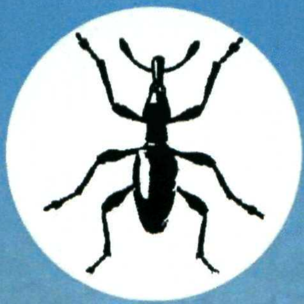
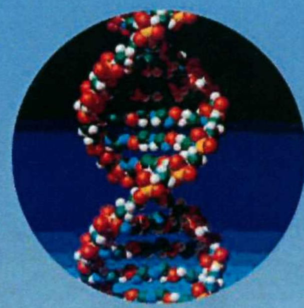
   

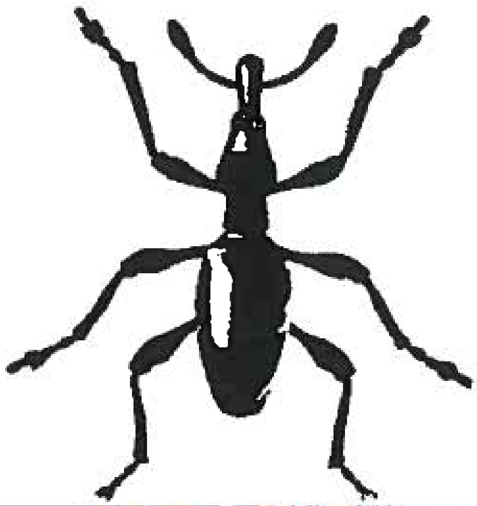
EDUCATIONAL REPORT:

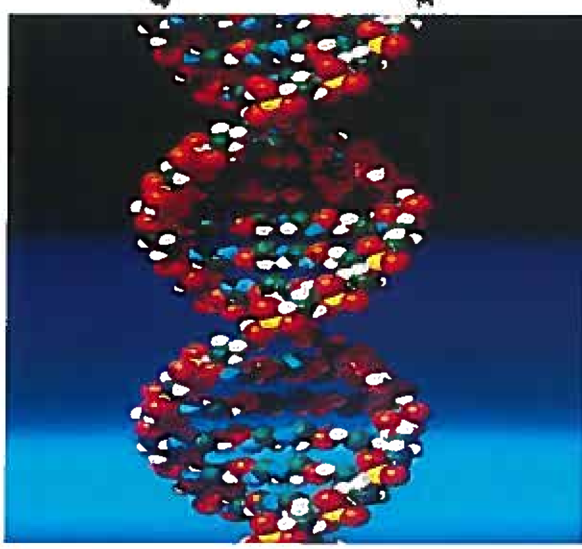
PATENT LANDSCAPE OF SEVERAL *BACILLUS THURINGIENSIS* CRY PROTEIN GENES IN SWEETPOTATO

PIERCE LAW
FRANKLIN PIERCE LAW CENTER

IP RESEARCH TOOLS TEAM (FALL 2007)

EDUCATIONAL REPORT: PATENT LANDSCAPE OF SEVERAL *BACILLUS THURINGIENSIS* CRY PROTEIN GENES IN SWEETPOTATO





IP RESEARCH TOOLS TEAM (FALL 2007)

EDUCATIONAL REPORT: PATENT LANDSCAPE OF SEVERAL *BACILLUS THURINGIENSIS* CRY PROTEIN GENES IN SWEETPOTATO

JANUARY 2008

FRANKLIN PIERCE LAW CENTER
IP RESEARCH TOOLS TEAM

PROFESSORS
JON CAVICCHI, J.D., LL.M (Intellectual Property)
STANLEY KOWALSKI, Ph.D, J.D.

STUDENTS
BUMRAE CHO
JOHN KENYON
NATALIA PENCE

Acknowledgements

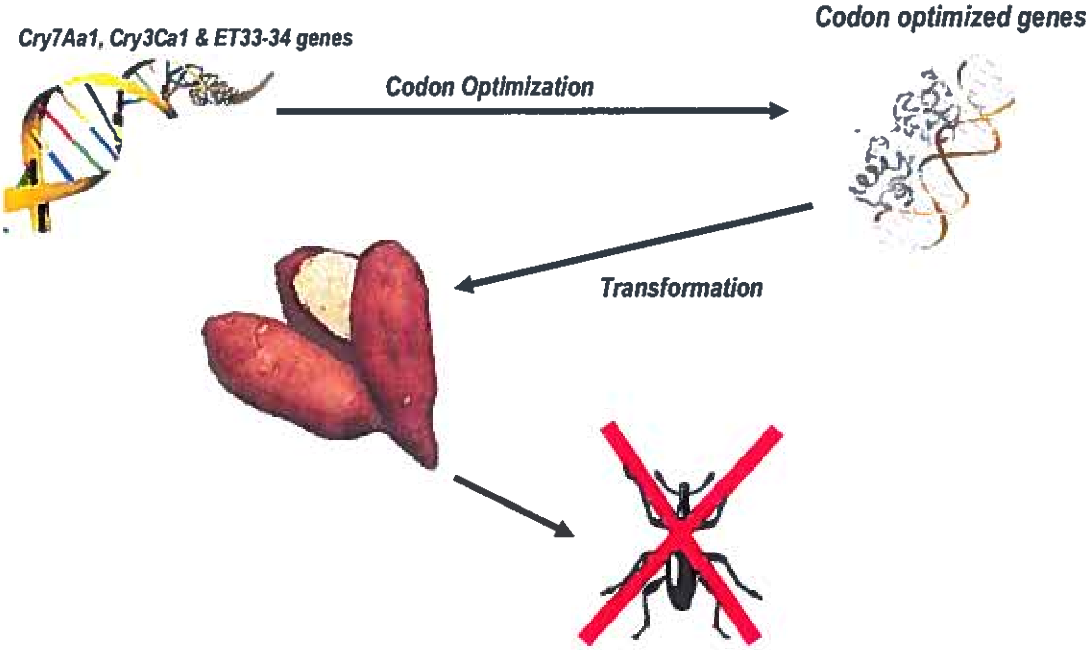
We gratefully acknowledge the patent searching assistance of Franklin Pierce Law Center alumni Rose Ndegwa, of the *International Livestock Research Institute's Intellectual Property Management Unit*, David Njuguna, of the Kenyan Industrial Property Institute, and Christopher Kiige, the Technical Director of ARIPO. We also wish to thank Franklin Pierce Law Center alumni Attorney Gisella Barreda Moller for her time and contribution with the Peruvian patent search.

We also appreciate the patience, support, and encouragement of our families and thank Professor Jon R. Cavicchi, J.D., LL.M and Stanley P. Kowalski, Ph.D, J.D., without whom this Report would be impossible.

TABLE OF CONTENTS

Executive Summary

a. Scope of the Project



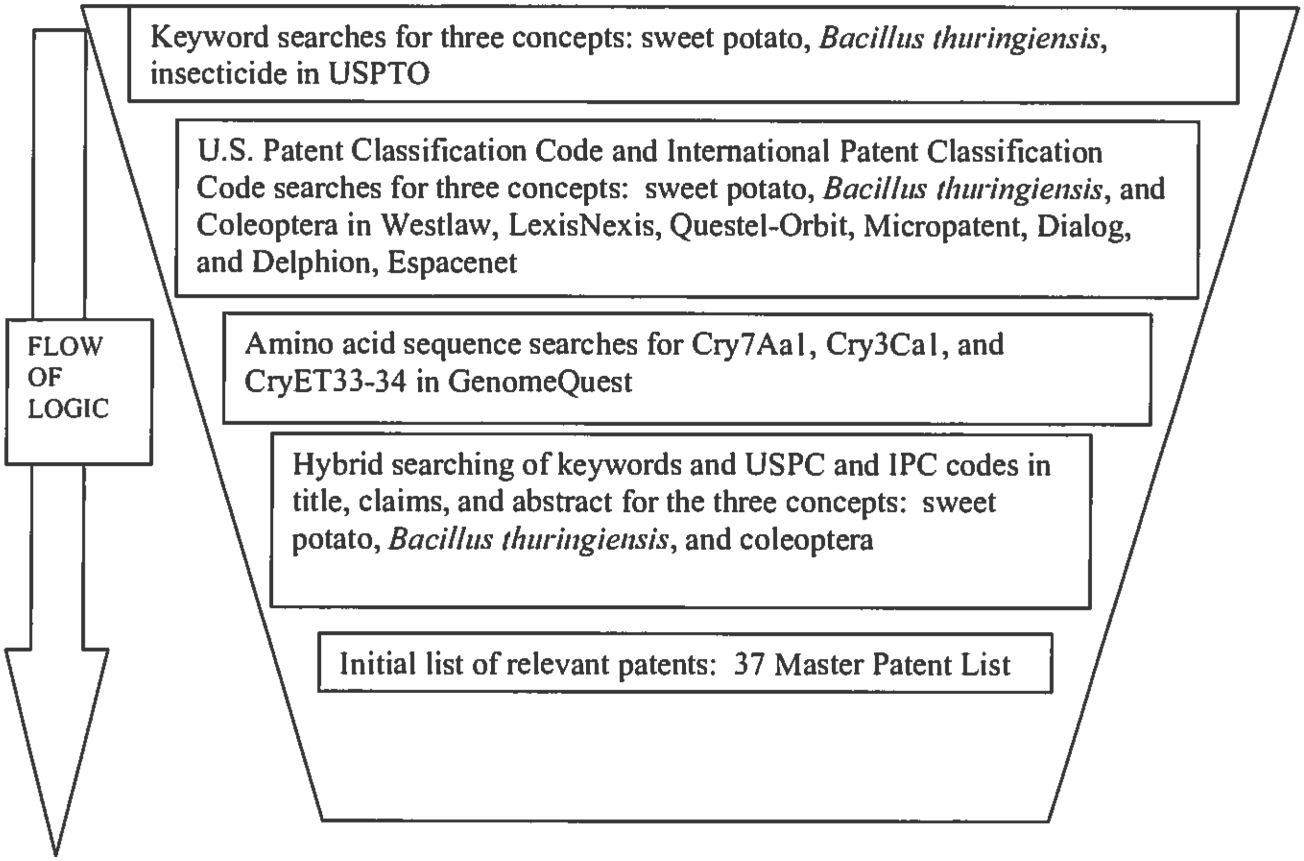
This Report is an information resource to facilitate a better understanding of the international patent literature landscape with regard to the development of a sweet potato expressing a *Bacillus thuringiensis* Cry protein, conferring resistance to *Cylas* species (sweet potato weevil) for use in African subsistence agriculture.

b. Value Added Features

This Report enhances previous Pierce Law reports by adding innovative capacity building features including:

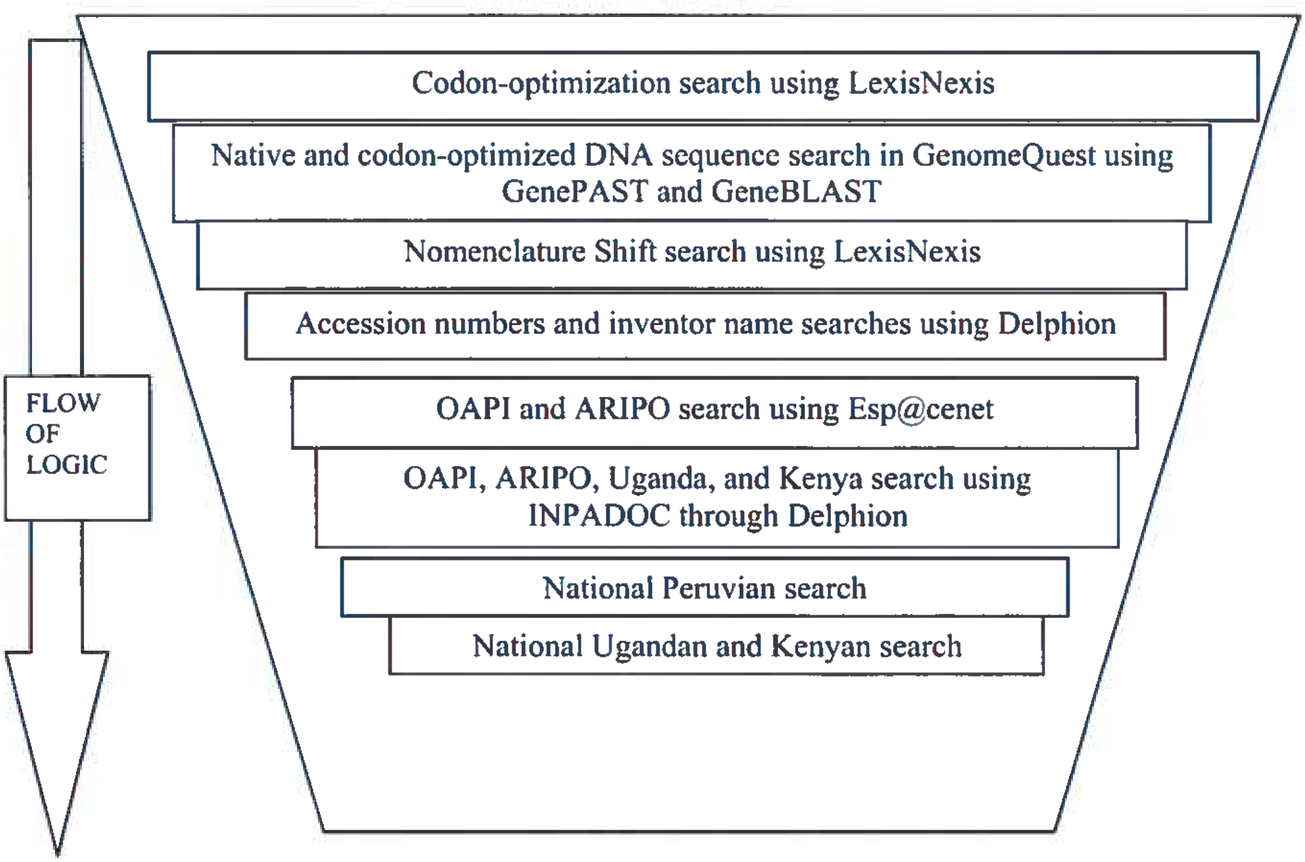
1. Codon-optimization searches;
2. Shift in nomenclature searches;
3. Native and codon-optimized DNA sequence searches;
4. GenBank Accession number and inventor name searches;
5. OAPI and ARIPO searches using Esp@cenet;
6. OAPI, ARIPO, Uganda, and Kenya searches using INPADOC through Delphion;
7. Alumni networking resulting in national and regional office searches and advice regarding research strategies; and
8. Work product spreadsheet of patent results hyperlinked to PDF publications of the patents or patent applications, foreign or domestic and color coded according to relevancy and Cry protein.

