trait(s) that may benefit floral designers and consumers. A limited array of GMO cut flower cultivars exist in the floral markets worldwide: nine carnations (*Dianthus caryophyllus*) and one rose (*Rosa ×hybrida*). Labeling GMO flowers in the United States is not required. Thus, most distributors, flower auctions, brokers, wholesalers, floral designers and consumers are not aware that they exist. To test the acceptance of GMO cut flowers with potential future floral designers, $n = 121$ students enrolled in Floral Design (HORT 1013) at the University of Minnesota during 2005–07, 2009, and 2011, designed with standard and miniature GMO Moon™ series carnations. Each student created a Hogarth design with both types of carnations and assembled a price sheet. Students examined the differences between GMO lavender/purple carnations and those created with classic methods of spraying, dipping, or infusion. In 2009 only, students were also assigned to write a marketing paragraph about their GMO floral design. Each year, students were given an identical question on a subsequent midterm examination to determine their position on GMO cut flowers, including development of a floral shop policy to inform customers. Student examination responses ranged from not carrying GMO products [1/121 (0.8% response)], offering GMO/non-GMO carnation options to the consumer [81/121 (66.9% response)], or only selling only GMOs [33/121 (27.3% response)] that differed significantly from a 1:1:1 chi-square (χ^2). A significant majority of students would inform their customers of the GMO crops [89/121 (73.6% response)]. In several instances, consumers were not to be informed of the GMO nature unless they queried about the higher price point. Similarly, marketing paragraphs did not uniformly highlight the GMO nature of the flowers. Implications for the next generation of floral designers demonstrate that, with the exception of students in 2005–06, most would sell both GMO and non-GMO flowers with a majority of shops clearly identifying GMOs.

Carnation, a staple in the world's cut flower supply, has been cultivated for nearly 2000 years (Besemer, 1980; Holley and Baker, 1963; Jawaharlal et al., 2003). Carnation production for the cut flower market has moved from traditional consumer markets such as the United States, Germany, Japan, and

the Netherlands to flower-exporting nations such as Colombia, Israel, Kenya, Spain and the Republic of China (Besemer, 1980; Nau, 2011). In 2011, standard carnations were produced in 15 states accounting for \$233,000 wholesale revenue in the cut flower sector of the horticulture industry [U.S. Department of Agriculture

(USDA), 2012a]. Carnations are available in a wide variety of colors derived from classical breeding techniques ranging from white, yellow and green to multiple shades of red, pink, and salmon (Besemer, 1980; Holley and Baker, 1963). Traditional breeding efforts are limited by the absence of key pigment biosynthesis genes in a particular genetic pathway (Chandler, 2007; Holley and Baker, 1963) inhibiting production of certain colors in many different flower species. For colors not commercially available, florists and producers use methods like dip dying, spraying or vascular uptake to obtain desired hues like blue and purple (Besemer, 1980; Hunter, 2000). However, with the advent of genetic modification techniques, breeders have been able to implement disease and insect resistance of commodity crops (Uzogara, 2000). In the case of ornamentals, there are research efforts underway to modify flower color and scent while incorporating resistance for abiotic stress, diseases and pests, and extending vase life (Chandler, 2012). Flower color modification dominates GMO research in ornamental crops (Auer, 2008; Clark et al., 2004; Holton et al., 1993). A key objective of breeders for floricultural crops is the creation of new flower colors, either to complete the range in a particular crop or replace an existing cultivar with a better performing genotype of the same color (Chandler, 2007).

In 1993, the gene encoding flavonoid 3'5'-hydroxylase was isolated (Holton et al., 1993), providing the tool to allow development of the color-modified carnation and a rose now on the market (Chandler, 2012). The first transgenic violet-colored carnation expressing the F3'5'H gene was originally marketed in Australia in 1996, followed by Japan, the United States, and Europe thereafter (Kikuchi et al., 2008). This carnation, 'Florigene Moondust™', was introduced by Florigene (Melbourne, Australia). The only GMO carnation products to be sold commercially thus far are this cultivar and eight additional newer ones in the Moon™ series ('Moondust™', 'Moonvista™', 'Moonlite™', 'Moonshade™', 'Moonaqua™', 'Moonique™', 'Moonpearl™', 'Moonvelvet™', and 'Moonberry™') (Chandler, 2007), possessing the F3'5'H gene expressing violet hues. These nine cultivars include the first introduced. The

successful commercialization of genetically modified floricultural products relies on both the marketplace perception of the value of the product and the specific complexities surrounding the current public debate on the pros and cons of gene technology (Chandler, 2007). GMO carnation's introduction in the marketplace was not a widely known fact, despite marketing by Florigene, resulting in silent response by florists and wholesale distributors as they were slowly made aware of the new technologies in flower color modification. The Florigene Moon™ carnation series are GMO products; this is now more common knowledge but still not a central part of marketing (Chandler, 2007).

