



# ReTain: Managing Growth and Market Share

*Michael McCollough, University of Idaho*

*John J. Lawrence, University of Idaho*

Johan Pienaar, Valent BioSciences Corporation (VBC) global business manager for Plant Growth Regulators (PGRs), reached for a Gala apple sitting on his desk and took a bite. Rewarded with a satisfying crunch, he reflected on the strong likelihood that the apple had been treated with ReTain, one of his division's bestselling products. It was late fall, 2012, and today Johan had to prepare his 2013 strategic recommendations for his CEO and board about how to manage the growth and market share of ReTain, which was finishing its best year ever with over 65 percent of the total available market (TAM) for U.S. apples. Introduced in 1997, ReTain was a PGR that inhibited ethylene production in plants. Ethylene was a natural plant hormone that affected the growth, development, and maturation (ripening) of all plants. Using ReTain to inhibit ethylene production in apples reduced fruit drop (apples falling from the trees before they could be harvested), provided more consistent premium fruit (larger, firmer, crisper, and better-colored apples), and aided in harvest and storage management.

The growth opportunities for ReTain were numerous. ReTain was used on a number of other fruit and nut crops besides apples, including pineapples, peaches, and walnuts, and Johan could seek to increase its use on these crops. ReTain had also recently been found to be effective on almonds, so the opportunity existed to develop a new market for ReTain with almond growers. He could explore expanding the use of ReTain internationally, focusing on fruit varieties where efficacy had been established. For instance, China produced approximately 50 percent of the world's apples and peaches, and its sheer size made it a market worth considering. Organic markets were growing and presented opportunities as well as challenges. While there didn't seem to be much room for growth in the domestic U.S. apple market, the resurgence of a once vanquished competitor might justify additional investments to defend the existing market share. General research and development efforts could expand the use of ReTain into other agricultural markets. The preceding choices had pros and cons, and none assured success. Given that financial and managerial resources were limited,

---

Copyright © 2015 by the *Case Research Journal* and Michael McCollough and John J. Lawrence. This case study was prepared as the basis for classroom discussion rather than to illustrate either effective or ineffective handling of an administrative situation. An earlier version of this case was presented at the 2013 Western Casewriters Association meeting. The authors wish to thank Johan Pienaar and Michael Donaldson for their participation in the development of this case. The authors also wish to thank CRJ Associate Editor Nancy Levenburg, the anonymous CRJ reviewers, and the reviewers and roundtable participants at the WCA meeting for their helpful suggestions on how to make this a more effective case.

he felt very strongly that he needed to develop a coherent, focused strategy for the board that delineated in which of these areas he would invest time and resources and in which areas he would not.

## **AGRICULTURAL CHEMICALS INDUSTRY**

---

The agricultural chemicals industry, a subset of the larger chemicals industry, was composed of several large multinational companies such as Bayer and BASF with home offices in Germany, Dow, Monsanto, and DuPont in the United States, Potash (Canada) and Syngenta (Switzerland). Aside from these large players there were numerous smaller, typically more specialized firms. Altogether there were over 4,000 businesses operating in the industry, employing an estimated 257,000 individuals. The overall global value of the industry was \$153 billion. The majority (70 percent) of industry revenues were from fertilizers<sup>1</sup> with pesticides including herbicides accounting for about 30 percent.<sup>2</sup> Overall, the industry was growing at a modest rate as world population increased and more developing countries adopted the intensive use of fertilizers and pesticides.<sup>3</sup>

## **SUMITOMO AND VALENT BIOSCIENCES CORPORATION**

---

VBC was a unit of Sumitomo Chemical which was in turn a member of the Sumitomo Group, which was headquartered in Japan and traced its roots to the seventeenth century. Sumitomo Chemical had been established in 1913 to manufacture fertilizers from sulfur dioxide emitted from the smelting operations of a Sumitomo Group copper mine in Japan. Sumitomo Chemical was a large, diversified international company with over 135 subsidiaries and affiliates in five business sectors—basic chemicals, petrochemicals, IT-related chemicals, health and crop sciences, and pharmaceuticals. Therefore, while a player in the agricultural chemicals industry, its scope was much greater than this single industry. Sumitomo Chemical had 2011 revenues of ¥1,948 billion (about US\$ 20 billion) and employed 30,000 people worldwide.

Sumitomo Chemical had acquired the Agricultural Specialties Business of Abbott Laboratories in 2000 and renamed it Valent BioSciences (VBC). VBC was headquartered in suburban Chicago, which Johan called home. VBC employed about 250 people worldwide, with the majority being employed at the corporate headquarters. In 2012 VBC had revenues of approximately \$250 million, and was profitable. The vision of VBC was “To be recognized as the worldwide leader in the commercialization and supply of low-risk, environmentally-compatible, agricultural (including post harvest) public health, forestry, and services that add value to our customers, stakeholders, and employees.” The focus was on using science and technology to develop naturally occurring and environmentally compatible pesticides and PGRs to help solve growers’ problems. VBC did this in a manner that was sustainable for the environment and industry by developing and marketing environmentally friendly biorational products. Biorational products had an active ingredient typically derived from biological or natural origins and were highly targeted to specific pests with a low impact on the environment or non-target organisms. Broadly, biorational products were microbial (such as bacteria, fungi, nematodes, yeast, viruses, and protozoa) and biochemicals (PGRs, insect growth regulators, enzymes, plant extracts, and pheromones) from a variety of naturally occurring sources. A consumer who bought ladybugs to spread in his or her garden to fight harmful insects was using a biorational product. The use

of sex pheromones in traps or to disrupt mating of insects was another example of a biorational product. Even consumers who purchased yogurt with a probiotic to aid digestion were using a biorational product.