SUMMER SEARCH



The present search was divided into Summer and Fall searches. It encompassed a U.S. and international search of patents related to the use of Bt genes (Cry7Aa1, Cry3Ca1, and CryET33-34) in the sweet potato against weevils. The search was broadened to include all crops and coleopteran. By broadening the search, we were able to better capture as many relevant patents thereby ensuring a thorough patent landscape analysis. The searches were premised on the Iterative Process Approach that involved continuous modification of searches as more information became available.

FALL SEARCH



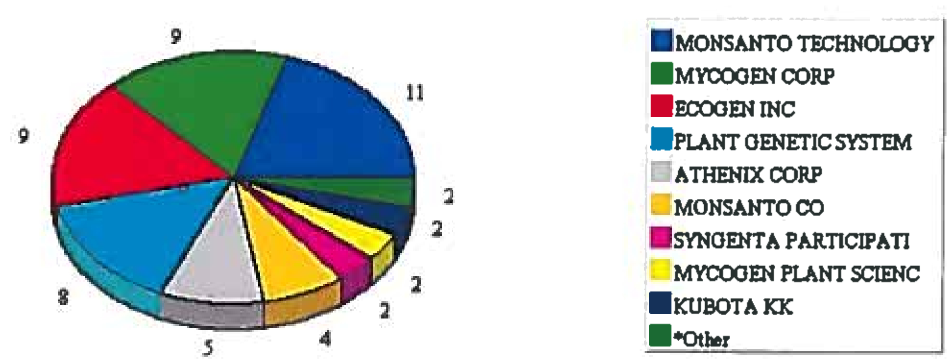
c. What was Done?

The search methodology was devised to initially generate a broad set of patents covering the general art and the disclosure in the Innovation Plan. The main concepts used throughout both searches were *Bacillus thuringiensis*, Bt genes (Cry 7Aa1, Cry3Ca1, and CryET33-34), coleoptera and Sweet Potato. The Summer search utilized keywords derived from the Innovation Plan to obtain relevant United States Patent Classification Codes (herein after USPC) codes in the United States Patent and Trademark Office database (herein after USPTO). With the USPC codes, a second round of searching was done which generated relevant International Patent Classification codes (hereinafter IPC). Hybrid searches were then performed using keywords, IPC and USPC codes in the search strings. From these several searches, we obtained a large number of patents, which were then culled down according to relevancy. A more specific search using the amino acid sequences for each of the three Cry proteins was done in GenomeQuest. Overall, the Summer Search yielded 37 relevant patents, which was termed the "Master Patent List." This list served as the starting point for the Fall Search.

The Fall Search was aimed at more refined and specific searches. The first round of searching was performed utilizing the concept of codon-optimization: a concept not explored in the Summer Search. Research into some of the relevant patents from the Summer and the codon-optimization searches led to the discovery of a shift in nomenclature for the Cry proteins. This discovery led to a second round of searching utilizing the newly discovered nomenclature. Third, a second GenomeQuest search was performed utilizing the codon-optimized and native DNA sequence for each of the Cry proteins. Fourth, accession number and inventor name searches were done to capture those patents, which obfuscated the specific DNA sequences with accession numbers.

Having completed an exhaustive search utilizing all the possible approaches, we then focused our attention to regional and national searches. Per the request of PIPRA, we focused on Peru, Kenya, Uganda, and the member states of OAPI and ARIPO. All patents obtained from each particular search were then categorized according to a color-coding scheme, which coded each patent according to relevancy. The patents were then added to the Master Patent List and placed into the "CIP Africa workproduct .xls" spreadsheet, which can be located in the DVD called "PIPRA DVD." The spreadsheet tracks valuable information including a hyperlinked publication number, publication title, assignee, inventor, patent family information and is color coded according to the color-coding scheme described in the Fall search section. Both searches, combined, yielded 182 patents, 27 color coded red, 48 coded yellow, and 107 coded green.

Pie Chart (Patent count vs. Assignee)



This figure illustrates the patent count (coded red and yellow) by assignee for the patent landscape for specific Bt genes used by CIP as per the Innovation Plan. The top three assignees include Monsanto Technology, Mycogen Corporation, and Ecogen Corporation.

1. Introduction

1.1 Purpose of the Project

In an effort to contribute to finding solutions for PIPRA ("The Public Intellectual Property Resource for Agriculture") and CIP[1] ("International Potato Center") in solving the long standing problems associated with the accessibility of agricultural biotechnology innovations in developing countries, the Franklin Pierce IP Tools Team undertook the objective of creating a patent landscape report specifically for one of these endeavors.

A Team of student patent researchers and scientists were asked to evaluate the U.S. and international patent and literature related to the use of *Bacillus thuringiensis ("Bt")* in the African sweet potato in combating weevil infestation.

As biotechnology patent law students, we recognize the ever-changing field that is biotechnology and understand the application of laws governing intellectual property. However, we still had much to learn about the extent of problems with making such innovations and inventions available to the impoverished and developing sector. Of particular importance are the issues confronting the agricultural arena, particularly to those areas of the world where any shortfalls in production and maintenance of agricultural products means a devastating impact on the health and sustenance of human life.[2] Important factors impeding the flow of such valuable technology from developed to underdeveloped countries include biosafety regimes, intellectual property rights, and liability issues.[3]

The main focus of our project is to address IP constraints that restrict the flow of biotechnology access to Africa. Our main objective is to provide a thorough patent landscape encompassing a biotechnological innovation that will provide stability for the agricultural market of Africa, specifically a staple crop that has been heavily impacted by insect pests: the sweet potato.[4]

Important to our objective is the desire to not only extend assistance to this endeavor, but to educate the law community about the obstacles confronting biotechnology by providing a "big picture" look at the impact of steps taken and those that need to be taken. An essential part of our research encompassed understanding the gene revolution and its effects on the agricultural arena. That is, while much research in multinational corporations is being done on the production of genetically modified crops, more needs to be done in the legal arena to facilitate the research, development, and deployment of these transgenic crops in developing countries.[5] Because today's gene revolution is being led by these multinational corporations, international organizations like CGIAR ("Consultative Group on International Agricultural Research") will

---

[1] CIP is a non-profit institution that conducts agricultural research, including potato improvement, to address food security, poverty, and sustainability of natural resources for developing countries. It was established in 1971 in Lima, Peru, and is supported by the Consultative Group for International Agricultural Research (CGIAR). (Fuglie, K. 2007b. "Priorities for Sweetpotato Research in Developing Countries: Results of a Survey." HortScience 42 (5):1200-1206.)

[2] Raney, Terri; Pingali, Prahhu , *Sowing a Gene Revolution*, Scientific American Magazine, September 2007 pp. 107-111.

[3] Muffy Koch; Shawn Sullivan, *Risks of biosafety, IPR and liability regimes on biotechnology availability to the poor,* Presentation for "A Roadmap towards Making the Benefits of GM Crops Available to Resource – poor Farmers in Africa," September 2005, at 1.

[4] 2003 *International Potato Center* Ann. Rep. at 1.

[5] Raney, Terri; Pingali, Prahhu , *Sowing a Gene Revolution*, Scientific American Magazine, September 2007 pp. 107-111.

have an increasingly important role in delivering innovative agrobiotechnological solutions. Through public interest organizations and the extensive training in Intellectual Property, Franklin Pierce Law Center seeks to continue its long-standing commitment to building intellectual property expertise in developing countries.[6]

Of the many factors affecting food stability in developing countries, insect infestation in crops has been a major contributor to famine.[7] As a result, farmers in developing countries are left to utilize chemical pesticides, and while a small percentage of their crops are protected by these agents, the use of such pesticides has led to soil erosion, affected the integrity of soil structure, and disturbed the microbial environment.[8] The use and deployment of transgenic crops and associated technologies to developing countries will not only benefit the farmers of those areas, but also aid in ameliorating the environmental effects from pesticidal use.[9] Essential to this success is the accessibility of these biotechnological products to poor farmers on favorable terms.[10] It will be by providing broad access to biotechnological advances in agriculture, and the cooperation of private sector research entities to problems requiring dedicated solutions, that these developing countries will have a chance at combating region specific issues such as crop infestation, drought, and disease.[11]

1.2 Disclaimer

This is an educational report. This report is neither inclusive nor extensive. It is not a Freedom to Operate (FTO) opinion. Rather, it is an information resource to facilitate a better understanding of the international patent literature landscape with regard to the development of a sweet potato expressing a *Bacillus thuringiensis* cry protein, conferring resistance to *Cylas* species (sweet potato weevil) in African subsistence agriculture.

Due to the international scope of this report, it was necessary to contact individuals and entities associated with the Peruvian, Ugandan, and Kenyan national patent offices and the ARIPO regional patent office to obtain patent searches on *thuringiensis*, as there was little to no electronic access to the patents using this search term at these locations. Therefore, the Team cannot guarantee that all patents in each location are represented using the search strategy. Furthermore, the Team cannot guarantee that its search strategies found every patent that may pose a barrier to implementation.

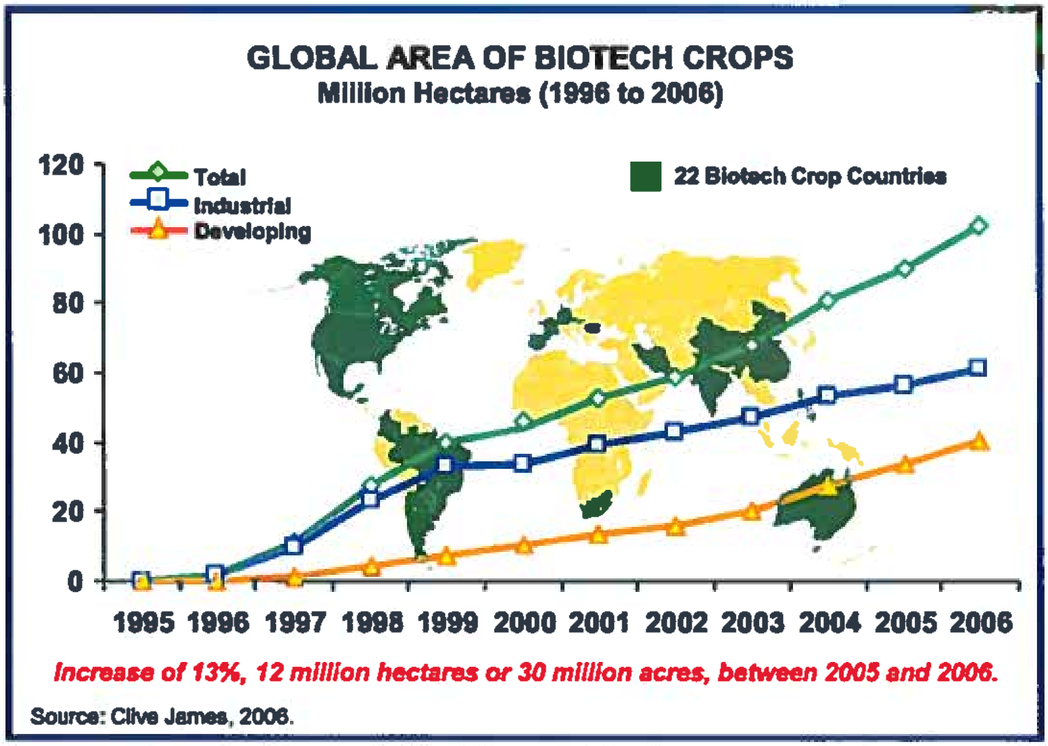
Due to the press of business, the Team was faced with time constraints, which limited the ability to analyze in depth DNA sequence claims. These sequences claimed may or may not be relevant and due to this uncertainty, we chose to place them into the "yellow" category. These patents and patent applications should therefore be subjected to subsequent analysis in order to ascertain their status.

[6] Cavicchi, Jon; Kowalski, Stanley, *Intellectual Property in the Public Interest at Pierce Law: Past, Present and Future*, Pierce Law Magazine, Summer 2007 pp. 2-6.
[7] Raney, Terri; Pingali, Prahhu , *Sowing a Gene Revolution*, Scientific American Magazine, September 2007 pp. 107-111.
[8] *Id.*
[9] *Id.*
[10] *Id.*
[11] *Id.*

2. About the Technology

2.1 Preface[12]

It has been more than ten years since the first commercial GM[13] tomatoes were planted in 1994. In 1996, 1.66 million hectares of crops were planted containing GM traits. Since then, there has been a dramatic increase in plantings and by 2005/06, the global planted area reached almost 87.2 million hectares. This is equal to five times the total agricultural area or nineteen times the total arable cropping area of the UK. In terms of the share of the main crops in which GM traits have been commercialized (soybeans, corn, cotton and canola), GM traits accounted for 29% of the global plantings to these four crops in 2005.



(James, Clive. 2006. Global Status of Commercialized Biotech/GM Crops: 2006. *ISAAA Brief* No. 35. ISAAA: Ithaca, NY.)

However, there are still many controversies about the safety of GM crops in the world. Within the context of the immediate and real needs in developing countries, it is important to address issues relating to food security.

[12] Brookes, G. and P. Barfoot. 2006. GM Crops: The First Ten Years - Global Socio-Economic and Environmental Impacts. ISAAA Brief No. 36. ISAAA: Ithaca, NY.
[13] Genetically Modified

2.2 Sowing a Gene Revolution[14]

Raney and Pingali have recently noted that:

> In 1960, roughly 1 billion people were undernourished. Yet the progress in filling empty bellies has been substantial. Today, around 5.6 billion people are fed adequately, compared with only 2 billion half a century ago.
>
> Modern agricultural technology has been the key to these dramatic gains. The development and distribution of high-yield seeds and the inputs (fertilizers and irrigation) to make them grow drove the green revolution of the 20th century. Now, society is witnessing a gene revolution. In recent decades, researchers have developed and honed techniques to transplant individual genes from one organism to another, creating cultivars with valuable new traits. ***For example, the gene from the soil bacterium Bacillus thuringiensis (Bt), when engineered into plants, results in a transgenic plant with resistance to insects such as weevils and borer beetles.*** (emphasis added)
>
> Transgenic crops are spreading faster than any other agricultural technology in history despite continuing controversy about potential risks such as gene flow, the emergence of resistance pests, and fears that eating genetically modified foods might affect the health of consumers. Recent peer-reviewed studies have shown that farmers in developing countries have indeed benefited by growing transgenic crops. These farmers saw increased yields and lowered expenditures on pesticides that more than compensated for the higher costs of the transgenic seeds.
>
> At least as important as the performance of the technology are institutional factors such as the agricultural research capacity of a nation, the functioning of agricultural input markets, and the overall policy-making infrastructure, including regulations relating to the environment, food safety, and trade and IP rights.