Regulation and labeling of GMOs has been a topic of debate in the United States for many years. The U.S. Food and Drug Administration has provided guidance to the labeling of GMO and non-GMO food products (Albert, 2009) but little regulation has been implemented for GMOs such as the Moon™ series carnations. The only noticeable difference between GMO and standard carnations has been the price differential as GMO carnations began to infiltrate the market (Table 1). Price differentials may not have a direct effect on the consumer but may be more noticeable to the retail or wholesale florist. Currently, the largest impediment to adoption of at least some GMO horticultural products is the lack of market acceptance (Clark et al., 2004). Therefore, how should future florists handle the case of supplying and marketing genetically modified carnation in the retail setting?

The concerns of GMO crops for future floral designers were addressed when $n = 121$ students enrolled in HORT 1013, Floral Design, at the University of Minnesota over 5 years (2005–07, 2009, 2011), were given the opportunity to design with commercially available standard and miniature Moon™ series carnation in the laboratory. The objective of allowing

these future floral designers to work with transgenic flowers was to determine the next generation of floral designers perceptions of such GMO products. Through designing, composition of marketing paragraphs and development of retail floral shop policies, students determined whether they felt it was acceptable to offer GMO flowers and how to approach informing (or not informing) their customers of the new introductions. This study allowed for insight into the future of, not only carnations, but also other GMO cut flowers and ornamentals which may be introduced to the market.

Methods

THE GMO DILEMMA. The introduction of the GMO Florigene Moon™ series carnation in 1996 (Kikuchi et al., 2008) transformed the commercial flower market by extending the available color line of carnation. Although wholesalers and retailers alike were slowly made aware of this introduction, consumers were and are still relatively uninformed. Retailers faced the dilemma of whether to use the transgenic carnations or continue with their classic methods of color modification (dip dyes, sprays, and vascular uptake) (Hunter, 2000). Would it be more cost effective to continue with their traditional methods or to convert to the slightly more expensive GMO cultivars for violet flowers? Another question of concern was the connotations associated with transgenic crops. Would the use of GMO crops potentially impose a negative opinion of the retail shop? Could the implementation of modified flowers affect the loyalty of certain customers? Are customers willing to pay more for the Moon™ series or are they satisfied with traditional methods of color alteration? How does the marketing of these flowers differ from classic offerings? All of these questions pose a concern for use of genetically modified carnations in the retail floral setting.

TESTING GMO CARNATION IN HORT 1013. Students enrolled in Floral Design were allowed the opportunity to design using the standard

and miniature GMO carnation. They made observations and noted differences between designing with non-GMOs and using alternative methods for color modification, like infusion or dye, compared with working with the GMO flowers. Students were also familiarized with the normal color palette of carnation derived from classic breeding, compared with available genetically modified cultivars. They were also made aware of pricing differentials each year between classical bred cultivars and transgenic flowers (Table 1 delineates sample prices during select years of the class). By 2009, the difference in wholesale price between more expensive GMO and less expensive non-GMO cultivars (\$0.12/stem increase) was half as much as the difference in 2005 (\$0.24/stem increase) (Table 1).

During their midterm examination each year, students were asked an identical question regarding GMO carnation and how they should be marketed in a retail setting (Fig. 1). Students (role-playing future floral designers) deciphered whether they would offer GMO flowers in the retail setting, based on the test question (Table 2). Answers were categorized 1) into GMO crop information; i.e., floral design students will: a) not carry GMOs, b) offer GMOS and non-GMOs or c) only sell GMOs and 2) informing customers, i.e., the floral design students will (a) inform or b) not inform their customers (Table 2). GMO crop information data were tested with a 1:1:1 χ^2 test that there was an equal chance for all three possible answers if student answers were in all three categories, otherwise, a 1:1 χ^2 was performed for data in the b) and c) categories, whereas the customer information part was tested with a 1:1 χ^2 test.

Results and Discussion

An astounding 99% response (120/121) of students overall test years chose to offer the Moon™ series carnation (Table 2). However, only in 1 year (2005) did any student indicate they will not carry GMOs which meant that only in this year was a 1:1:1 χ^2 test possible (1:1:1 $\chi^2 = 5.99$, $P \leq 0.001$).

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
2.54	inch(es)	cm	0.3937

In all other years a significant majority of students answered they will offer non-GMOs and GMOs, rather than will only sell GMOs; the 1:1 χ^2 was significant for all years except 2006 (Table 2). Thirty-three students, in

all years, stated they would offer only GMO flowers.