## JOHAN PIENAAR

---

Johan Pienaar had received a bachelor of sciences in agriculture from the University of the Orange Free State, in South Africa. After a year spent teaching high school biology, he took a job in R&D with a major agriculture chemical company. From the early days, he had been involved with PGRs, moving from R&D to technical support and then to sales and marketing as a regional manager. Obtaining a complete understanding of the industry, including channel relationships and the key commercial drivers, Johan joined Abbott Labs in 1992 as the South Africa country manager. Following this assignment, he had been promoted to global product manager for PGRs at Abbott's Chicago headquarters. Johan had continued his formal training in marketing, taking courses with Northwestern University's Kellogg School of Management, the University of Wisconsin, and Purdue. Courses delivered internally at Abbott and at his previous employer rounded out his education. Along the way Johan had learned how to refine a value proposition and the importance of demonstrating to the agricultural producers the ROI of PGRs to generate end-user demand. Johan stayed with VBC after its acquisition by Sumitomo from Abbott. Between Abbott and VBC, Johan had over twenty years of experience, spanning the technical world of R&D to the customer focused world of marketing.

## ReTAIN

---

The active ingredient in ReTain, aminoethoxyvinylglycine hydrochloride (aviglycine HCl), formerly designated as aminoethoxyvinylglycine (AVG), was a naturally occurring substance produced by the process of fermentation. AVG and its impact (ethylene biosynthesis inhibitor) had been discovered in the late 1970s. However, scaling up production of AVG had created such problems that it was not until twenty years later that VBC had been able to devise a method of successful commercial production. As a result, ReTain was not under any form of patent protection and VBC's only protectable intellectual property (IP) associated with it were the trade secrets associated with its manufacturing.

ReTain had extremely low toxicity to bees and other beneficial insects and had no lingering effects on future crops or tree performance. As a naturally occurring substance, it had the same toxicological classification as table salt and as of 2012, had been used for almost fifteen years with no noticeable adverse environmental impact.

When introduced in 1997, ReTain had been successfully targeted to apple orchard managers in the U.S. as a harvest management tool which could extend the harvest window. This was important to growers for a number of reasons. By delaying harvest, fruit stayed on the tree longer and grew larger, which resulted in both a higher yield per acre and premium prices for the larger fruit. This was particularly important for varieties that had naturally smaller fruit. For instance, shortly after the introduction of ReTain, Red Delicious apples fell out of favor with consumers and growers began to look for new varieties in an effort to appeal to consumers' changing tastes. Gala apples had excellent taste and color but tended to be smaller than consumers ideally wanted.

ReTain could extend the harvest by ten to fourteen days, with each day on the tree adding one gram (or about 1 percent) of weight for the apple. In addition to increasing the apple's size, use of ReTain also reduced fruit drop, which further increased an orchard's yield per acre.

Finally, the proper application of ReTain could allow an orchard to stagger the harvest. This resulted in more efficient use of labor and capital equipment. For instance, an orchard might spray half of its orchard over several weeks. This allowed a picking crew to be hired for a longer period of time and fewer workers overall to be hired. Since apple production was geographically concentrated in a few areas, the impact of all the orchards in an entire geographic area ripening at the same time had historically resulted in the use of migrant labor that moved from one section of the country to another, following the harvest of various crops. Often undocumented immigrants, the housing, working conditions, and pay of these workers was a major organizational, public policy, and human rights issue. Further, tightening immigration policies and increased enforcement in the U.S. had resulted in severe labor shortages for the industry. Orchards that used ReTain could hire fewer workers and employ them longer. Since labor costs were a significant cost for orchards, this was a significant benefit, especially when coupled with the higher yield ReTain provided. **Table 1** shows the typical cost structure for a large apple orchard.

There were 345,000 acres of apple orchards in the U.S. and VBC had achieved an almost 65 percent share of the total available market (TAM) for ReTain. TAM was calculated by first ruling out those varieties of apples that did not produce high levels of ethylene. For instance, ReTain worked well on Red Delicious, Gala, Golden Delicious, McIntosh, Rome, and Honeycrisp, since they all produced high levels of ethylene. For apples low in ethylene such as Fuji, Granny Smith, Braeburn, and others, ReTain delivered limited benefits and acreage planted in these varieties was not included in TAM (see **Table 2** for varieties of apples grown worldwide, by region). Approximately 75 percent of the varieties grown in the U.S. produced high levels of ethylene, reducing the acreage appropriate for the use of ReTain to 258,750. Further, apples produced for processing (juice and canning) were not considered part of the TAM because a grower received a far lower price per pound (\$0.092/lb. on average) for apples destined for processing compared to apples sold for fresh consumption (\$0.31/lb. on average). Growers could not justify ReTain's price for apples grown for the processing market. In addition, orchards that grew for processing were smaller, located in the Northeast and Midwest, and did not, because of their smaller size, have the same labor challenges that made staggering the harvest so desirable in the crucial Washington state orchards. Further, apples grown for processing were promptly processed, reducing ReTain's value in aiding storage quality. About 68 percent of the U.S. apple crop was produced for consumption as fresh, unprocessed fruit, further reducing the acreage appropriate for the application of ReTain to 176,000. Finally, the approximately 20,000 acres of very small family farms (which averaged less than fifteen acres) were not targeted. In summary, VBC targeted approximately 156,000 acres of the total U.S. acreage under production of 345,000 and had achieved a share of the TAM of about 100,000 or approximately 65 percent. While this might seem to allow some room for growth, it was unlikely that even loyal users of ReTain would treat their entire orchard because of its use as a harvest management tool.