2.3 *Bacillus thuringiensis*

2.3.1 What is *Bacillus thuringiensis*?[15]

Bacillus thuringiensis is a Gram-positive, soil dwelling bacterium of the genus *Bacillus*. *B. thuringiensis* was discovered 1901 in Japan by Ishiwata and 1911 in Germany by Ernst Berliner, who discovered a disease called *Schlaffsucht* in flour moth caterpillars. *B. thuringiensis* is closely related to *B. cereus*, a soil bacterium, and *B. anthracis*, the cause of anthrax: the three organisms differ mainly in their plasmids. Like other members of the genus, all three are aerobes capable of producing endospores.

---

[14] Raney, Terri; Pingali, Prahhu , *Sowing a Gene Revolution*, Scientific American Magazine, September 2007 pp. 107-111

[15] Madigan, Michael; Martinko, John (editors) (2005). *Brock Biology of Microorganisms*, 11th ed., Prentice Hall

2.3.2 The Use of *Bacillus thuringiensis* in Insect Control[16]

Bacillus thuringiensis (Bt) strains are indigenous to many environments and have been isolated worldwide from many habitats. The remarkable diversity of Bt strains and toxins is due to a high degree of genetic plasticity.

Upon sporulation, *B. thuringiensis* forms crystals of proteinaceous insecticidal δ-endotoxins (Cry toxins: *Bacillus thuringiensis* Toxin Nomenclature[17]) which are encoded by *cry* genes. Cry toxins have specific activities against species of the orders Lepidoptera (Moths and Butterflies), Diptera (Flies and Mosquitoes) and Coleoptera (Beetles). Thus, *B. thuringiensis* serves as an important reservoir of Cry toxins and *cry* genes for production of biological insecticides resources and insect-resistant genetically modified crops.[18]

Most Bt toxin genes reside on plasmids, often as parts of composite structures that include mobile genetic elements. This observation led to the development of bioinsecticides based on Bt for the control of insect species among the orders Lepidoptera, Diptera, Hymenoptera, Homoptera, Orthoptera, Mallophaga, and Coleoptera.

Bt is successful in controlling a wide diversity of insect species due to the insecticidal nature of the Bt parasporal crystal, a type of cry protein. The cry proteins are very specific to the groups of insects and invertebrate pests against which they have activity, but are not pathogenic to mammals, birds, amphibians, or reptiles. The mechanism of action of the Bt Cry proteins involves solubilization of the crystal in the insect midgut, proteolytic processing of the protoxin by midgut proteases, binding of the Cry toxin to midgut receptors, and insertion of the toxin into the apical membrane to create ion channels or pores.

The use of Bt cry proteins has several advantages. Cry-based pesticides have low costs for development and registration. Finally, the mode of action for the Cry proteins differs completely from the modes of action of known synthetic chemical pesticides, making Cry proteins key components of integrated pest management strategies aimed at preserving natural enemies of pests and managing insect resistance. Cry-based pesticides, therefore, have broad based applicability to integrated pest management strategies.

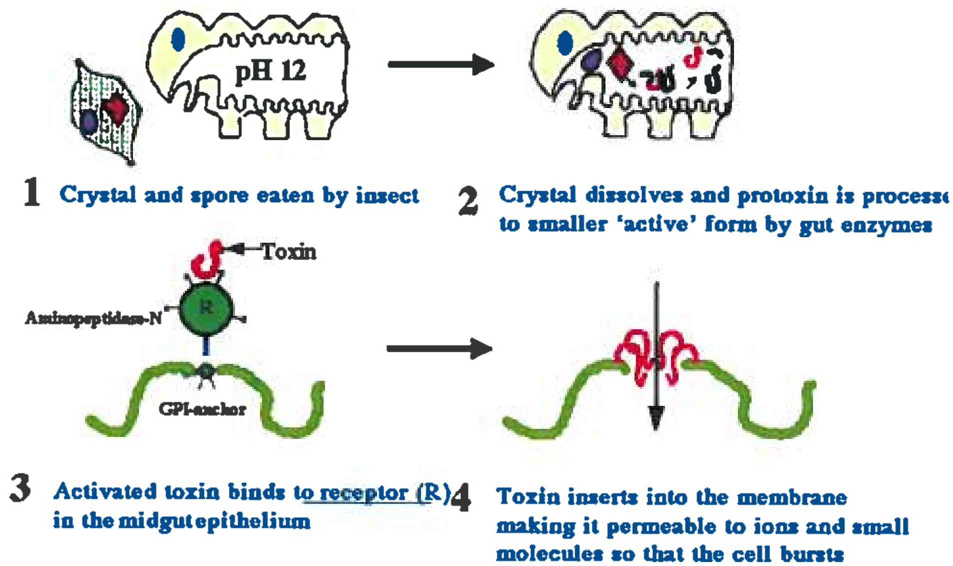
---

[16] From Sept 1998, Microbiology and Molecular Biology Reviews, pp 775-806

[17] http://www.lifesci.sussex.ac.uk/home/Neil_Crickmore/Bt/index.html

[18] Charles, Daniel. Basic Books (Publishers), NY. "Lords of the Harvest: Biotech, Big Money, and the Future of Food." Ch. 4: "The First Useful Gene: *Bacillus thuringiensis* and Its Many Inventors." Pp. 41-50.

MECHANISM OF TOXIN ACTION



(http://www.bioc.cam.ac.uk/~dje1/)[19]

2.3.3 Use in Pest Control

Spores and crystalline insecticidal proteins produced by *B. thuringiensis* are used as specific insecticides under trade names such as Dipel and Thuricide. Because of their specificity, these pesticides are regarded as environmentally friendly, with little or no effect on humans, wildlife, pollinators, and most other beneficial insects. The Belgian company Plant Genetic Systems was the first company (in 1985) to develop genetically engineered (tobacco) plants with insect resistance by expressing *cry* genes from *B. thuringiensis.*[20]

B. thurigiensis-based insecticides are often applied as liquid sprays on crop plants, where the insecticide must be ingested to be effective. It is thought that the solubilized toxins form pores in the midgut epithelium of susceptible larvae. Recent research has suggested that the midgut bacteria of susceptible larvae are required for *B. thuringiensis* insecticidal activity.[21]

2.3.4 Discovery, Origin and Applications of Bt Genes

In the mid-1980s, the biotechnology industry, led by Monsanto, designed a transgenic plant expressing the toxic protein product of a single Bt gene. However, the success was short-lived, as these transgenic plants did not express Bt toxin for prolonged periods of time and in the quantities necessary to kill hardy pests in the field. Monsanto scientists solved this problem with the development of a transgenic tomato plant by tailoring the Bt sequence to the host tomato

---

[19] From the web site of Professor David Ellar, Department of Biochemistry, University of Cambridge (http://www.bioc.cam.ac.uk/~dje1/)

[20] Höfte H, de Greve H, Seurinck J, Jansens S, Mahillon J, Ampe C, Vandekerckhove J, Vanderbruggen H, van Montagu M, Zabeau M (1986). "Structural and functional analysis of a cloned delta endotoxin of *Bacillus thuringiensis* berliner 1715". *Eur J Biochem* **161** (2): 273-80.

[21] Broderick N, Raffa K, Handelsman J (2006). "Midgut bacteria required for *Bacillus thuringiensis* insecticidal activity". *Proc Natl Acad Sci U S A* **103** (41): 15196-9.

plant, a process called codon optimization. These tomato plants expressed Bt toxin one hundred to five hundred times higher than anything previously seen in a plant cell.[22]

There are several *Bt* crystal protein categories established based on primary structure information and the degree of protein similarities to one another. Over the past decade, research on the structure and function of *B. thuringiensis* crystal proteins has covered all of the major categories, and while these proteins differ in specific structure and function, general similarities in the structure and function are assumed. Based on the accumulated knowledge of *B. thuringiensis* insect inhibitory proteins, a generalized mode of action for *B. thuringiensis* insect inhibitory proteins has been created and includes: ingestion by the insect, solubilization in the insect midgut (a combination of stomach and small intestine), resistance to digestive enzymes sometimes with partial digestion actually "activating" the insect inhibitory protein, binding to the midgut cells, formation of a pore in the insect cells and the disruption of cellular homeostasis (English and Slatin, 1992).[23]

Most of the nearly 200 *Bt* crystal proteins presently known have some degree of lepidopteran activity associated with them. The large majority of *Bacillus thuringiensis* insect inhibitory proteins, which have been identified, do not have coleopteran controlling activity. Therefore, it is particularly important, at least for commercial purposes, to identify additional coleopteran specific insect inhibitory proteins.[24]

2.3.5 Bt genes and its classification[25]

Many of the δ-endotoxins are related to various degrees by similarities in their amino acid sequences. Historically, the proteins and the genes, which encode them, were classified based largely upon their spectrum of insect inhibitory activity. The review by Schnepf et al. (Microbiol. Mol. Biol. Rev. (1998) 62:775–806) discusses the genes and proteins that were identified in *B. thuringiensis* prior to 1998, and sets forth the most recent nomenclature and classification scheme as applied to *B. thuringiensis* insect inhibitory genes and proteins.

Using older nomenclature classification schemes, *cry1* genes were deemed to encode lepidopteran-inhibitory Cry1 proteins; *cry2* genes were deemed to encode lepidopteran- and dipteran-inhibitory Cry2 proteins; *cry3* genes were deemed to encode coleopteran-inhibitory Cry3 proteins; and *cry4* genes were deemed to encode dipteran-inhibitory Cry4 proteins. However, new nomenclature systematically classifies the Cry proteins based upon amino acid sequence homology rather than upon insect target specificities. The classification scheme for many known proteins, not including allelic variations in individual proteins, including dendograms and full *Bacillus thuringiensis* protein lists is summarized and regularly updated at http://epunix.biols.susx.ac.uk/Home/Neil_Crickmore/Bt/index.html.[26]

---

[22] Charles, Daniel. Basic Books (Publishers). NY. "Lords of the Harvest: Biotech, Big Money, and the Future of Food." Ch. 4: "The First Useful Gene: *Bacillus thuringiensis* and Its Many Inventors." Pp. 42-46.
[23] US Patent 7,214,788: Insect inhibitory *Bacillus thuringiensis* proteins, fusions, and methods of use therefor
[24] *Id.*
[25] *Id.*
[26] US Patent 7,214,788: Insect inhibitory *Bacillus thuringiensis* proteins, fusions, and methods of use therefor

2.4 IP and Legal History for Coleopteran Resistant Genes

In 1983, *Bacillus thuringiensis*, var. tenebrionis, a strain of Bt effective against Coleoptera was discovered by Aloysius Krieg, a German scientist, who, enticed with the concept of patenting useful microbes, did not want to give up their rights to the microbe. Then, in 1984, a scientist from Mycogen visited Dr. Krieg and within two years, Mycogen patented a strain of Bt dubbed *Bacillus thuringiensis* San Diego, since it was "discovered" in Mycogen's San Diego lab. As information spread about the two varieties, scientists were struck by how similar they appeared to be. Eventually, Dr. Krieg sued Mycogen for suspected microbial larceny, and a settlement was reached which included reassignment of patent rights concerning the San Diego variety to Novo Nordisk, the assignee of Dr. Krieg's tenebrionis patent. Both "varieties" are effective against Coleoptera[27].

The *Bt* proteins, which have been identified as having coleopteran-inhibitory activity, are either related to the Cry3 protein class, or are greater than about 74 kDa in size. (Berhnard, 1986; Donovan et al., 1988, 1992; Herrnstadt et al., 1986; Hofte et al., 1987, 1989; Kreig et al., 1983, 1984, 1987; McPherson et al., 1988; Sekar et al., 1987; Sick et al., 1990; U.S. Pat. No. 4,766,203; U.S. Pat. No. 4,771,131; U.S. Pat. No. 4,797,279; U.S. Pat. No. 4,910,016; U.S. Pat. No. 4,966,155; U.S. Pat. No. 4,966,765; U.S. Pat. No. 4,999,192; U.S. Pat. No. 5,006,336; U.S. Pat. No. 5,024,837; U.S. Pat. No. 5,055,293; U.S. Pat. No. 6,023,013; European Pat. Appl. Publ. No. 0318143; Eur. Pat. Appl. Publ. No. 0324254; Eur. Pat. Appl. Publ. No. 0382990; PCT Intl. Pat. Appl. Publ. No. WO 90/13651; Intl. Pat. Appl. Publ. No. WO 91/07481).

U.S. Pat. No. 6,063,756 disclosed *Bacillus thuringiensis* strains comprising novel crystal proteins that exhibit insect inhibitory activity against coleopteran insects including red flour beetle larvae (*Tribolium castaneum*) and Japanese beetle larvae (*Popillia japonica*). Also disclosed therein are novel *B. thuringiensis* genes, designated *cryET33* and *cryET34*, which encode the coleopteran-inhibitory crystal proteins ET33 and ET34. *cryET33* encodes the CryET33 (29-kDa) crystal protein, and the *cryET34* gene encodes the 14-kDa CryET34 crystal protein. Also disclosed therein are methods of making and using transgenic cells comprising the novel nucleic acid sequences of the invention.

Rupar et al. (WO00/066,742; PCT/US00/12136) describe still other expression systems isolated from *Bacillus thuringiensis* strains which express proteins, which, when present in approximately equimolar concentrations, exhibit *Coleopteran* insecticidal activity. In particular, a binary toxin system referred to as CryET80 and CryET76, ET76 being about 44 kDa and ET80 being about 14 kDa, are effective in controlling corn rootworms.

Narva et al. (U.S. patent application Ser. No. 09/378,088; WO01/14417(A2); PCT/US00/22942) disclose yet at least one other coleopteran inhibitory binary toxin exhibiting corn rootworm controlling bioactivity, isolated from *Bacillus thuringiensis*, and describe the construction of a fusion between the two components of the toxin, but failed do demonstrate any bioactivity of this fusion.[28]

U.S. Pat. No. 4,766,203 related to a 65-70 kilodalton (kDa) insecticidal crystal protein identified in *B. thuringiensis tenevrionis* (see also Berhnard, 1986). Sekar et al., (1987) report the cloning and characterization of a gene for a coleopteran-toxic crystal protein from *B. thuringiensis tenebrionis*. The predicted size of the polypeptide (as deduced from the gene sequence) is 73 kDa, however, the isolated protein consists primarily of a 65-kDa component.

---

[27] Charles, Daniel. Basic Books (Publishers), NY. "Lords of the Harvest: Biotech, Big Money, and the Future of Food." Ch. 4: "The First Useful Gene: *Bacillus thuringiensis* and Its Many Inventors." Pp. 47-49.