Another concern of the future floral designers was whether they would inform their customers about the integration of GMO flowers into

the retail shop. Responses over 5 years were generally consistent as students would inform customers of the new GMO flower offerings (Table 2). With the exception of students in 2009, all others had a significant majority of students who would inform customers about the GMOs than those who would not (Table 2). In 2009 ($n = 23$ students), results were just the opposite and the 1:1 χ^2 was not significant. Only 8 students stated they would inform their customers, while 15 students did not plan to tell their customers about the GMO flowers. These students (2009) were also asked to compose marketing paragraphs for the Hogarth or S-curve designs using the GMO carnation in laboratory.

Table 1. Wholesale prices and price differentials between nongenetically modified organism (non-GMO) and GMO standard carnation for 2005, 2007, and 2009, three of the sample years in which this experiment was conducted. Price data were collected from flowers sold at Koehler & Dramm Wholesale Florists (Minneapolis, MN).

Yr	Non-GMO standard carnation price (\$/stem)	GMO standard carnation price (\$/stem)	Price differentials between non-GMO and GMO carnation price (\$/stem)
2005	0.33	0.57	0.24 increase
2007	0.35	0.49	0.14 increase
2009	0.40	0.52	0.12 increase

Midterm exam question for HORT 1013: Floral Design Students	“You just purchased lavender and purple <i>Dianthus caryophyllus</i> at your floral wholesaler, as they are needed for floral designs at a special gala event for the public. Usually you dye (dip or spray) your own carnations to achieve these colors, but you’re impressed by the new cultivars on the market. You have also learned that these are genetically modified flowers (GMO) and, consequently, they have a higher price point (nearly 2x higher than conventional ones). Develop a shop policy on how you will inform your customers about these new flowers. Think about who your customers are, what they need to know (if anything), and how you would convey this appropriately.”
Student suggestions for GMO carnation marketing ideas	Survey customers to decipher whether or not they would be willing to purchase GMO carnations at a slightly higher premium.
	Create separate displays for non-GMO and GMO standard carnations and identify the difference in the cooler and in designs, too.
	Print pamphlets describing GMO carnations to inform consumers.
	Utilize marketing tactics such as mailings and/ or social media to announce the introduction of GMOs in the retail shop.
	Track sales to determine whether or not GMOs are affecting/ reducing sales to determine whether or not to continue carrying the products.

Fig. 1. Midterm examination question and selected student (role-playing future floral designers) suggestions for implantation of floral shop policies regarding the introduction and offering of genetically modified organism (GMO) *Dianthus caryophyllus* (carnation) flowers.

Figure 1 shows two examples of the marketing paragraphs written for these designs. In one example, students chose to begin with “GMO flower products are in!...” and state the use of GMO flowers in the design (Fig. 2A). In the second example, the student mentions “...new, state-of-the-art purple carnations...” but does not include the fact that these flowers have been genetically modified for color (Fig. 2B). From the marketing paragraphs written by each student, data were again categorized for the number of students who chose to inform their customers about GMOs. The marketing paragraph results differed from those in the midterm exam question, but still remained relatively consistent. Only six students (26.1%) chose to inform their customers about GMOs in their marketing paragraphs as opposed to the eight students (34.8%) who stated

in their examination question they would inform their customers when creating GMO policies for the retail floral shop. However, this difference in responses was not significantly different. In both instances (the marketing paragraph and examination responses), the 1:1 χ^2 were significantly different.

STUDENT-DESIGN POLICY FORMATION. Every year students were asked on their midterm exams to develop a retail floral shop policy for those retail shops choosing to offer transgenic flowers and how to inform their customers of the new offerings. Figure 1 illustrates some of the suggestions made by students (role-playing future floral designers) for informing consumers about the introduction of GMO cut flowers. A variety of tactics were suggested from traditional marketing efforts and use of social media

to clearly labeling the difference between the GMO and non-GMO flowers (and their price differentials) in both the coolers and the arrangements. Students also suggested surveys and tracking of sales to determine customer opinions toward GMO ornamentals and whether they were willing to purchase the flowers. Tracking of sales would also indicate how the price differentials of GMO flowers are affecting the productivity of the floral shop. In general, students believed some approach to action must be taken to illustrate the difference or highlight the potential of the transgenic violet/purple carnation. Figure 3 shows a sample design created by a student in HORT 1013 Floral Design, showcasing the GMO violet standard and miniature carnation. Students observed designs similar to this to draw their conclusions on policy

Table 2. Year, sample size data, and chi-square (χ^2) tests (1:1 $\chi^2 = 3.84$, df = 1, $P = 0.05$; 1:1:1 $\chi^2 = 5.99$, df = 2) from midterm examination question whether students (role-playing future floral designers) will offer genetically modified organisms (GMOs) in their floral shops (categories: will not carry GMOs, will offer non-GMOs and GMOs, or will only sell GMOs) and whether they will inform their customers of the offerings (categories: will or will not inform customers).