**Table 1: Typical Cost Structure and Return per Acre for an Established Apple Orchard**

<b>Revenues (\$/acre)</b>	
Estimated Production (bins/acre)	60
Estimated Price (\$/bin)	\$500
<b>Total Revenues</b>	<b>\$30,000</b>
<b>Variable Costs (\$/acre):</b>	
<i>Orchard Activities</i>	
Pruning and Training	\$895
Chemicals (including labor to apply)	\$900
Fertilizer (including labor to apply)	\$350
Beehives	\$40
General Farm Labor	\$215
Irrigation/Electric Charge	\$200
<i>Harvest Activities</i>	
Picking Labor	\$1,680
Other Labor (checkers, tractor drivers)	\$420
Hauling Apples	\$480
<i>Warehouse Packing Charges</i>	\$9,546
<i>Maintenance and Repairs</i>	\$360
<i>Other Variable Costs</i>	
Overhead	\$754
Interest	\$594
<b>Total Variable Costs</b>	<b>\$16,434</b>
<b>Fixed Costs (\$/acre):</b>	
Depreciation	\$736
Interest	\$655
Management Cost	\$400
Insurance Cost (all farm)	\$50
Land & Property Taxes	\$60
<b>Total Fixed Costs</b>	<b>\$1,901</b>
<b>TOTAL COSTS</b>	<b>\$18,335</b>
<b>ESTIMATED NET RETURNS</b>	<b>\$11,665</b>
<i>Source: Galinato, S. and Gallardo, K. (2012) "2011 Cost Estimates of Establishing, Producing and Packing Honeycrisp Apples in Washington"—Washington State University Extension Fact Sheet FS062E.</i>	

Prior to the introduction of ReTain, growers managed their harvest by treating their orchards with NAA (naphthaleneacetic) as part of their overall spray program for insects and fungus. NAA protected the abscission layer in the stem (which controlled when the apple fell from the tree), thus reducing fruit drop, but it actually accelerated maturity. It had use in agriculture well beyond its use on apples. For instance, it was commonly used as a rooting agent to enhance propagation via cuttings. The price of NAA to treat apples was between \$30 and \$50 per acre.

**Table 2: 2011 World Tonnage by Variety by Region**

	Europe	China	India	Iran	U.S.	S. America	Other	WORLD
Acreage in ha <sup>1</sup>	<b>1,056,048</b>	<b>2,056,231</b>	<b>282,900</b>	<b>130,291</b>	<b>138,383</b>	<b>117,245</b>	<b>915,161</b>	<b>4,696,259</b>
<b>Variety</b>								
Fuji	270,000	24,500,000			370,847	597,040	908,937	26,646,823
Red Delicious	679,500	3,100,000	1,540,000	125,000	1,037,117	771,000	1,595,481	8,848,098
Gold Delicious	2,659,100	1,100,000		833,000	458,386	63,000	1,583,491	6,696,977
Gala	1,112,500	1,200,000			627,807	1,463,000	551,732	4,955,039
Jonagold	588,500	1,000,000			25,967	7,000	89,263	1,710,729
Granny Smith	375,500	80,000			352,596	362,000	342,650	1,512,746
Idared	715,000				102,132	0	169,479	986,611
Braeburn	330,000				66,355	54,156	186,141	636,652
Cripps Pink	177,000	32,000			74,813	170,000	158,000	611,813
Elstar	433,500					1,506	0	435,006
Jonathan	225,100				77,671	5,000	83,200	390,971
McIntosh	64,800				194,092	0	128,090	386,981
Jonagored	272,500					0	0	272,500
Rome Beauty	87,000				153,723	3,000	10,000	253,723
Reinette	107,000					0	131,000	238,000
Honeycrisp	0				161,934	0	6,803	168,737
All Others	2,549,500	3,988,000	210,000	1,542,000	523,908	93,298	2,566,304	11,473,010
Total Covered <sup>2</sup>	10,646,500	35,000,000	1,750,000	2,500,000	4,227,346	3,590,000	8,560,570	66,274,416
Not Covered <sup>3</sup>	1,382,000	0	0	0	0		585,000	1,967,000
<b>GRAND TOTAL</b>	<b>12,028,500</b>	<b>35,000,000</b>	<b>1,750,000</b>	<b>2,500,000</b>	<b>4,227,346</b>	<b>3,590,000</b>	<b>9,145,570</b>	<b>68,241,416</b>
Productivity <sup>4</sup>	11.39	17.02	6.19	19.19	30.55	30.62	9.99	14.53

<sup>1</sup> ha or hectare is equal to 2.47 acres

<sup>2</sup> In some countries, variety breakdowns are available only for commercial orchards.

<sup>3</sup> Tonnage is known, but not variety breakdown.

<sup>4</sup> Productivity is measured in tons/ha

Source: Belrose, Inc., Pullman, WA 99163, U.S.A.