[28] US Patent 7,214,788: Insect inhibitory *Bacillus thuringiensis* proteins, fusions, and methods of use therefor

Höfte et al. (1987) also reports the DNA sequence for the cloned gene from *B. thuringiensis tenevrionis*, with the sequence of the gene being identical to that reported by Sekar et al. (1987). McPherson et al. (1988) discloses a DNA sequence for the cloned insect control gene from *B. thuringiensis tenebrionis*; the sequence was identical to that reported by Sekar et al. (1987). E. coli cells and *Pseudomonas fluorescens* cells harboring the cloned gene were found to be toxic to Colorado potato beetle larvae. Intl. Pat. Appl. Publ. No. WO 91/07481 dated May 30, 1991, describes *B. thuringiensis* mutants that produce high yields of the same insecticidal proteins originally made by the parent strains at lesser yields. Mutants of the coleopteran-toxic *B. thuringiensis tenevrionis* strain are disclosed. A coleopteran-toxic strain, designated *B. thuringiensis* var. San Diego, was reported by Herrnstadt et al. (1986) to produce a 64-kDa crystal protein toxic to some coleopterans, including *Pyrrhalta luteola* (elm leaf beetle)[29]

2.5 Genetic Engineering of Bt for Pest Control

2.5.1 Usage[30]

Bt crops (in corn and cotton) were planted on 28.15 million hectares in 2006 (16.56 million ha of Bt corn and 11.59 million ha of Bt cotton). This was equivalent to 11.1% and 33.6% respectively of global plantings of corn and cotton in 2006.

This technology has delivered major economic and environmental benefits. In the first ten years of use (1996-2005), the farmers who used GM (Bt) insect resistant technology derived a total of nearly $9.9 billion worth of extra farm income, with the much of this benefit going to small, resource poor farmers in developing countries (especially from the use of Bt cotton). Over this ten year period insecticide use on these two crops fell by 35.6 million kg of insecticide active ingredient, which is roughly equal to the amount of pesticide applied to arable crops in the EU in one year. Using the Environmental Impact Quotient (EIQ) measure of the impact of pesticide use on the environment, the adoption of Bt technology over this ten year period resulted in 24.3% and 4.6% reduction respectively in the environmental impact associated with insecticide use on the cotton and corn area using the technology.

2.5.2 Advantages[31]

There are several advantages in expressing Bt toxins in transgenic Bt crops: i). The level of toxin expression can be very high thus delivering sufficient dosage to the pest, ii). The toxin expression is contained within the plant system and hence only those insects that feed on the crop perish, iii). The toxin expression can be modulated by using tissue-specific promoters, and iv) replaces the use of synthetic pesticides in the environment. The latter observation has been well documented world-wide

---

[29] US Patent 6,063,756 : *Bacillus thuringiensis* cryET33 and cryET34 compositions and uses therefor
[30] Brookes, G. and P. Barfoot. 2006. GM Crops: The First Ten Years - Global Socio-Economic and Environmental Impacts. ISAAA Brief No. 36. ISAAA: Ithaca, NY.
[31] Brookes, G. and P. Barfoot. 2006. GM Crops: The First Ten Years - Global Socio-Economic and Environmental Impacts. ISAAA Brief No. 36. ISAAA: Ithaca, NY.

2.6 Agrobiotechnology and IPR in Africa[32]

Recommendation 16

AU member states should strengthen the capacity of their intellectual property systems such that a balance is found between the need to reward inventors while promoting the freedom to innovate. This should be accompanied by exploration of additional approaches to intellectual property protection including "open source" systems that help AU member states to effectively use the world's body of available scientific and technical knowledge.

Increased success for Africa's nascent biotechnology industry will depend largely on the extent to which researchers in the continent's public research organizations can secure access to enabling technologies, the "source code" for adding value to known biological information. Unlike the case some 20 or 30 yeas ago, much of this additional knowledge is now tied up in proprietary patents, which are often owned by large companies. These patents are expensive to use, and there is an increasing consensus that they are acting as a barrier to innovation.

In biotechnology, the private sector holds at least as much technological information and knowledge (probably more) than the public sector worldwide. According to the 2004 edition of *The State of Food and Agriculture* (FAO) the private sector in 2001 funded up to $1.5 billion in developed country biotechnology R&D compared with $1 billion that came from the public purse. Moreover, a large and growing portion of scientific information on biotechnology is held in the private sector, often in the patent offices of industrialized countries.

Alternatives systems and new ways of navigating the IPR maze are beginning to emerge, however, fuelled in large part by the realization that open access to agricultural science, one of the pillars of food security in the developed world, is less available to developing countries. One of these initiatives is the African Agricultural Technology Foundation, designed to assist researchers from Africa navigate the international patent system, and to negotiate patent rights on behalf of AU scientists. Devised by three agencies (DFID, The Rockefeller Foundation and USAID), the foundation's aims include enabling Africa's scientists have access to technologies in critical areas such as: insect resistance in maize, mycotoxins in food grains, drought-tolerance and striga-control in cereals.

A second is known as PIPRA (Public Intellectual Property Resource for Agriculture), an initiative of some 39 public-sector universities and non-profit agricultural research organizations in 10 countries to share knowledge of their discoveries, inventions and innovations. The PIPRA database contains some 6600 patents and patent applications, and has also benefited from Rockefeller funding.

The third initiative, known as BIOS, is an ambitious attempt to persuade universities and private companies to change the way they protect their intellectual property – drawing on lessons from the ICT industry, particularly the emergence of the non-proprietary Linux operating system

[32]Abstracted from Juma, Calestous and Ismail Serageldin, (Lead Authors). Freedom to Innovate: Biotechnology in Africa's Development. Report of the High-Level African Panel on Modern Biotechnology. Addis Ababa, Ethiopia: African Union and Pretoria, South Africa: New Partnership for Africa's Development, August 2007.

and the emergence of other Open Source products. BIOS is an initiative of Cambia, a Canberra-based non-profit biotechnology research organization.

Under BIOS, scientists agree to make patents on new technologies freely available under a Biological Open Source license. Anyone (or any company) that wants to use the technology can only do so if they agree to contribute their own developments to the initiative's patent database. BIOS is guided by the view that "freedom to innovate" needs researchers to have access to all the available technological options, especially preceding ideas. The goal is to create wealth by freeing up the tools of biological innovation to create and deliver useful technologies for the benefit of society.

New models for IPR are sorely needed as the relationships between intellectual property rights (IPR), international trade, sustainable development, and technological innovation continue to be the subject of debate and controversy, especially in international forums such as the World Trade Organization (WTO) and the UN Convention on Biological iversity. One aspect to this ongoing conversation has been the implications of the WTO agreement on the Trade-related Aspects of Intellectual Property Rights (TRIPS) for international trade in general, and for developing countries in particular.

The agreement recognizes the role of technology in social and economic welfare and sets out its objectives in Article 7 as: "The protection and enforcement of IPR should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations."

Many in developing countries believe that the requirement under TRIPS that innovation be protected through IPR adversely affects their ability to use technological knowledge to promote public interest goals such as health, nutrition and environmental conservation. Furthermore, many also regard conventional IPR systems as not giving sufficient recognition to the rights of, for example, farmers, groups in society, or local (perhaps historical) contributors to innovation.

2.7 Sweet Potato Weevils

2.7.1 General Information for Sweet Potato[33]

The sweet potato, *Ipomoea batatas* L. (Lam.), is grown for its storage roots and vines. Its storage roots are used for human consumption, animal feed, and seed in temperate regions, while its vines are used as animal feed and seed mainly in the tropics.

Sweet potatoes are an important food crop in terms of area and production. They are grown in over 100 countries, with 78% of the global sweet potato area located in developing countries in Asia and Africa. Roughly 73% of the global area and 84% of the global production of sweet potato is concentrated in China, yet production is spread over many countries. Other significant concentrations of sweet potato are in Asia (Vietnam, Indonesia, India and the Philippines) and the East African Highlands (Uganda, Rwanda, Burundi and Kenya).

In East Africa, sweet potato plays an important role in the diet and food security of the population indicated by the high per capita consumption (e.g. 160 and 85 kg/cap/year for Rwanda and Uganda, respectively). However, sweet potato yields in the region are very low (1.6-9.7 t/ha) compared to yields of over 20 t/ha (24, 26, 32 t/ha for Japan, the Cook Islands and

---

[33] Mwanga, Robert O., Ph.D. Dissertation, *Nature of Resistance and Response of Sweetpotato to Sweetpotato Virus Disease*, NCSU 2 (2001) (citation omitted).

Israel, respectively). Major constraints to increased sweet potato productivity in East Africa include, sweet potato weevils (*Cylas puncticollis* and *C. brunneus*), viruses (mainly sweet potato virus disease), *Alternaria* stem blight, poor yielding varieties of low nutritive value (low or no ß-carotene), shortage of high quality planting materials, marketing problems, and limited range of processing and utilization options, leading to high postharvest losses, estimated between 30-35%. Below is a table indicating the relative sweet potato productivity in Uganda from 2002-2006.

	2002			2003			2004			2005			2006 (projection)		
Crop	**Area**	**Yield**	**Prod.**	**Area**	**Yield**	**Prod.**	**Area**	**Yield**	**Prod.**	**Area**	**Yield**	**Prod.**	**Area**	**Yield**	**Prod.**
Cereals	1 445		2 368	1 495		2 508	1 549		2 274	1 605		2 459	1 679		2 657
Maize	676	1 800	1 217	710	1 831	1 300	750	1 440	1 080	780	1 500	1 170	819	1 569	1 285
Finger Millet	396	1 490	590	400	1 600	640	412	1 600	659	420	1 600	672	429	1 613	692
Sorghum	285	1 498	427	290	1 452	421	285	1 400	399	294	1 527	449	308	1 601	493
Rice	80	1 500	120	86	1 535	132	93	1 301	121	102	1 500	153	113	1 504	170
Wheat	8	1 750	14	9	1 667	15	9	1 667	15	9	1 667	15	10	1 800	18
Pulses	940		692	958		690	991		623	1 009		668	1 032		767
Beans	765	699	535	780	673	525	812	560	455	828	600	497	849	700	594
Other Pulses	175	897	157	178	927	165	179	939	168	181	945	171	183	945	173
Root Crops	1 065		8 511	1 080		8 617	1 092		8 723	1 063		8 094	1 053		8 050
Cassava	398	13 500	5 373	405	13 457	5 450	407	13 514	5 500	387	13 000	5 031	379	13 000	4 927
Sweet Potato	589	4 401	2 592	595	4 387	2 610	602	4 402	2 650	590	4 200	2 478	584	4 300	2 511
Irish Potato	78	7 000	546	80	6 963	557	83	6 904	573	86	6 802	585	90	6 800	612
Matoke (Plantain)	1 648	6 000	9 888	1 661	5 840	9 700	1 670	5 800	9 686	1 675	5 400	9 045	1 677	5 600	9 391

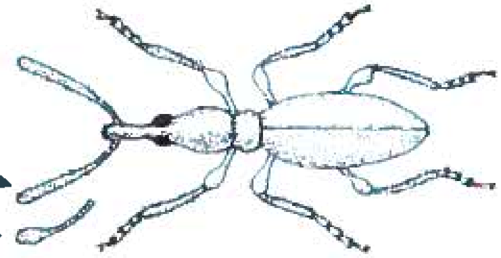
Source: Ministry of Agriculture Animal Industry and Fisheries (MAAIF)
Note: Calculations computed from unrounded data.
From http://www.fao.org/docrep/009/j8416e/j8416e00.htm#3 accessed on 12/8/07.

2.7.2 Sweet Potato Weevils *(Cylas puncticollis and Cylas brunneus)*

2.7.2.1 Biology and lifecycle[34]

The sweet potato weevil is a type of beetle; the adult stage is a black beetle that looks like a large ant. There are a number of species of sweet potato weevil; *Cylas puncticollis* and *Cylas bruneus* are the most common species in East Africa, while *Cylas formicarius* is the most abundant in North America and the Far East. *Cylas brunneus* is brown and smaller than the larger, black *Cylas puncticollis*, while *Cylas formicarius* is as small as *Cylas brunneus* but has a bluish-black abdomen and a red thorax. The male and female adult sweet potato weevils can be told apart by the shape of their antennae. The antennae of the males are straight while those of the female are round or club-shaped (see diagram below). When an adult weevil is disturbed, it plays dead.

[34] www.cipotato.org/vitaa/manual/09_TM%20Chapt%204b.pdf



			
Sweetpotato weevil egg	*Sweetpotato weevil larva*	*Sweetpotato weevil pupa*	*Adult sweetpotato weevil*

The weevil has a life cycle of four stages: egg, larva, pupa and adult. The duration of each stage in the life cycle of the weevil depends mainly on temperature: the higher the temperature, the faster the development. After mating, the female sweet potato weevil lays eggs singly in holes that she has chewed in either the vines or exposed/ easily accessible roots of sweet potato. The female adult weevil can survive for 140 days, although most of her eggs are laid in the first 50 days of the adult stage; a female can produce 50-250 eggs. Eggs will hatch after 3-7 days (depending on the environmental conditions). The developing larvae, which are legless, curved and white, tunnel while feeding within the vine or root and are the most destructive stage; larvae live for 11-33 days before pupating. Pupation takes place within the larval tunnels and adults emerge after 3-28 days. The development of the weevil from egg to adult takes 32 days on average. When the adult beetle emerges from the pupa, initially it is light brown in color. It takes 6-8 days for the outer surface of the weevil to harden and become dark brown. Once this has occurred, the adult leaves the root zone in search of mates. High numbers of weevils in the foliage usually indicates that there is a high number in the root zone.

The female adult weevil produces a pheromone that attracts the male for mating. Male weevils are active at night; they move around on the foliage to search for females. During the day the weevils hide under leaves or in soil cracks. Although the females mate at night, they feed and lay eggs during the day. Their egg-laying behavior depends on the growth stage of the sweet potato crop.

2.7.2.2 Damage[35]

The sweet potato storage root is the preferred site for feeding and egg-laying. However, at the beginning of the growing season, when the plants have not yet produced any storage roots, the adult weevils live on the stem and leaves. The adult will feed on foliage; lay its eggs on the vines and leaves, and the larvae will feed in the stem or the leaf and pupate inside the vines.

[35] *Id.*

Plants may wilt or even die as a result of extensive stem damage, and damage to the vascular system can reduce the size and number of future storage roots.