Year	Students (no.)	Will not carry GMOs (no.)	Will offer non-GMOs and GMOs (no.)	Will only sell GMOs		Will inform customers (no.)	Will not inform customers	
				(no.)	1:1 χ^2		(no.)	1:1 χ^2
2005	26	1	14	11	***	21	5	***
2006	26	0	16	10	NS	25	1	***
2007	23	0	19	4	***	11	6	***
2009	24 ^a	0	19	4	***	8	15	NS
2011	22	0	18	4	***	18	4	***
Pooled	121	1	81	33	***	89	32	***

^aOne student did not answer this question.

NS=Not significant at $P > 0.05$ and ***very highly significant at $P \leq 0.001$.

(A) GMO flower products are in! These new top quality flowers are the new trend! GMO flowers come in many unique shades. There is no more dying and no more staining on your clothes and hands. There is no additional care for these unique flowers. It has already been taken care of unlike dyed flowers. These flowers have long vase life. This distinguishing trait is great for any ideal floral design!

(B) Gently curved scotch broom, delicate white statice, leaves of pittosporum, gracefully arched purple liatris, and new state-of-the-art purple carnations live harmoniously in this elegant design. Displayed in a rectangular olive green container, this S-curved arrangement measures approximately 28" h x 18" w x 18" d, and is designed to be viewed from the front. A perfect addition to any buffet table, end table, office, or event, this lovely arrangement is sure to make anyone feel like royalty!

Fig. 2. Selected student-composed marketing paragraphs (role-playing future floral designers) written for Hogarth (S-curve) designs containing genetically modified organism (GMO) carnation (*Dianthus caryophyllus*). (A) This student specifically identifies GMO flowers in the marketing paragraph whereas in (B), the student does not. Scientific names of the crops mentioned are: scotch broom (*Cytisus scoparius*), statice (*Limonium sinuatum*), pittosporum (*Pittosporum tobira*), and liatris (*Liatris spicata*); 28 inches high (h) x 18 inches wide (w) x 18 inches deep (d) = 71.1 x 45.7 x 45.7 cm.

Fig. 3. Sample floral design created in Floral Design (HORT 1013) showcasing transgenic, violet carnations; bar = 12 inches (30.5 cm).

formulation of GMO flowers in the retail setting.

ISSUES FOR FUTURE FLORISTS. As the development of genetically modified products continues to grow, there are still concerns surrounding their introduction. The case for future floral designers has been initiated with this study involving GMO carnation. Over the 5 years of this study, we were able to see differences in opinion from the students regarding GMO flowers in the retail setting. However, consumers are still relatively uninformed of the implementation and use of transgenic flowers on the market. As consumers begin to become more aware of the transgenic flowers, what other questions or dilemmas will arise and need to be addressed? Will they be as accepting of GMO cut flowers as future florists? As with transgenic food crops, safety is a serious concern for regulatory agencies and consumers. How do transgenic ornamentals rate in safety? According to the Australia Agriculture Biotechnology Report (USDA, 2012b), biotech carnations became the first biotech products to be assessed by the Gene Technology Regulator to “pose minimal risks to people or the environment, and are sufficiently safe to be used by anyone without the need for a license” (USDA, 2012b). How can we emphasize the safety of

carnation to all consumers, especially those who may be wary of GMO products?

Another serious issue for future floral designers will be the loyalty of their customers. For small and large operations alike, customer loyalty plays a key role in maintaining a strong business. Loyal customers expect to remain informed and information sharing is even more crucial with a controversial topic at hand. Not only are there concerns of the future floral designer and the customer, but technical, economic, regulatory and other market factors combined create hurdles for the utilization of biotechnology in horticultural crops (Bradford and Alston, 2004). Introduction and commercialization of the transgenic Moon™ series carnation by Florigene is a significant step in revolutionizing biotechnology in the horticultural sector.

Conclusions

Analyzing the acceptance of GMO carnation in the course and laboratory setting of Floral Design (HORT 1013) over 5 years has provided insight for the future use of transgenic cut flowers and their acceptance by florists. Future floral designers (students in the course) generally believed the transgenic flower offerings were an economical and time-saving option as

opposed to traditional methods of color modification (dip or spray dye). Acceptance of GMO flowers by future flower designers was higher than expected. Marketing of the GMO cultivars, as opposed to classic standard carnation, posed a more opinionated response with some future designers ignoring to inform their customers of the new offerings. Concerns still remain regarding how to market and inform customers of transgenic cut flowers. Potential customer opposition may include disregard for a higher price point, potential safety of GMO ornamentals, continued trust, and loyalty to their florist. Continued observation and testing of the retail sector and customer perceptions of GMO carnation will improve introduction policies for future cut flowers and other ornamentals.

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