To combat the tendency of growers to stick to traditional, tried-and-true methods, VBC developed a multipronged strategy to market ReTain. First, VBC carefully researched the market to better understand the customers. This led to a proof of concept that generated detailed data to demonstrate the superior value of the product (see **Table 3**). The sales force, distributors, and growers were educated on methods to change overall orchard management practices. VBC focused on “key influencers” such as researchers, agricultural experts in universities, including agricultural extension agents, and best practice orchards that served as models for their peers. Finally, the product was positioned to emphasize the overall value of using ReTain.

**Table 3: Drop Control Benefit, McIntosh Apples, New York**

	Yield Boxes/Ac	% Drop	Fresh Mkt Boxes/Ac	Fresh Mkt \$18.25/box	Juice Number/boxes	Juice \$5.00/box	Total (\$)
Retain	1,046	13.5%	904	\$16,498	142	\$710	\$17,208
Untreated	1,046	52.0%	502	\$9,162	525	\$2,625	\$11,787
<b>ReTain Benefit per Acre = \$5,421</b>							
Source: VBC Research and Marketing Materials.							



VBC had priced ReTain such that orchards paid \$250 per acre, reflecting its value to growers, its high cost to manufacture, and its premium margin potential. Thus, ReTain was about five times as expensive as the competing product, NAA. ReTain was not directly positioned against NAA, nor was it positioned as simply part of the spray program since its use could increase an orchard's spray budget by 50 percent to 100 percent. Rather, ReTain was marketed as a relatively small part of the overall production program and budget. And while the price of ReTain was five times that of NAA, growers generally saw a fivefold to tenfold Return on Investment (ROI) from its use, with some orchards seeing a return as high as twenty-fold. Because NAA was sold as a liquid or powder and because growers often went "off-label"<sup>4</sup> when using agricultural chemicals to get desired results, ReTain was launched as a "one pouch per acre" water soluble packet that could be dropped into the spray tank with no measuring.

Indeed, ReTain essentially created the product category of harvest management, launching under the tagline "Harvest the Potential." ReTain worked best as part of an overall harvest management strategy, aimed at sophisticated growers. To get maximum results, everything else had to be optimal in the orchards, from pruning to pest control. Further, growers treated only a part of their orchards (on the order of 50 percent) with ReTain to optimize the time period in which they were harvesting fruit. While it might seem that a grower could use ReTain to delay harvest and "time the market" to deliver fresh from the tree fruit to customers over a longer period of time, this was not a factor in practice since apples could be stored for nine months or more.

While VBC depended on wholesalers and retailers to distribute the product, it relied on its technical sales force to help the market overcome "sticker shock." VBC invested in considerable training of this sales force just as it had invested in research to demonstrate ReTain's value to growers. Initially, this sales force focused on key influencers by hosting them on field trips and engaged them at industry meetings. As a result, growers came to see ReTain as a critical component of their management program to optimize overall apple crop profitability, and it was accepted as standard industry practice by top growers.

## USE OF ReTAIN BEYOND APPLES

---

As a PGR, ReTain could be used on crops beside apples, but the effect on each was different. In addition, subtle differences in the operations of different types of growers also impacted customer use and acceptance and, therefore, marketing strategy. Broadly speaking, ReTain could be used at harvest, such as with apples, or it could be used at flowering to improve fruit set. For example, VBC had already developed and marketed ReTain successfully for use on walnuts. A key problem for walnut growers was pistillate flower abscission (PFA). Occurring during bloom, PFA could lead to reduced fruit set and low yields. ReTain could block the production of ethylene which resulted in PFA. Thus, unlike apples, walnut growers applied ReTain during bloom as opposed to harvest. Application of ReTain to walnuts during bloom could significantly increase yields. Acting most effectively on the Serr variety of walnuts, ReTain had a 75–80 percent share of the California and Chile walnut markets. Satisfied with the success of ReTain in walnuts, Johan saw little potential growth in this sector.

## Peaches

ReTain could be used on stone fruit, primarily peaches. Here the marketplace results were decidedly mixed. In South Africa and Australia, the introduction of ReTain for peaches had been very successful. Australians grew primarily for the domestic market, so producing quality fruit that was fresh, sweet, and ready-to-eat was paramount. Fruit had to be tree-ripened to sell. ReTain was applied seven to fourteen days prior to harvest, allowing the peaches and nectarines to “hang longer” to gain size and develop excellent flavor. This worked for the Australian domestic market when combined with swift speed to market. In the U.S., the introduction of ReTain in the key California production region for peaches had so far not been successful. While consumers seemed very aware of different varieties of apples, and grocery stores could be counted on to have an aisle of many different varieties of apples, for most consumers a peach was a peach. At best, some consumers might seek out locally grown peaches or peaches from a specific region (e.g., Georgia peaches). As a result, California growers had developed a harvest management technique that involved planting several peach varieties that matured at different times to stagger the harvest. Applying ReTain actually produced a “gap” in the harvest, which in turn resulted in a bottleneck as several varieties ripened at the same time. Further, growers picked the fruit when it was firm and before it was tree-ripened to allow for shipping to distant domestic and international markets. This resulted in the common grouse of consumers that peaches went from too firm to eat in the store to overripe and rotting in the kitchen in what seemed like a very short time. Also, while the fruit looked good in the store, it was not sweet. Some California growers, recognizing this problem, had begun to work with packing houses on a tree-ripe program. These growers, similar to the Australian growers, had begun to apply ReTain in order to allow the fruit to remain on the tree longer so it could “sugar up.” Consumers were becoming more demanding about the quality of their fruit as well as buying locally (locavores), two trends that favored ReTain. Therefore, in the smaller peach production areas of Georgia, the Carolinas, and the Northeast, ReTain had begun to gain use in the tree-ripened niche where product was rapidly shipped to market.