As the plant gets older and starts to form storage roots, the weevils search for exposed ones. Most weevils (80-90%) can be found in the foliage from 10 cm above the soil surface to 15 cm below the soil. They cannot dig, so their penetration into the soil layer is limited, not allowing them to reach roots that are well buried. The only way for them to get to the roots is through cracks in dry soil. When an adult finds a root, it punctures the surface as it feeds. In addition to feeding punctures the female adults also make egg-laying punctures. The eggs are laid just below the surface of the root. The punctures containing eggs can be distinguished by their dark color because the eggs are covered with a plug of weevil frass (insect excrement). Both the feeding and egg laying punctures lower the quality of the root, and can reduce the market price. If roots with egg punctures are stored, they will serve as a source of infestation for the clean roots stored beside them.

The larva, after hatching from the egg, will bore into the tissue of the root. While external damage to roots can affect their quality and value, internal damage can lead to complete loss. Even low levels of infestation can reduce root quality and marketable yield because the plants produce a bitter toxin, called a terpenoid, in response to *Cylas* weevil feeding. Sweet potato weevils are a particularly serious problem under dry conditions, because the insects, which cannot dig, can reach roots more easily through cracks that appear in the soil as it dries out. It is for this reason that during the dry season, unlike cassava, sweet potato roots cannot be stored in-ground for any significant period of time.

As sweet potato weevils fly infrequently, and generally only for short distances ranging from 500 m (if there are sweet potato plants) to 1,000 m (if there are no sweet potato plants) newly planted fields are most likely to be infested via: planting material infested with eggs or larvae within the vines or adults hiding amongst the leaves; survivors in infested roots and residues from a preceding crop; immigrating *Cylas* spp. weevils from neighboring fields or alternative host plants. The sweet potato weevil has several host plants of the same plant family as the sweet potato, for instance the water spinach plant, *Ipomoea aquatica.* The flowers of these plants resemble the flower of the sweet potato. These plants can shelter weevils between planting seasons and serve as a source of weevil infestation when a new crop of sweet potato is planted.

Damage caused by the different species of sweet potato weevil is similar. More than one species may often be present in the same field or even the same root.

2.7.2.3 Natural Enemies[36]

The natural enemies of the sweet potato weevil include several kinds of predators, parasites and pathogens. The predators are the most easily observed of these. They include ants, earwigs, ground beetles and spiders. Ant nests from banana fields can be moved to the sweet potato field to enhance predation.

A fungus (*Beauveria bassiana*) that commonly lives in the soil can infect and kill the weevil fairly effectively. This fungus is easily cultivated by trained individuals on coffee residue, wheat and rice straw, and is commercially available in some countries. The fungal culture can be used for treating the planting material and the soil to reduce the weevil population.

---

[36] *Id.*

2.7.2.4 Management[37]

Chemical control is not effective because the weevils are protected for, at least part of their lifecycle by their development within roots or stems, where they are not easily reached by pesticides. Pesticides kill natural enemies that under natural circumstances quite effectively control weevil populations, and can also present health risks for humans and animals. In some countries planting materials are dipped into a synthetic pesticide before planting, which can delay pest infestation for several months, however most pesticides are expensive and highly toxic therefore dipping is only likely to be economical for large-scale commercial root production or vine-multiplication nurseries.

Breeders have spent many years trying to develop varieties that are resistant to the weevil. So far they have not been successful. However, varieties that form roots relatively deep in the soil are less attacked because the weevils cannot easily reach the roots to lay eggs. Other varieties escape weevil damage because their storage roots mature quickly and can be harvested early.

2.7.3 Pest Control Using Bt Gene in Sweet Potato[38]

Sweet potato is grown in Sub-Saharan Africa as a staple food for the urban and rural poor. Major producing countries include Uganda, Nigeria, Rwanda, Burundi, Kenya, and Tanzania. Annual production in 2002 totaled nearly 7 million tons. Although yield potential is thought to be of the order of 50 tons per hectare, the average yield in eastern Africa has been only 4.17 ton/ha over the last three years. Principal yield reducing factors include poor soil fertility, weevils, and viral diseases.

Although viral diseases are responsible for up to 50% of the losses in some cases, weevils constitute the most important threat to crop productivity and sustainability. The principal weevil species that are widespread in Sub-Saharan Africa and cause severe damage to sweet potato are *Cylas puncticollis*, *C. brunneus*, and, to a lesser extent, *C. formicarius*. Production losses due to weevil feeding may often reach 60% to 100%. Even slightly damaged roots are unsuitable for human consumption. In field conditions, the cryptic feeding habit of the larvae and the nocturnal activity of the adults make it difficult to detect infestations. Moreover, approximately 80 to 90% of the weevil population within vines and roots are distributed below the soil surface, further limiting the effectiveness of chemical insecticides applied for weevil management.

Previous experience has shown that conventional integrated pest management practices are not practical in SSA because it is extremely difficult to control field sanitation in a small-scale subsistence production system with sweet potato grown all year around. In addition, in-ground storage and strip harvesting is a common practice. This practice guarantees that fresh roots are available for consumption during a large part of the year, but it also means that sweet potato crops are exposed to weevils throughout the year.

The search for resistance in the crop's germplasm yielded no reliable result for sweet potato weevils. The use of biotechnological approaches to introduce 'resistance genes', therefore, holds the greatest promise to protect sweet potato against weevils. According to Matin Qaim

---

[37] *Id.*

[38] *Innovation plan : Development of 'Bacillus thuringiensis' –Bt sweetpotato resistant to Cylas spp. in African subsistence agriculture* (International Potato Center (Peru), Auburn University (USA) & National Agricultural Research Organization (Uganda), Unpublished Working Paper) (citation omitted)

(2001), weevil resistance technology would create welfare gains of 9.9 million US $ and an approximate internal rate of return on biotechnology research investment of between 33 to 77%. Scientists familiar with the problem believe that the use of *Bacillus thuringiensis* (Bt) genes currently represents the most feasible means for achieving sustainable control of weevils under African farm conditions. The identification and transfer of genes that produce a protein(s) toxic to weevils represents such an approach.

Crops containing Bt genes are the second most widely grown group of transgenic plants, herbicide tolerant being the number one (James, 2003). To date, a body of knowledge has been published that confirms the safety of Bt to human health, its positive impact on the environment, and its effectiveness in controlling targeted pests.

Sweet potato and therefore sweet potato weevils have received relatively little attention from the private sector, which has been the key player in the development of Bt technology. More Bt strains and proteins have been screened (and subsequently found to be toxic) against lepidoptera essentially due to their economic impact in developed countries, ease of rearing, and polyphagus nature (e.g. they are pests of multiple commercial crops). Contrastingly, the database of Cry proteins active against weevils is limited to four Bt proteins and their corresponding genes (*cry2Aa*, *cry3Aa1*, *cry3Aa4*, *cry3Ba2*) for cowpea, cotton, and alfalfa weevils. Therefore the lack of Bt toxins active against weevils may be partly a reflection of low commodity value of the sweet potato rather than exclusively a biological fact.

As with any novel technology, advances with Bt have drawn both skepticism and criticism. For example, many developing countries fear that the use of transgenic plants will lead to a drop in export sales. Sweet potato, which is essentially a subsistence crop in Africa, is likely to be exempt from such concerns.

Local and external stakeholders across Africa are implementing a diverse array of activities to support the utilization of biotechnology to help solve problems of agriculture in the continent. These activities are targeted at local, national, sub-regional, continental and international audiences. Activities cover the range of assistance needed for development of human capacity, creation of a supportive policy and legal environment, advocacy through public awareness, financing through public-private sector linkages, installation or improvement of laboratories and facilities and special financing to implement specific crop and livestock improvement projects. The project that is the subject of this report will seek to take maximum advantage of the presence of these diverse efforts through networking or other collaborative linkages in activities of mutual interest.

2.8 Bt Technologies by CIP

2.8.1 Intro

In an effort to serve the poorest and most vulnerable members of society, the Applied Biotechnology Laboratory, International Potato Center (CIP) scientists, working side by side with researchers in Africa and Latin America, are pairing genetic diversity with the tools of modern molecular biology to provide solutions to a series of long-standing problems (1).

After nearly a decade of research, CIP and African scientists recently concluded that the development of a transgenic sweet potato may be the only way to control one of Africa's major crop pests: the sweet potato weevil (2).[39] The techniques for making Bt transformed sweet potato used by CIP will be cited entirely as below.

2.8.2 Innovation Plan[40]

Development of Bt gene constructs

Four Bt toxins have been chosen as candidate toxins for a host plant expression strategy to protect sweet potato crop from insect damages. They share very low sequence identity (the highest is Cry1Ba and cry7Aa1 share 39%). Several gene constructs will be developed shortly considering the following options:

- Develop immediately 6 gene constructs each with different combinations of promoter and Bt genes (2 per cassette).
- To circumvent liability issues, genes will be synthesized in a Germany company (we used their service before) based on the amino acid sequence of the toxin (not the protoxin) disclosed in the Bt toxin patents and scientific publications, optimized for codon usage for sweet potato or dicot plants if there are not enough sweet potato sequences available.
- To circumvent IP issues, Not-to-Assert Rights agreements may be proposed to patent holders who will be identified by an IP internship. Alternatively, a gene synthesis company will be searched for in country where patents were not registered.
- Use as promoter either CAMV35s, gSPOA1 (Sporamin promoter of sweet potato), β-Amy (β-amylase promoter of sweet potato), or FMV34s (humanitarian license available); and as terminator, those of the sweet potato promoters, NOS or the 35s.
- Concerning the selectable marker, we will use either the *nptII* or the *hptII* gene depending on the plant transformation vector used for developing the gene constructs. The *nptII* gene will be also purchased from the chemical company.
- Eventually we may consider avoiding the presence of the selectable maker into the final transformed events by transformation without selection or using CIP Cre-*loxP* excision system (pCIP54/55).
- We will use as backbone vector, pBIN20 (*nptII* gene – kanamycin resistance), or / and pCAMBIA (*hptII* gene – hygromycin resistance).
- In parallel, the public sector IP organization PIPRA may use their new plant transformation vector developed to have with maximum freedom – to –operate. A proposal is currently under evaluation.

Selectable marker

Hygromycin resistance mediated by *hptII* is reported to be as effective as kanamycin in sweet potato. This antibiotic is not used in human therapy and there is no cross resistance with other antibiotics (van den Eede et al., 2004, Food Chem Toxicol 42 1127-1156). We will use either kanamycin or hygromycin.

Backbone vector

The pCAMBIA1305.1 was chosen as backbone vector because it provides the most convenient cloning strategy by replacing the reporter gene with one of the Bt genes and adding the second Bt gene in the multi-cloning site (see details after).

[39] Scientists familiar with the problem believe that the use of Bt genes represents the most feasible means for achieving sustainable control of weevils under African farm conditions (Innov. Plan 6). The CIP research group incorporated into sweetpotato a gene derived from Bt that acts as a natural pesticide (1-2). Bt is widely used as a bio-insecticide by organic farmers (2). Crops containing Bt genes are the second most widely grown transgenic plants, and most importantly, they are considered safe for human consumption (2).

[40] *Innovation plan : Development of 'Bacillus thuringiensis' –Bt sweetpotato resistant to Cylas spp. in African subsistence agriculture* (International Potato Center (Peru), Auburn University (USA) & National Agricultural Research Organization (Uganda), Unpublished Working Paper) (citation omitted)

Coding sequences CDS and mRNAs

The coding sequence corresponding to the Cry7Aa1, Cry3Ca1, ET33-34 toxins, together with 5' leader sequences and natural terminators for sporamin and beta amylase genes, will be synthesized at Entelechon, Germany, with codon optimized for sweet potato.

Cry7Aa1: aa sequence of the Cry7Aa1 toxin [initiation codon *m* + v (for appropriate initiation sequence context [Joshi et al., 1997]) + residue 59 to 637] based on NCBI# AAA22351 region 59 to 637:

*m*vintvvsvtgatlsalgvpgasfitnfylkiagllwpengkiwdcfmtcvealidqkieeyvmkaiaeldglgsaldkyqkaladwlgkqddpeailsvatefri idslfefsmpsfkvtgyeiplltvyaqaanlhlallrdstlygdkwgftqnnieenynrqkkriseysdhctkwynsglsrlngstyeqwinynrfrremilmaldl vavfpfhdprrysmetstqltrevytdpvslsisnpdigpsfsqmentairtphlvdyldelyiytskykafshciqpdlfywsahkvsfkkseqsnlyttgiygkts gyissgaysfhgndiyrtlaapsvvvypytqnygvcqvcfygvkghvhyrgdnkydltydsidqlppdgepihekythrlchataifkstpdydnatipifswth rsaeyynriypnkitkipavkmyklddpstvvkgpgftggdlvkrgstgyigdikatvnsplsqkyrvrvryatnvsgqfnvyindkitlqtkfqntveiigegkd ltygsfgyieysttiqfpdehpkitlhlsdlsnnssfyvdsiefipvd

cry7Aa1: nucleotide sequence of synthetic cDNA (5' leader sequence from ß-Amylase gene [NCBI# D12882] + CDS optimized for sweet potato + 3' terminator sequence from ß-Amylase gene [NCBI# D12882]). The whole mRNA sequence will have restriction sites for *Pst*I at the 5' end and *Bss*HII and *Xma*I at the 3' end. The *cry7Aa1* cds fragment will have restriction sites for *Nco*I at the 5' end, and *Bst*EII at the 3' end.

atctgcagatagccacttctcaatcttctccattattctcagctctctctctctcactcttgctttagtctcttgcaaaataaccaacaccatggcgataaacacagtcgtgtca gtcacaggagctactctatctgcacttggagttccaggtgcatccttcataaccaacttctacctcaagattgctggattactttggccagaaaacggcaagatttgggatg agttcatgacagaagtggaggctttgatcgatcagaagatcgaggaatacgtgagaaacaaggctattgctgagttggatggattaggaagtgcattggacaagtacc aaaaggcattagctgattggttaggaaagcaagatgatcctgaggctattctgtctgtggctacagagtttcggattatagacagcctattcgagttctctatgcctagcttc aaggttacaggatacgagataccattgctgactgtgtatgctcaagctgcaaacttgcatcttgctcttttgagggattctaccttgtatggagataagtggggattcactca gaacaacattgaggagaactacaaccgacaaaagaagcgtatctctgagtacagtgatcactgcactaagtggtacaacagtggattgtctagactgaatggctcaac gtatgagcaatggatcaactacaacagattcagaagagagatgattctcatggctttggatctagttgctgtgtttccgtttcacgatcctaggagatactctatggagact agtacccaacttactagagaggtttacactgatcctgtttccttgtccatttctaaccctgatattggaccttctttctcgcaaatggaaaacacagcgattagaactccacat ctagtggattaccttgacgaactgtacatctacacctctaagtacaaggctttcagtcatgagatacagccagacttgttctactggtcagcacataaggtctcgttcaaga agtcagaacagtctaacctgtatactaccggtatatacggtaagacttctgggtacatatcttctggagcatactcctttcatggcaatgacatctacagaacgttagcagc tccttcagtggttgtgtacccgtatacgcaaaactacggagttgaacaagtggagttctatggagtcaaaggacatgttcactacagaggtgacaacaagtacgacttga catacgacagtatcgatcaactgccacctgatggtgaacctattcacgagaagtacactcacagattgtgtcatgcaacagctatcttcaagagtactcctgattacgaca atgctacgatccctatttctcctggacacatagatcagctgagtactacaaccgaatctatccgaacaagattaccaagatacctgctgtgaagatgtacaagctagatg atccatctactgttgtgaaaggtcctggtttcacaggaggtgatttggtcaagagaggatctactggatacattggagacattaaggctactgtcaattctccgttgtctcaa aagtacagagtgagagttagatacgctactaacgtgtctggacaattcaacgtgtacatcaacgacaagatcactcttcagacaaagttccagaatacagtcgaaacaa ttggcgaaggaaaggatctgacttacggaagttcggatacatcgagtactctacgaccattcagttccctgatgaacacccaaagatcactctacacttgtctgacttgt ccaacaactcgtctttctacgtggactcaatcgagttcattcctgttgactgaggtgaccttaggatgacatcaccctcctccctggactactgcatgtggaacaataataa gttaatgcataaatattataaataaatgaataatccagctttcagtgctgaaggtgaaggaggagcagagaagatagtgtttggataatgttgaggaattaataaaaaatg gacttgagatgttgtgcaagccattcattagtacgtacgtagctttgtatatgaattatgaagctaagagcctaagaaataagaacgttgtctaataatcataatcataataat aataatatgtgaagtaacttgtgatacgatgacatcaatgttataaatattactaataagttagaacgtatccacaaattgtcatttctattttaataatttaaatttcataatcatt acatgttaatttaagcgcgccccgggat

Cry3Ca1: aa sequence of the Cry3Ca1 toxin [initiation codon *m* + v (for appropriate initiation sequence context [Joshi et al., 1997]) + residue 64 to 649] based on NCBI# CAA42469 region 64 to 649:

*m*viqkgisiigdllgvvgfpyggalvsfytnllntiwpgedplkafmqqvealidqkiadyakdkataelqglknvfkdyvsaldswdktpltlrdgrsqgrirelf sqaeshfrrsmpsfavsgyevlflptyaqaanthllllkdaqiygtdwgystddlnefhtkqkdlticyinhcakwykagldklrgstyeewvkfnryrremtltvl dlitlfplydvrtytkgvkteltrdvltdpivavnnmngygttfsnienyirkphlfdylhaiqfhsrlqpgyfgtdsfnywsgnyvstrssigsdeiirspfygnkstl dvqnlefngekvfravangnlavwpvgtggtkihsgvtkvqfsqyndrkdevrtqtydskmvggivfdsidqlppittdeslekayshqlnyvrcfllqggrgii pvftwthksvdfyntldsekitqipfvkafilvnstsvvagpgftggdiikctngsgltlyvtpapdltysktykiriryastsqvrfgidlgsythsisyfdktmdkgn tltynsfnlssvsrpieisggnkigvsvggigsgdevyidkiefipmd

cry3Ca1: nucleotide sequence of synthetic cDNA (5' leader sequence from g-SPOA1 gene [NCBI# X13509] + CDS optimized for sweet potato + 3' terminator sequence from g-SPOA1 gene [NCBI# X13509]). The whole mRNA sequence will have restriction sites for *Pst*I at the 5' end and *Bss*HII and *Hind*III at the 3' end. The *cry3Ca1* cds fragment will have restriction sites for *Nco*I at the 5' end, and *Bst*EII at the 3' end.

atctgcagaacacaacacaccaacaaattaaacatcattacctcttagctttctcccaagttgtcatctcatctgccaccatggctatccaaaagggcataagcatcatag gagaccttctaggagttgtcggattcccttatggaggtgcattagtgtcgttctacacgaacctactcaacaccatttggcctggtgaagatcctcttaaggctttcatgcaa

caagtggaagctctgatagaccagaagattgcggattacgctaaggataaggctacagctgaattgcaaggactcaagaacgtgttcaaggattacgtctctgctctgg
attcatgggataagactcctcttacgttgagagatggtagatcacaagggagaattcgagagttgttcagtcaagctgagtcacatttcagacgctctatgcctagtttcgc
agttagtggatacgaagtgttgttcttgcctacctatgctcaagctgcaaacacgcatctactgctgttgaaagatgcgcaaatttacggaacagattggggatactctac
ggatgatctcaacgagttccatacgaaacagaaggatctcacaatcgagtacaccaaccattgtgcaaagtggtacaaagcaggattggacaagttgagaggaagta
cttatgaagagtgggttaagttcaaccgttatcgtagagagatgacgttgactgtcttggatttgattacccttttcccattgtacgatgtcagaacctacacaaagggagtt
aagactgagttgacaagagatgtgcttacagaccctattgtggctgtcaacaacatgaacggttatggaaccacattctccaacattgagaactacattcgtaaacctcac
ttgttcgattacctccatgcaatccagtttcactcgagattacaacctggatacttcggaacagactcgttcaactactggtctggtaactacgtgtcaaccagaagttccat
tggatctgacgagattatcagaagcccattctacggaaacaagtccacacttgacgttcagaaccttgagttcaacggagagaaagtgttcagagctgttgctaacgga
aaccttgctgtttggccagttggtacaggaggtaccaagatccattcaggagtgacaaaggtgcaattcagtcagtacaacgacagaaaggatgaggttagaactcag
acttacgactctaagaggaatgttggaggaattgtgttcgactctatagaccaacttccacctattaccactgatgagtctctagagaaggcttactcacaccaactcaact
acgtcagatgcttcttgctacaaggtggaagaggaatcattcctgtgttcacttggactcacaaatctgtcgacttctacaacacgttggattccgagaagattacccagat
tcctttcgtgaaggcattcatcctggttaactctacgagtgtggttgctggtcctggattcactggaggtgacatcataaagtgcaccaatggatctggattgaccctgtat
gttactccagcaccagacttgacctactccaagacctacaagataaggatccgatatgcttctacatcgcaagtgagattcggcatagatttgggaagctacactcactc
aatcagctacttcgacaagactatggacaaaggaaacactctgacttacaactccttcaacctgtcttcagtgtctagacctatcgagatttctggtggaaacaagatagg
tgtctctgtgggtggaattggatctggtgatgaagtgtacatcgacaagatcgagttcattccgatggattgaggtgaccagtgaaaagtgccggttatgaggttgcttgtt
agctatgcaacgttgccactttgacaacgttgtacgtgtaagaataaacttgcaacaaatccgagcgggtatggttgtgtaaatcctaaataaatctgaagaaataataag
gataaaatattatcctgtgtttgttttaattaattcgtcagttctctacttcttcctctttattacctttattgatatctatattattgggtaacaactcagagaatcaaatctaacattat
gttatcaaaacgtgaagctaattaacttctatacaagtataattaaggaaataaaattaaaattttgctactaaatataactttaattttaagctaggttattttgcgcgcaagctt
at

ET33-34: aa sequence of the CryET33/CryET34 protein, taken from patent US 2004/0023875 A1 (pp. 18-19).

mgiiniqdeinnymkevygattvkstydpsfkvfnesvtpqftciptcpvnnqlttkrvdntgsypvestvsftwtethtetsavtegvkagtsistkqsfkfgfvns
dvtltvsaeynysttnttttcthtwsdstkvtippktyveaayiiqngtynvpvnvecdmsgtlfcrgyrdgaliaavyvsvadladynpnlnltnkgdgiahfkgs
gfiegaqglrstiqvteypldd nkgrstpitylingslapnvtlknsnikfgsggasmtvynatftinfynegewggpepygyikayltnpdhdfeiwkqddwgk
stperstytqtikissdtgspinqmefygdvkeydvgnaddilaypsqkvestpgvtvrldgdekgsyvtikysltpa

ET33-34: nucleotide sequence of synthetic DNA for the *ET33-34* cds. The cds fragment will have restriction sites for *Nco*I at the 5' end, and *Bst*EII at the 3' end.

ccatgggcattatcaacatacaggatgagatcaacaactacatgaaagaggtgtacggtgcaacaaccgtcaaatccacttacgatcccagtttcaaggtgttcaacga
atctgtcacaccacagttcacagagattccaactgagcctgtcaacaaccagcttacaaccaagagagtcgataacactgggtcttatcctgttgagagtactgtctcctt
cacttggactgaaacgcatactgagacttctgctgtgactgaaggcgtgaaagctggaacctctatctcgacaaagcaatccttcaagttcggcttcgtgaactctgatgt
gaccttgactgtgtcagctgagtacaactactctaccacgaacactaccactacaactgagactcatacgtggtctgattctacgaaggtgacaatacctcctaagacct
acgttgaagctgcctacatcattcagaacggaacctacaatgtgccagtcaatgtcgagtgtgacatgtctggaacccttttttgcagaggttacagagatggagctttga
ttgctgctgtgtacgtgtctgttgctgatcttgccgattacaacccaaacctcaacttgaccaacaagggagatggtattgcacacttcaagggttctggcttcattgaagg
agcacaaggattgcgatccatcattcaggtgactgagtaccctttggatgacaacaagggaagatctactcccattacctacctgatcaacggatcgttagctccaaacg
tgacgttgaagaactccaacatcaagttcggatctggaggtgcttcaatgacggtgtacaatgctaccttcaccataaacttctacaacgagggagaatggggtggacc
tgaaccttacggctacataaaggcctacttgacaaaccctgatcatgacttcgagatttggaagcaagatgattggggaaagtctactcctgagagatctacgtacactc
agaccatcaagatatccagtgacactggatctccgattaaccaaatgtgcttctacggagatgtgaaggagtacgatgtgggaaacgcagacgatatcctagcatacc
caagccaaaaggtgtgttctactcctggtgtgactgtgagattggatggtgacgaaaagggttcttacgtgaccattaagtactctctgactcctgcttgaggtgacc

Cry1Ba2: aa sequence of the Cry1Ba2 toxin [initiation codon *m* + v (for appropriate initiation sequence context [Joshi et al., 1997]) + residue 64 to 649] based on NCBI# CAA65003 region 51 to 636:

mvqtgintagrilgvlgvpfagqlasfysflvgelwprgrdqweiflehveqlinqqitenarntalarlqglgdsfrayqqsledwlenrddartrsvlhtqyialel
dflnamplfaimqevpllmvyaqaanlhllllrdaslfgsefgltsqeiqryyerqvertrdysdycvewyntglnslrgtnaaswvrynqfrrdltlgvldlvalfp
sydtrtypintsaqltrevytdaigatgvnmasmnwynnnapsfsaieaaairsphlldfleqltifsassrwsntrhmtywrghtiqsrpigggInts thgatntsin
pvtlrfasrdvyrtesyagvllwgiylepihgvptvrfnftnpqnisdrgtanysqpyespglqlkdsetelppetterpnyesyshrlshigiilqsrvnvpvyswth
rsadrtntigpnritqipmvkaselpqgttvvrgpgftggdilrrtntggfgpirvtvngpltqryrigfryastvdfdffvsrggttvnnfrflrtmnsgdelkygnfvr
rafttpftftqiqdiirtsiqglsgngevyidkieiipvt

Cry1Ba2: nucleotide sequence of synthetic DNA still unavailable. The cds fragment will have restriction sites for *Nco*I at the 5' end, and *Bst*EII at the 3' end.

Nucleotide sequence optimization: sequences were optimized for codon usage and other expression determinants by the experts at the Entelechon company using sweet potato sequence information available in public databases.

- Codon optimization used the codon frequency table for sweet potato-expressed sequences available at www.kazusa.or.jp/codon/ based on 152 sequences from *Ipomoea batatas*;
- Nucleotide sequences surrounding initiation codon was optimized by favorable initiation context and avoidance of nearby second initiation codon (Kozak, 1999);
- Consensus sequences for exon-intron junction was avoided (Iannacone *et al.*, 1997; van Aarssen et al., 1995);
- AT rich sequences typically found in Bt genes was avoided (Adang *et al.*, 1993; Sutton *et al.*, 1992);
- Polyadenylation signal sequences and undesired restriction endonuclease recognition sites was also avoided (Haffani *et al.*, 2000);
- Excessive formation of secondary predicted mRNA structures was avoided by changing the nucleotide sequence (Gustafsson, 2004).

These DNA sequence optimization were all performed by Entelechon with Leto 1.0.

Promoters

Sporamin promoter: gSPOA1 promoter described in Hattori *et al.* (1990) and NCBI# X13509. The gSPOA1 promoter was isolated at CIP, using primers designed with the help of the above-mentioned references. DNA sequence was verified and resulted in 23 changes from the previously published sequence since 8 of these are located into the putative functional promoter motives (Hattori et al., 1990; Wang et al., 2002), we decided to isolate again this promoter from its native source. We are currently working on this second isolation.

β-amylase promoter: β-Amy promoter was obtained from Dr. K. Nakamura, Nagoya University, Japan, without restriction for use by CIP, no patents granted.

Untranslated sequences

5'UTR are those of the sporamin and ß-amylase genes with small modifications only for adding restriction sites (NCBI accessions: X13509 and D12882 respectively).

3'UTR is also based on those of the sporamin and β-amylase genes with small modifications only for adding restriction sites and corresponds to 377 bp (1781 to 2151 of X13509) and 411 bp (4243 to 4653 of D12882) respectively.

Table 1: Desirable gene constructs to develop for proof-of-concept.

Bt gene 1	Bt gene 2	Selectable marker	Backbone vector	pCIP	Availability
β-Amy:cry7Aa1	None	*hptII*	pCAMBIA1305.1	pCIP74	**Available**
gSPOA1:cry3Ca1	None	*hptII*	pCAMBIA1305.1	pCIP76	**Available**
gSPOA1:ET33-34	None	*hptII*	pCAMBIA1305.1	pCIP81	**Available**
β-Amy:cry7Aa1	None	*nptII*	PCAMBIA2305.1	pCIP78	**Available**
gSPOA1:cry3Ca1	None	*nptII*	PCAMBIA2305.1	pCIP79	**Available**
gSPOA1:ET33-34	None	*nptII*	PCAMBIA2305.1	pCIP82	**Available**
35s:cry1Ba2	None	*hptII*	pCAMBIA1305.1	pCIP86	Not av.
β-Amy:cry7Aa1	gSPOA1:cry3Ca1	*hptII*	pCAMBIA1305.1	pCIP80	**Available**
gSPOA1:ET33-34	β-Amy:cry7Aa1	*hptII*	pCAMBIA1305.1	pCIP83	**3/2007**
β-Amy:cry7Aa1	gSPOA1:cry3Ca1	*nptII*	PCAMBIA2305.1	pCIP84	**Available**
gSPOA1:ET33-34	β-Amy:cry7Aa1	*nptII*	PCAMBIA2305.1	pCIP85	**3/2007**
35s:cry1Ba2	β-Amy:cry7Aa1	*hptII*	pCAMBIA1305.1	pCIP87	Not av.
gSPOA1:ET33-34	35s:cry1Ba2	*hptII*	pCAMBIA1305.1	pCIP88	Not av.