Johan could relaunch ReTain in the California peach market by focusing on education and building niche markets among growers that wanted to ship high quality, tree-ripened fruit. Inevitably, this would not be the largest growers, but smaller, quality producers. Similar to the introduction of ReTain in apples, the education effort would be long and time consuming. While there had been a clear unmet need with apples and walnuts, Johan was less sure that there was a large enough unmet need in this market. Regardless, the overall size of the peach market was much smaller than the international apple market (see **Table 4**).



**Table 4: World's Top Producers of ReTain Appropriate Crops, by Tonnage in 2010**

<b>Apples</b>				<b>Walnuts</b>			
Rank	Country	MT	ha	Rank	Country	MT	ha
1	China	33,265,186	2,044,631	1	China	1,060,600	299,500
2	U.S.A.	4,212,330	139,435	2	U.S.A.	458,000	95,911
3	Turkey	2,600,000	165,078	3	Iran	270,300	60,600
4	Italy	2,204,970	57,907	4	Turkey	178,142	90,683
5	India	2,163,400	305,800	5	Ukraine	87,400	14,060
6	Poland	1,858,970	188,245	6	Mexico	76,627	69,548
7	France	1,711,230	39,951	7	Romania	34,359	18,500
8	Iran	1,662,430	130,291	8	India	33,400	30,800
9	Brazil	1,275,850	38,563	9	France	30,460	17,541
10	Chile	1,100,000	35,029	10	Chile	30,000	15,451
	World Total	69,569,612	4,728,333		World Total	2,555,090	844,162
<b>Pineapples</b>				<b>Peaches</b>			
Rank	Country	MT	ha	Rank	Country	MT	ha
1	Philippines	2,169,230	58,549	1	China	10,718,048	732,359
2	Brazil	2,120,030	58,507	2	Italy	1,590,660	90,259
3	Costa Rica	1,976,760	45,000	3	Spain	1,134,750	73,000
4	Thailand	1,924,660	93,312	4	U.S.A.	1,044,440	59,461
5	China	1,519,072	57,327	5	Greece	639,400	37,030
6	India	1,420,400	91,900	6	Turkey	534,903	28,773
7	Indonesia	1,390,380	121,410	7	Iran	500,000	45,000
8	Nigeria	1,052,000	130,000	8	Chile	357,000	19,301
9	Mexico	701,746	16,604	9	France	324,401	13,747
10	Viet Nam	477,200	41,100	10	Argentina	318,000	26,500
	World Total	19,408,581	879,175		World Total	20,528,283	1,538,682
<b>Almonds</b>							
Rank	Country	MT	ha				
1	U.S.A.	1,413,800	291,373				
2	Spain	222,518	546,789				
3	Iran	158,050	72,972				
4	Australia	156,324	29,340				
5	Italy	108,160	86,184				
6	Morocco	87,104	142,018				
7	Syria	73,104	49,133				
8	Algeria	56,973	39,757				
9	Afghanistan	56,000	11,210				
10	Turkey	55,398	18,415				
	World Total	2,701,765	1,624,250				

*Source:* Food and Agricultural Organization of the United Nations statistics website ([www.faostat.fao.org](http://www.faostat.fao.org))  
ha = hectare; 1 ha = 2.47 acres MT = metric tons; 1 MT = 2,204.6 pounds.

## Pineapples

VBC had developed a special formulation of ReTain for pineapples called PinCor, which was applied prior to flowering. PinCor addressed the production of ethylene which caused naturally differentiated flowering (NDF), leading to uneven fruit development. NDF led to a pineapple field ripening over a longer period of time, resulting in the same field having to be harvested several times. Pineapples produced ethylene due to stress, most notably a drop in temperature, which would cause premature flowering. Application of PinCor needed to commence prior to NDF and continue at seven-day intervals while NDF was a threat. In practice, this meant multiple applications of PinCor, sometimes over several months, while the pineapples were in the vegetative fruit state (prior to flowering). A temperature drop to around 18 to 20 degrees Celsius (65°–68° Fahrenheit) was sufficient to trigger NDF. This was primarily a problem in the growing regions of Costa Rica, Honduras, Hawaii, and the Philippines from mid-November until March, while in some other pineapple growing regions, notably Ecuador, NDF was not an issue. Application of PinCor could also produce larger fruit and more fruit per acre.

Because PinCor had to be applied weekly while NDF was a problem, the price per dose of PinCor was set lower than that of ReTain to make treatment with PinCor more affordable. However, the total cost to treat an acre of pineapples with PinCor over a season (> \$2,000) was higher than the cost to treat an acre of apples with ReTain. PinCor was registered only for use on Pineapples. Growers raised and harvested pineapples year-round and the TAM for PinCor was, in the areas where NDF was a problem, reduced to only about four months of the year, or one-third of the growing season. In other words, fields that flowered from April to October would not be a candidate for PinCor. Like apples, the market was only for export-quality fresh fruit, not pineapples destined for processing. Markets like Thailand that grew fruit almost exclusively for processing were not included in TAM. Johan wondered if VBC should try to further develop the markets of Honduras, Costa Rica, and the Philippines, which had the most trouble with premature flowering and grew a significant quantity of export-quality fresh fruit. While Hawaii had problems with premature flowering, Hawaii was no longer a significant player in the international pineapple market.