Optimization of sweet potato transformation protocol

The organogenesis transformation protocols will be applied in parallel to the 4 genotypes aforementioned at the beginning of the first phase of the project at CIP. Capacity building of African scientist will take place when the insect bioassay will be established at NARO.

Two African genetic transformation facility sites are being considered: (1) at the biotechnology laboratory at the NARO Uganda, and (2) at the ILRI Biosciences Facilities. The CIP regional representative and CIP headquarter scientists will ensure the earliest transfer of the transformation protocols at the respective African institutions in Uganda.

At least 50 transformation events per variety or cultivar will be produced and characterized molecularly for *cry* gene insertion and Cry protein expression. The variety SPK004 will receive much emphasis because of its high rate of adoption and orange-flesh (rich in precursors of vitA). Each group of events of a variety or cultivar will be screened for high expressers. Antibodies specific to each Cry protein will be used to identify rapidly these plants, which will likely be the most resistant plants.

The highest Cry toxin-expressing transformation events will then be used to produce roots and test their resistance to *C. puncticollis*, and *C. brunneus* at the African genetic transformation facility.

The final delivery of the Bt varieties to resource-poor farmers will be developed after the proof of concept is completed. CIP will promote the release of such varieties as global public goods.

Refining toxicity assessment (LC_{50})

Dr. Moar will make several more trips to Uganda to finalize and improve bioassays so that a scientific journal level of LC_{50}'s can be developed. In addition to allowing our results to be disseminated, these LC_{50}'s will allow us to determine more precisely the differential toxicities of our candidate Bt proteins. Preliminary evidence suggests that the dose-response of these Bt's is relatively flat (low slopes) and that additional lower concentrations are needed to understand more thoroughly the toxicity potential of these proteins. Additional bioassays will be conducted with various Cry1B derivatives to determine whether the Cry1Ba from CIP-PH-Bt-J has unique toxicity.

Binding studies

Dr. Moar will work closely with the laboratories of Drs. Juan Ferre and Baltasar Escriche at the University of Valencia, Spain, to develop a method to isolate BBMV's from *Cylas* spp. and to conduct Bt-specific binding studies with Cry3Aa, ET 33-34, ET 70, CryCa1, Cry7Aa1 and Cry1Ba. Currently Drs. Ferre and Escriche are using *C. formicarius* as a model, but when this work is optimized, Dr. Moar will acquire *C. puncticollis* and *C. brunneus* from Namulonge and import the BBMV's to Valencia. Those proteins found to be non-competitive in binding studies would be given priority for plant expression.

Characterizing the identity of the crystal toxin of CIP-PH-Bt-J

Dr. Moar will be culturing CIP-PH-Bt-J to purify crystals for solubilization, activation, and HPLC purification of Cry1Ba to be conducted by Marianne Carey, CWRU. Dr. Moar will also produce Cry1Ba1 protein from *E. coli* clones to be characterized as described above. Both proteins will be characterized for insecticidal activity primarily in Namulonge. If both proteins are similar in toxicity, then the DNA sequence from Cry1Ba1 can be used to construct a Cry1Ba synthetic gene. If the Cry1Ba from CIP-PH-Bt-J is substantially more toxic, then this Cry1Ba gene will be cloned, sequenced and expressed in the Moar lab and then this gene sequence will be used to construct a synthetic gene.

Assessment of sweet potato weevil mortality using purified products

We hope to finalize Bt bioassays to confirm toxicity (preferably with LC_{50}'s) of the promising Bts for both *C. puncticollis* and *C. brunneus*. Currently, LC_{50}'s will be established for ET 33-34, Cry3Ca1 and Cry7Aa1. Subsequent bioassays will be conducted with the other promising Bt proteins. Moses Ekobu will complete his MSc. work at Makerere University on this project. Maureen Solera will continue to conduct Bt bioassays using the artificial diet developed by Moses Ekobu.

3. Patent Mining Process and Findings

3.1 Search Methodology

The search methodology consisted of two major searches:

1. Summer search
2. Fall search

Both searches utilized a number of patent databases including USPTO, Westlaw, LexisNexis, GenomeQuest, Questel-Orbit, Delphion, Dialog, Derwent Worldwide Patent Index, and MicroPatent (Aureka), INDECOPI, OAPI, and ARIPO. Each database had its limitations for patent searching such as limitations in natural language and term and connector searches, but all provided its own value added. Likewise, each database had a distinct method for searching including, but not limited to, differing uses of Boolean operators and acronyms for the International Patent Classification. The purpose in utilizing different databases in the search process was to acquire a familiarity for patent searching among different databases and to benefit from the various services unique to each database. In addition, searching various databases allowed the searchers to verify the success of their search strings as results from one database were compared to the results from other databases. (See Appendix Section B for description of databases used in search process; see Appendix Section C for definition of U.S. and International Patent Classifications used as part of search strings).

The search scope was defined by CIP's interest in the method of transforming the sweet potato using *Bacillus thuringiensis* to make it resistant to weevil infestation. The search's scope as defined focused on, but was not limited to, U.S. patents and patent applications, Kenyan patents and patent applications, Ugandan patent and patent applications and Peruvian patent and patent applications. However, because of the complexity of the disclosure, the popularity of the bacteria, and the potential deployment of the transgenic crop to other African countries, the scope of the searches was later extended to include OAPI and ARIPO patent and patent applications. Consequently, the searches include:[41]

1. U.S. patents and patent applications;

2. National patents and patent applications for Uganda, Kenya, and Peru;

3. Regional patents and patent applications for ARIPO (African Regional Industrial Property Organization) and OAPI (African Intellectual Property Organization);

4. National, regional, international and family patent and patent applications deemed relevant;

5. Patent and patent applications relating to the use of *Bacillus thuringiensis* in crops against coleopteran;

6. Patent and patent applications relating to the use of *cry3Ca1*, *cry7Aa1*, and *cry Et 33-34* in the sweet potato against weevil infestation;

---

[41] See the PIPRA DVD for the patent search spreadsheet file entitled: "CIP Africa work product.xls"

7. Amino acid sequence searches in GenomeQuest using GeneBLAST and GenePAST;

8. Codon-optimized DNA sequence searches in GenomeQuest using GeneBLAST and GenePAST; and

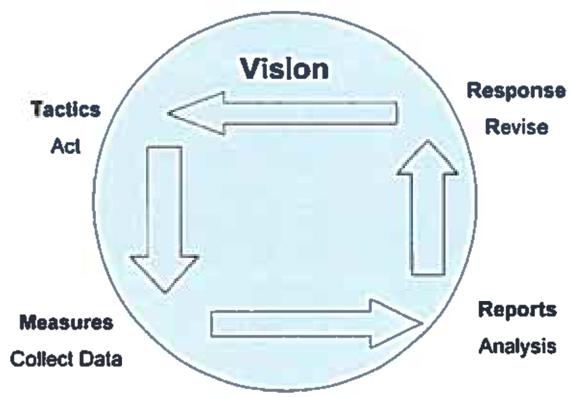
9. Native DNA sequence searches in GenomeQuest using GeneBLAST and GenePAST.[42]

3.2 The **Summer Search:**

The Summer search commenced on May 27, 2007 with a referral from PIPRA. Cecilia Chiham, Director Biotechnology Resources at PIPRA was the contact and coordinator. During several telephone conferences, the scope was defined by Cecilia Chiham after her consultation with Mark Ghislain, Ph.D., Biotechnology advisor, Head, Applied Biotechnology Laboratory of CIP. The goal of the Summer search was to find relevant patents encompassing the use of the three Bt cryproteins in the sweet potato against weevil infestation.

The patent searchers were divided into two distinct Teams: Team 1 consisted of Bum Rae Cho and Kerry Swift, two expert patent searchers and Team 2 was comprised of Natalia Pence and John Kenyon, two novice patent searchers (see Appendix for Curriculum Vitaes). The purpose in dividing the search Team into two distinct groups was to ensure a thorough and detailed search denoted as the Iterative Process Approach. The Iterative Process Approach (as innovatively applied to patent searching strategies by Professor Jon Cavicchi) is a continuous modification of searches as more information becomes available. The summer search ended on June 22, 2007.

Iterative Process



[42] See the PIPRA DVD for the Summer Search and Fall Search *GenomeQuest* search reports in the "*GenomeQuest* Search Report" folder.

3.2.1 Team 1 Methodology overview:

Team I premised the summer search on the USPTO because most international patent applicants apply for U.S. patent protection. From the innovation plan provided to us by Mark Ghislain, Ph.D at CIP, we deduced three major concepts for patent searching:

a. Organism: *Bacillus thuringiensis*

b. Insecticidal uses

c. Transgenic uses

From these major concepts, we derived an initial list of keywords to be employed in the patent searches. The keywords led the Team to a list of relevant patents from which they derived the most relevant US Classification/sub-classifications, International Patent Classifications, assignees, and alternative keywords, which were later employed in the searching of the remaining databases.
For finding patent literature, we searched the following database platforms:

1. **GenomeQuest Search:** Using the amino acid sequences of the Bt genes, we performed a GenePAST search through GenomeQuest database. Using this search result, we found patents, which included the three sets of Bt cryproteins: Cry7Aa1, Cry3Ca1 and ET33-34. After analyzing the search results, we arranged the most relevant patents in our PATENT LIST.

2. **Questel-Orbit Search**: Using the analysis tool, we found the most relevant U.S. Classification/sub-classifications, International Patent Classifications, ECLA, and assignees. We then repeated the search using a hybridization of classifications with the keyword terms. We listed additional patents, which were not found in our prior search into our PATENT LIST.

3. **USPTO, Espacenet, WIPO, Westlaw, LexisNexis, Delphion, Micropatent (Aureka) and Dialog Search**: Using keywords, classifications, and assignee information, we searched the databases for any additional relevant patents and listed any new patents in the PATENT LIST.

3.2.2 Team 1 Search Tables:

DB name	GenomeQuest GenePAST
Keywords	1. Amino acid sequences for each cry-protein given in disclosure 2. 70% or greater homology
U.S. Class/sub-classifications	None used
Search Strings	See keywords
Results	Patents searched: 39 Relevant: 39

DB name	USPTO Patent Database
Keywords	**1. Organism** Bacteria, Bacillus, *Bacillus thuringiensis*, B. thuringiensis, plant, potato **2. Insecticidal uses** Insectici?, Entomopathogenic, pesticide?, Reduce?, Control?, Resist?, Biopesticide?, Damage **3. Transgenic Uses** Transgen?, Recombin?, Genetic modification, Transform, Express?, Plasmid, Construct, Agrobacterium **4. BT Endotoxin** Toxi?, Endotoxi?, cry, protein, polypeptide, anthonomous, hydrolase, proteinase, receptor binding, ion channel **5. Assignee List from Patent list** Monsanto, Syngenta, Mycogen, Plant Genetic Sciences, Ecogen, Bayer, Imperial, Abbott, Valent Biosciences **6. Keyword list from abstracts of patent list:** *Bacillus thuringiensis*, Cry$ (cry3$, Cry7$, ET33), Coleoptera?, Toxi$, Insect$, Pest$, Endotoxin, Polynucleotide, Protein?, Nucleic acid, Transgen$, Plant
U.S. Class/sub-classification	**1. Organism** 435 –bacteria 435/832 – bacillus 800 /295 – plant 800/317.2 – potato plant 426/637 – potato **2. Insecticidal uses** 424 – Insecticide 424/93.461 – Insecticide using whole BT **3. Transgenic Uses** 800 – multicellular organisms 800/279 – introducing a nucleotide into a plant that confers pest resistance 800/288 – non-plant material is expressed 800/292-294 – methods by which the nucleotides are introduced, including using agrobacterium

DB name	USPTO Patent Database
	800/300 – pathogen resistant plant that is transgenic or mutant 800/302 – insect resistant plant that is transgenic or mutant FOR102 – recombinant plant FOR107 – genetically modified seed 435/418 – plant cell that is pest resistant or pest lethal 435/320.1 – gene vector, such as a plasmid 435/440 – genetic modification of an organism 435/468 – introduction of a gene within a plant cell 435/469 – introduction into a plant via Agrobacteria 435/470 – introduction into a plant via mechanical processes **4. BT Endotoxin** 530/350+ - proteins (more than 100+ AA) 530/825 – proteins from bacteria **5. Organism Classification Searches** 435/832 – bacillus - 432 435/832 AND "thuringiensis" -112 435/832 AND "cry3S" or "cry7S" or "cryET33" - 0 **New Classification codes** 424/405 – biocides 424/418 – a protein/polysaccharide based biocide 424/780 – active ingredient extracted from a microorganism 435/69.1 – making a protein using a recombinant technique 435/252.5 – isolation of Bacillus species 435/822 – general use of bacteria reference 536/23.1 – organic compounds, specifically DNA/RNA 536/23.4 – organic compounds that encode a fusion protein 800/317.2 – potato – 209 800/317.2 AND "thuringiensis" - 33 435/410 - plant cell or cell line for regeneration of plant 435/320.1 - gene vector, such as a plasmid **6. Insecticidal Classification Searches** 514/2 - Peptide containing a designated organic active ingredient 514/12 - Peptide of 25+ AA containing a designated organic active ingredient 424/93.2 - genetically modified micro-organism, cell, or virus 424/184.1 - antigen, epitope or other specific immunoeffector 424/185.1 – a protein sequence encoding 184.1 424/192.1 – a fusion protein encoding 184.1 424/278.1 – a non-specific immunoeffector 424/93.3 - mixture of two or more micro-organisms, cells, or viruses 536/23.71 - *Bacillus thuringiensis* insect toxin **7. Transgenic Classification Searches** 800/302 – insect resistant plant that is transgenic or mutant 435/418 – plant cell that is pest resistant or pest lethal 435/468 – introduction of a gene within a plant cell 800/279 – introducing a nucleotide into a plant that confers pest resistance **8. BT Endotoxin Classification Searches** 530/825 –proteins from bacteria