## INTERNATIONAL MARKETS

---

Johan, a frequent international traveler, thought back to the fruit markets he had seen around the world. The fruit industry was truly international in scope, with many crops grown around the world. However, the difference in the way each crop was grown and the appropriateness and correct marketing approach of ReTain varied greatly, both by crop and international market.

## China

Johan could seek to grow internationally by focusing on crops where the efficacy of ReTain had been established, like apples. Table 4 shows the ten largest producing countries, by tonnage, for the fruits ReTain was most suitable. China was by far the world's largest apple producer. Chinese orchards produced thirty-three million tons of apples in 2010, eight times more than U.S. orchards produced. Apple production in China was also growing steadily at about 5 percent to 6 percent per year, with the

largest growth coming in apples grown for fresh domestic consumption. In 2011, approximately 82 percent of China's apple crop was for fresh domestic consumption (up from 70 percent in 2007), 15 percent was processed (down from 27 percent in 2007), and the remaining 3 percent were exported fresh. Despite the shift of usage from processed to fresh, China remained the leading worldwide producer of apple juice, accounting for more than 50 percent of the worldwide supply.

Since VBC's parent company was based in Japan, it was no stranger to Asian markets. Further, a number of VBC's products were being marketed in China, and VBC had received requests to distribute ReTain in China. But there were significant differences between the Chinese and U.S. apple industry. Production was highly fragmented, with many smaller orchards that averaged  $\frac{1}{10}$  of a hectare.<sup>5</sup> Even large orchards in China were smaller than their U.S. counterparts. Only about 10 percent of the orchards used high production technology methods. Unless orchards were managed for high yields, they didn't produce enough fruit per acre to justify the cost of ReTain. In addition, numerous examples existed of the misapplication of agriculture chemicals in the developing world, as growers reasoned "if a little is good, more is better." While the over-application of ReTain was not likely to harm the crop or the environment, over-application would drive up costs and lead to producers rejecting ReTain as too expensive. While labor was the highest cost for U.S. orchards, it was not for Chinese orchards. Further, the popularity of the apple varieties grown in China differed from those grown in the U.S. (see Table 2). Some popular varieties (e.g., Fuji) produced less ethylene close to harvest, which meant the need to delay maturity was lower and the responsiveness to ReTain would also be less.

In addition to apples, China was also a major producer of pineapples, walnuts, and peaches. Despite the overall size of the Chinese market, Johan was concerned that it might be too different from the U.S. market for ReTain to be successful.

## Europe

Europe, like China, produced considerably more apples and stone fruit than the U.S. and also produced walnuts in significant numbers. European orchards produced twelve million tons of apples annually, almost three times more than U.S. orchards produced. Italy, Poland, and France were the three largest producers in Europe, accounting for almost 60 percent of all apples grown in Europe. The European apple market tended to look more like the U.S. market than the Chinese market. Like in the U.S., Red Delicious, Gala, and Golden Delicious were the top three varieties grown. Most apples (about 85 percent) were grown in small to moderately large orchards that employed high production technology methods, and labor was typically the highest cost for these orchards. About 75 percent of this production was for fresh consumption, primarily within Europe, with the remaining 25 percent being processed, primarily into apple juice. Apple production in Europe was also growing at a moderate 3 percent growth rate.<sup>6</sup>

In order to sell ReTain in Europe, VBC would need to obtain the necessary certification, which would be expensive and time consuming. And while some PGRs had been approved in Europe, approval of ReTain was by no means assured. Johan estimated that the cost to conduct the studies needed to attain European certification would take the majority of the budget he had to pursue growth opportunities and could take five years or longer. Johan felt that if VBC sought certification in Europe, the likelihood of success was only about 20 percent.

## ORGANIC MARKETS

---

Organic fruit was a growing segment of the produce market. Globally, sales of organic food had experienced double digit annual growth rates for nine of the last ten years.<sup>7</sup> In 2010, sales of organic food exceeded \$55 billion dollars. The countries with the largest organic markets were the U.S., Germany, and France. On the production side, there were 37.2 million hectares of organic agricultural land, including land in the process of being converted to organic worldwide. While much of this was in grassland/grazing land, there were 2.4 million hectares of land used for the organic production of perennial crops, including coffee, cocoa, fruits, and nuts. Australia had the most total organic agricultural land, followed by Argentina and the United States.

Organic production of apples in the U.S. had grown by 70 percent from 2005 to 2009, from 12,507 acres to 21,269 acres.<sup>8</sup> The state of Washington accounted for almost 75 percent of the organic apples grown in the U.S., with 15,735 acres under organic production. This represented more than 10 percent of the apple acreage in Washington. Most major fruit companies in Washington grew both conventional and organic apples in order to satisfy the varied needs of their customers. Growers in the state of Washington sold 5.6 million forty-pound boxes of organic apples in 2009. While the price premium received for organic apples was somewhat volatile, that premium averaged \$6.47 per box over the period from 2005–2009. Production costs per acre of organic apples were estimated to be about 6 percent, or \$650, higher than for conventional apples.

Depending on whom you asked, ReTain either qualified or didn't qualify for use on fruit that was labeled organic. As a naturally occurring substance, ReTain qualified as organic according to the U.S. Department of Agriculture's National Organic Program (NOP) guidelines.<sup>9</sup> The Washington State Department of Agriculture's Organic Program reviewed and registered input materials for use in organic production based on the NOP guidelines and published a list of allowed materials by brand name. ReTain had been included on that list as an allowed crop production aid for organic produce since 2001.<sup>10</sup> The Organic Materials Review Institute (OMRI), the leading independent organic certification organization in the U.S., did not currently include ReTain on its list of approved inputs for organic produce.<sup>11</sup> OMRI had recently re-evaluated ReTain and, despite having listed it as suitable for organic production for a number of years, had recently determined that ReTain did not qualify as organic because of questions regarding how it was produced. The OMRI list did contain thirty-seven other VBC products, including other PRGs. Johan believed that with some effort, VBC could overcome OMRI concerns and obtain organic designation from the organization again. Based on compliance with the USDA's NOP guidelines and explicit recognition by state programs like those in Washington state, VBC continued to market ReTain as suitable for use on organic produce despite not designated as such by OMRI. Further, a number of growers continued to use ReTain on their organic apples, particularly the larger Washington state growers who grew both conventional and organic apples and had used ReTain for many years.

## THE DOMESTIC MARKET—DEFEND AND HARVEST?

---

As a passionate sports fan, Johan had loved to play rugby and cricket in South Africa, and with his move to the U.S. he had developed fervor for NCAA football, basketball,

and hockey. Johan knew that in business, as in sports, a strong defense was as important as a strong offense, even if defensive battles were often less appreciated. The resurgence of NAA (naphthaleneacetic acid) as a competitor in the U.S. apple market was causing Johan to consider whether some of the dollars he hoped to use to grow ReTain would be better spent defending ReTain's strong position in that market. ReTain customers were sophisticated and very aware of their cost structures. Some orchards had recently begun to mix half the recommended ReTain with NAA, reducing their costs while achieving the desired longer "stop drop" window. VBC had obtained research that showed that using ReTain at full strength with NAA produced the best results, but Johan wondered if the research would be compelling enough to check the resurgence of NAA. Further, he worried that promoting a spraying program consisting of a full treatment of ReTain combined with NAA could have the effect of legitimizing the practice of using partial dosages of ReTain in combination with some quantity of NAA. VBC had rejected selling a premixed ReTain and NAA product because of differences in rates of applications of NAA depending on timing, region, and variety. One possibility was for VBC to begin to manufacture and market NAA, something which it had not done in the past. NAA would be a small niche product but its margins would be good. Possibly NAA could be co-marked with ReTain. While not strictly a biorational product, NAA still was regarded by Johan as being a low impact, low residual product with no toxicity.

## RESEARCH AND DEVELOPMENT

---

Johan wondered how much of his resources he should allocate to continuing R&D on ReTain. After all, it was VBC's investment in R&D that had led to the original development of ReTain for the U.S. apple market. After the U.S. apple market had been developed, VBC's continuing commitment to R&D had revealed its efficacy on walnuts, stone fruits, and pineapples. Because ReTain acted on ethylene production, a chemical present in most crops, it was very possible that efficacy could be established for new fruit or other agricultural crops.

Money allocated to R&D not only supported investigation of brand new uses for ReTain, but also supported expansion of previously registered uses for ReTain and the pursuit of regional and/or specific segment opportunities. This work fell more on the commercial development side of R&D and was typically driven by feedback from VBC and/or Sumitomo affiliates' salespeople based on their work with growers and/or regional agricultural specialists. In a typical case, salespeople would work with individual growers to explore the use of ReTain by treating just a few trees for efficacy. As an example of this bottom-up approach to R&D, Johan had received a proposal to reinvigorate the commercialization efforts for ReTain's use on almonds. The proposal had come from salespeople and was based on growers' experiences. Similar to walnuts, ReTain could be applied during flowering. While VBC had registered ReTain for use on almonds, it had not gathered significant performance data on almonds nor had it attempted to market ReTain for use on almonds. But the market was sizable. In California alone there was over 700,000 acres of almonds. The R&D proposals would investigate how to drive adoption of ReTain's use on almonds with the hope it could be as successful as ReTain's use on walnuts.

Alternatively, Johan had a confidential proposal prepared by VBC research scientists singling out another promising fruit for which a Proof of Concept (POC) study

was being proposed. A POC would involve field trials that would demonstrate not just efficacy in the field but the exact amount of ReTain that should be applied, including its timing schedule. This would in turn allow the registration of ReTain for use on the crop and the development of the value proposition that would be presented to growers. The basic science in the lab had established that this new crop was very promising, and the market size of the crop was significant. Currently there was vast acreage of this crop under cultivation worldwide. Further, the crop grew year-round and therefore ReTain would be applied multiple times throughout the year to the same plant. The crop was grown on massive farming operations using very sophisticated techniques. Given the sheer size and complexity of the industry, however, it was difficult to even determine with any certainty how much pursuing this crop would cost and what percent of his budget it would consume. The cost would no doubt be very significant and success was not in any way assured.

## THE DECISION

---

Johan reflected on his decision as he finished his apple. He could not do everything; resources were, after all, limited. How should he prioritize potential actions in his recommendation to his CEO? Johan found the problem very frustrating because it was hard to focus on a single large market. There was no international apple market because the farming methods varied from country to country, as did the varieties grown. Likewise, there was no easy way to dominate any one international fruit market, such as the U.S. Johan also found it frustrating that, while ReTain was successful in stone fruit in Australia, it was very difficult to capitalize on this success in the U.S. It would be so much simpler if he could simply focus on the U.S. (or for that matter China or Europe) for all fruits. Or if he could simply concentrate on apples (or stone fruit or pineapples), no matter where they were grown. Some kind of integrated strategy was required that focused VBC to build on ReTain's success to date.

There was also the question of how to balance the apparent need to respond to threats with the desire to push for new growth. Should VBC focus on defending the market share ReTain had obtained in the U.S. to date and/or its status as suitable for certified organic production? Or should it focus on known growth opportunities in pineapples and peaches, or organic markets, or in China or Europe? Or should resources be put into more basic research on the ReTain formulation in an effort to find entirely new market opportunities that might not face the challenges of the known growth opportunities? Johan had jotted down the eight primary options from which he would build his recommendation to the CEO and beside each had noted approximately how much of his estimated budget for the next two years it would take to pursue the option (see **Table 5**). He had listed the options in order of increasing uncertainty, both in terms of how much of his budget the effort would take as well as the ultimate outcome that would be achieved in pursuing the option. The new POC option was the most uncertain, and it was very difficult to know just how much of his budget it might take. Johan guessed he would need to allocate at least 20 percent of his budget to the effort to make any real progress, and that allocating more would allow them to get to an answer on POC sooner rather than later. Johan tossed the apple core aside and looked at the note pad where he had listed the options. It was time to make some decisions on which options should be pursued to help VBC get the most out of its ReTain product line.



**Table 5: Percent of Budget Required to Pursue ReTain Growth Opportunities (opportunities are listed in order of increasing uncertainty)**

	% of available resources needed to commit to pursue the option
Continued development of the pineapple market.	15
Increase efforts to market ReTain in the U.S. peach market.	10
Work to reestablish OMRI certification.	15
Develop and launch a VBC NAA product.	30
Pursue commercial development of almond market.	60
Invest in market development work in China.	40
Pursue certification of ReTain for use in Europe.	90
Investigate proof of concept for use in a previously untested agricultural product with market potential of several million hectares.	??
<i>Source:</i> Estimates provided by Johan Pienaar.	

**Exhibit 1: List of Abbreviations**

AVG	Aminoethoxyvinylglycine hydrochloride (aviglycine HCl), formerly designated as aminoethoxyvinylglycine (AVG)
NAA	Naphthaleneacetic
NDF	Naturally Differentiated Flowering
NOP	National Organic Program
OMRI	Organic Materials Review Institute
PFA	Pistillate Flower Abscission
POC	Proof of Concept
RGR	Plant Growth Regulator
TAM	Total Available Market
VBC	Valent BioSciences Corporation

**NOTES**

1. IBISWorld (2013). "Global Fertilizers & Agricultural Chemicals Manufacturing: Market Research Report." Accessed online at <http://www.ibisworld.com/industry/global/global-fertilizers-agricultural-chemicals-manufacturing.html>.
2. Hoovers (2013). "Agricultural Chemical Manufacturing Industry Overview." Accessed online at <http://www.hoovers.com/industry-facts/agricultural-chemical-manufacturing.1086.html>.
3. Pate, M. (October 9, 2012). "The Unabridged Guide to the Global Fertilizers & Agricultural Chemicals Industry," *Insider Monkey*. Accessed at <http://www.insidermonkey.com/blog/the-unabridged-guide-to-the-global-fertilizers-agricultural-chemicals-industry-23046/>.

4. Off-label was the practice of using a product in a manner not approved or authorized by the manufacturer or regulatory agencies. It could mean using the product for a use other than intended or changing the dosage amounts in an effort to get a different result.
5. Hectare (ha) is a metric measure of land. One hectare equals 2.47 acres.
6. Statistics reported in this paragraph are taken from data in case Tables 2 and 4 and from USDA Foreign Agricultural Service (2013). "Global Agricultural Information Network Report 'EU-28 Fresh Deciduous Annual Report.'"
7. Statistics in this paragraph are from, Willer, Helga, Kilcher, and Lukas (Eds.) (2011) *The World of Organic Agriculture—Statistics and Emerging Trends 2011*. IFOAM, Bonn, and FiBL, Frick.
8. Statistics in this paragraph are from Kirby, E. and D. Granatstein. 2009. "Recent Trends in Organic Tree Fruit Production: Washington State 2009. Center for Sustaining Agriculture and Natural Resources." Washington State University, Puyallup, WA. [http://csanr.wsu.edu/publications/techreports/wa\\_ortreefr\\_11\\_09\\_final.pdf](http://csanr.wsu.edu/publications/techreports/wa_ortreefr_11_09_final.pdf).
9. See USDA National Organic Program website for guideline details at: <http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateJ&leftNav=NationalOrganicProgram&page=NOPNationalList&description=National%20List%20of%20Allowed%20and%20Prohibited%20Substances&acct=nopgeninfo>.
10. WSDA Organic Program—Brand Name Material List—Sorted by Product Type (May 4, 2012), page 2 accessed at [http://agr.wa.gov/FoodAnimal/Organic/docs/2012\\_WSDA\\_BNML\\_May.pdf](http://agr.wa.gov/FoodAnimal/Organic/docs/2012_WSDA_BNML_May.pdf).
11. See <http://www.omri.org/omri-lists/download> for access to OMRI's approved product lists.