DB name	USPTO Patent Database
	9. Common Codes 424/93.461 – Insecticide using whole BT 435/69.1 - Recombinant DNA technique in method of making a protein or polypeptide 435/252.5 – Isolation of Bacillus species 514/2 - Peptide containing a designated organic active ingredient - 530/825 – proteins from bacteria 536/23.71 -*Bacillus thuringiensis* insect toxin 800/279 – introducing a nucleotide into a plant that confers pest resistance **10. Other Codes** 424 - insecticide 424/93.2 - genetically modified micro-organism, cell, or virus 424/93.3 - mixture of two or more micro-organisms, cells, or viruses of different genera 424/184.1 – antigen, epitope or other specific immunoeffector 424/185.1 – a protein sequence encoding 184.1 424/192.1 – a fusion protein encoding 184.1 424/278.1 – a non-specific immunoeffector 424/405 -Biocides; animal or insect repellents or attractants 424/418 - Protein or derivative or polysaccharide or derivative 424/780 – active ingredient extract or material obtained from a microorganism 426/637 – potato, sweet potato, yam 435 -bacteria 435/320.1 –gene vector, such as a plasmid 435/410 – plant cell or cell line for regeneration of plant 435/418 –plant cell that is pest resistant or pest lethal 435/440 –genetic modification of an organism 435/468 – introduction of a gene within a plant cell 435/469 – introduction into a plant via Agrobacteria 435/470 – introduction into a plant via a mechanical process 435/485 - Microorganism of the genus Bacillus is a host for the plasmid or episome 435/822 - Using bacteria or actinomycetales for the destruction of toxic substances- 435/832 – bacillus 514/12 – Peptide of 25+ AA containing a designated organic active ingredient 530/350+ - proteins (100+AA) 536/23.1 – organic compounds made up of DNA or RNA fragments 536/23.4 – 23.1 where the DNA/RNA encodes a fusion protein 536/23.6 – 23.2 where the DNA/RNA e -ncodes a plant polypeptide 800 – multi-cellular organism 800/288 – non-plant material is expressed 800/295+ - plant 800/301 – pathogen resistant plant that is transgenic or mutant 800/302 – insect resistant plant that is transgenic or mutant 800/317.2 – potato plant
Search Strings	CCL/435/832 :432 CCL/435/832 AND thuringiensis :112 CCL/800/317.2 : 209 CCL/800/317.2 AND thuringiensis : 33 CCL/424/93.461 : 206 CCL/424/93.461 AND toxin :161 CCL/424/93.461 AND potato : 98 CCL/424/93.461 AND cry : 49 CCL/424/93.461 AND CCL/800/279 : 3 CCL/424/93.461 AND CCL/800/301 : 0

DB name	USPTO Patent Database
	CCL/424/93.461 AND CCL/800/302 : 8 CCL/424/93.461 AND cryET33 : 2 (CCL/424/93.461 AND cry) AND coleoptera? : 36 CCL/800/279 : 1030 CCL/800/279 AND thuringiensis :707 CCL/530/825 : 517 CCL/530/825 AND thuringiensis : 29 CCL/530/825 AND cry :9 (CCL/800/279 AND thuringiensis) AND potato :556 CCL/800/279 AND cry : 52 CCL/800/302 : 1104 CCL/800/302 AND thuringiensis : 959 (CCL/800/302 AND thuringiensis) AND potato : 731 CCL/800/302 AND cry : 89 CCL/435/418 :472 CCL/435/418 AND thuringiensis : 203 (CCL/435/418 AND thuringiensis) AND potato : 154 CCL/435/418 AND cry :40 CCL/435/418 AND cry? : 41 CCL/435/468 : 1827 CCL/435/468 AND thuringiensis : 581 (CCL/435/468 AND thuringiensis) AND potato : 488 CCL/435/468 AND cry :38 CCL/435/468 AND "bt toxin" : 20 CCL/435/252.5 : 486 CCL/435/252.5 AND thuringiensis : 172 CCL/435/252.5 AND insecticid$: 141 CCL/435/252.5 AND coleoptera? : 65 CCL/435/252.5 AND cry : 35 CCL/536/23.71 :264 CCL/536/23.71 AND cry :110 CCL/536/23.71 AND thuringiensis : 257 CCL/536/23.71 AND coleoptera? : 156 (CCL/536/23.71 AND coleoptera?) AND cry : 90 CCL/435/69.1 : 11538 CCL/435/69.1 AND thuringiensis : 524 (CCL/435/69.1 AND thuringiensis) AND cry : 62 (CCL/435/69.1 AND thuringiensis) AND coleoptera? : 92 AN/Bayer : 13788 AN/Bayer AND thuringiensis : 378 (AN/Bayer AND thuringiensis) AND cry :3 (AN/Bayer AND thuringiensis) AND cry3$: 44 (Pub App) CCL/530/825 : 3

DB name	USPTO Patent Database
	(Pub App) CCL/435/252.5 : 22 (Pub App) CCL/435/252.5 AND cry : 3 (Pub App) CCL/424/93.461 : 18 (Pub App) CCL/424/93.461 AND cry :7 (Pub App) CCL/435/69.1 : 15400 (Pub App) CCL/435/69.1 AND thuringiensis : 399 (Pub App) CCL/435/69.1 AND thuringiensis AND cry : 45 (Pub App) CCL/435/69.1 AND thuringiensis AND coleoptera? :31 (Pub App) CCL/536/23.71 : 6
Results	Total patents searched: 1297 (redundant) Relevant: 15

DB name	Questel-Orbit FamPat
Keywords	1. General(&) Transform?, Recombinant, Transgenic plant, GMO, Genetically Modified Organism. 2. Bacteria(&) *Bacillus thuringiensis*, B. thuringiensis, B.t. 3. Weevils(optional) Cylas puncticollis, Cylas brunneus, C. puncticollis, C. brunneus 4. Gene(&) DNA, Strain, gene, sequence (toxin) Cry, Cry7Aa1, ET33-34, Cry3Ca1, Cry1Ba2, (Cyt) (sweet potato) Agrobacterium tumefaciens, A. tumefaciens, EHA105 5. Promoter(optional) CAMV46w, gSPOA1, ß-Amy, beta-Amy, FMV34s, NOS, 35s pBIN20 6. Selectable marker(optional) nptII, hptII, 7. Vehicle(optional) pBIN20, pCAMBIA 8. Toxin(&) Toxi?, insecticid?, insect, pesticid? 9. Target Plant(&) sweet potato, yam, ipomoea batatas, batatas
U.S. Class/sub-classifications	426/637 Sweet potato 800/279 The polynucleotide confers pathogen or pest resistance. 800/302 Insect resistant plant which is transgenic or mutant. 435/069.1 Recombinant DNA technique included in method of making a protein or polypeptide. • 435/252.1 Bacteria or actinomycetales; media therefor; 435/252.3 Transformants (e.g., recombinant DNA or vector or foreign or exogenous

DB name	Questel-Orbit FamPat
	gene containing, fused bacteria, etc.). • 435/418 Plant cell or cell line, per se, is pest or herbicide resistant or pest lethal • 424/093.461 B. thuringiensis. • 424/093.2 Genetically modified microorganism, cell, or virus (e.g., transformed, fused, hybrid, etc.). • 514/012 25 or more peptide repeating units in known peptide chain structure. • 514/002 Peptide containing (e.g., protein, peptones, fibrinogen, etc.) DOAI. • 530/350 Proteins, i.e., more than 100 amino acid residues. • 536/023.1 DNA or RNA fragments or modified forms thereof (e.g., genes, etc.). • 536/023.71 *Bacillus thuringiensis* insect toxin.
Class (European classification ECLA /International Patent classification IPC)	• C07K-014/325 *Bacillus thuringiensis* crystal protein (delta-endotoxin). C12N-015/82C8B6E [EPO: for insect resistance] [N9607]. A01N-063/00 Biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates or substances produced by, or extracted from, micro-organisms or animal material. A01N-063/02 Fermentates or substances produced by, or extracted from, micro-organisms or animal material. C12R-001/07B [EPO: *Bacillus thuringiensis*]. C07K-014/00 Peptides having more than 20 amino acids; Gastrins; Somatostatins; Melanotropins; Derivatives thereof C07K-014/415 from plants. C07K-014/00 Peptides having more than 20 amino acids; Gastrins; Somatostatins; Melanotropins; Derivatives thereof C07K-014/195 from bacteria C07K-014/32 from Bacillus (G). C07K-014/00 Peptides having more than 20 amino acids; Gastrins; Somatostatins; Melanotropins; Derivatives thereof C07K-014/435 from animals; from humans C07K-014/435A [EPO: from invertebrates] [N9604] C07K-014/435A4 [EPO: from insects] [N9604]. C12N-015/63 Introduction of foreign genetic material using vectors; Vectors; Use of hosts therefor; Regulation of expression C12N-015/79 Vectors or expression systems specially adapted for eukaryotic host C12N-015/82 for plant cells, [EPO: e.g. plant artificial chromosomes (PACs)] [C0211] C12N-015/82B [EPO: Methods for controlling, regulating or enhancing expression of transgenes in plant cells] [N9607] [C0211]. C12N-015/79 Vectors or expression systems specially adapted for eukaryotic host C12N-015/82 for plant cells, [EPO: e.g. plant artificial chromosomes (PACs)] [C0211] C12N-015/82C [EPO: Phenotypically and genetically modified plants via recombinant DNA technology] [N9607] C12N-015/82C8 [EPO: with agronomic (input) traits, e.g. crop yield] [N9607] [C0211] C12N-015/82C8B [EPO: for stress resistance, e.g. heavy metal resistance] [N9607] [N0211] C12N-015/82C8B6 [EPO: for biotic stress resistance, pathogen resistance, disease resistance] [N9607] [C0211] C12N-015/82C8B6B [EPO: for fungal resistance] [N0211].
Search Strings	1st search : (("*Bacillus thuringiensis*" or "**B**. Thuringiensis" or "Thuringiensis") and (DNA or Gene or RNA))/BI/ICLM Results : 460 patents 2nd search : (("*Bacillus thuringiensis*" or "B. Thuringiensis" or "Thuringiensis") and (DNA or Gene or RNA) and (Cry or ET))/BI/ICLM Results : 129 patents 3rd search : (("*Bacillus thuringiensis*" or "B. Thuringiensis" or "Thuringiensis") and (DNA or Gene or RNA) and (Cry or ET) and (potato or yam or batatas))/BI/ICLM

DB name	Questel-Orbit FamPat
	Results : 15 patents 4th search : ((“*Bacillus thuringiensis*” or “B. Thuringiensis” or “Thuringiensis” or B.t. or Bt. Or Bt) and (DNA or Gene or RNA or strain) and (Cry or ET) and (Transform? Or Recombinant or transgenic or GMO))/BI/ICLM Results : 87 patents 5th search : ((“*Bacillus thuringiensis*” or “B. Thuringiensis” or “Thuringiensis” or B.t. or Bt. Or Bt) and (DNA or Gene or RNA or strain) and (Cry or ET) and (Transform? Or Recombinant or transgenic or GMO) and (sweet or Potato or yam or batatas) and (Cylas or Puncticollis or brunneus))/BI Results : 70 patents 6th search : ((“*Bacillus thuringiensis*” or “B. Thuringiensis” or “Thuringiensis” or B.t. or Bt. Or Bt) and (DNA or Gene or RNA or strain) and (Cry or ET) and (Transform? Or Recombinant or transgenic or GMO) and (sweet or Potato or yam or batatas) and (Cylas or Puncticollis or brunneus))/BI grouped in families Results : 45 patents 7th search : ((“*Bacillus thuringiensis*” or “B. Thuringiensis” or “Thuringiensis” or B.t. or Bt. Or Bt) and (DNA or Gene or RNA or strain) and (Cry or ET) and (protein or aminoacid or amino) and (Transform+ Or Recombinant or transgenic or GMO) and (sweet-potato or yam or batatas))/desc Results : 303 patents
Results	Total patents searched: 1109 (redundant) Relevant: 4

DB name	Dialog World Patent Index
Keywords	Thuringiensis Polypeptide or protein? or endotoxin Cry3? And cry7? Or cryET? Plasmid or vector or construct Gene? or nucleic or polynucleotide or nucleotide? Transgen? or transform? Or recombinant Plant Coleopteran? or weevil or cylas
U.S. Class/sub-classifications	800/279 – introducing a nucleotide into a plant that confers pest resistance 435/320.1 – gene vector, such as a plasmid
Search Strings	**1st Search : Cry Derwent search** ? s thuringiensis S1 2051 THURINGIENSIS ? s **(polypeptide or protein? or endotoxin)** 53744 POLYPEPTIDE 203470 PROTEIN? 3623 ENDOTOXIN S2 221229 (POLYPEPTIDE OR PROTEIN? OR ENDOTOXIN) ? s s1 **and s2** 2051 S1 221229 S2 S3 1473 S1 AND S2 ? s **s3 and (cry3? and cry7? or cryet?)** 1473 S3 43 CRY3? 7 CRY7? 14 CRYET?

DB name	Dialog World Patent Index
	S4 16 S3 AND (CRY3? AND CRY7? OR CRYET?) **? s s3 and (cry3? or cry7? or cryet?)** 1473 S3 43 CRY3? 7 CRY7? 14 CRYET? S5 37 S3 AND (CRY3? OR CRY7? OR CRYET?) **2nd Search (Cry only search)** **? s (cry3? or cry7? or cryet?)** 49 CRY3? 4 CRY7? 24 CRYET? S1 70 (CRY3? OR CRY7? OR CRYET?) **3rd Search (Cry Dialog search)** **? s (plasmid or vector or construct) and (gene? or nucleic or polynucleotide or nucleotide?)** 10504 PLASMID 73477 VECTOR 19065 CONSTRUCT 1480277 GENE? 57974 NUCLEIC 19747 POLYNUCLEOTIDE 61978 NUCLEOTIDE? S1 67823 (PLASMID OR VECTOR OR CONSTRUCT) AND (GENE? OR NUCLEIC OR POLYNUCLEOTIDE OR NUCLEOTIDE?) **? s thuringiensis** S2 1728 THURINGIENSIS **? s (polypeptide or protein? or endotoxin?)** 42321 POLYPEPTIDE 111236 PROTEIN? 2443 ENDOTOXIN? S3 128353 (POLYPEPTIDE OR PROTEIN? OR ENDOTOXIN?) **? s (cry3? or cry7? or cryet?)** 49 CRY3? 4 CRY7? 24 CRYET? S4 70 (CRY3? OR CRY7? OR CRYET?) **? s s1 and s2** 67823 S1 1728 S2 S5 381 S1 AND S2 **? s s5 and s3** 381 S5 128353 S3 S6 348 S5 AND S3 **? s s5 and s4** 381 S5 70 S4 S7 22 S5 AND S4 **? s s1 and s4** 67823 S1 70 S4

DB name	Dialog World Patent Index
	S8 33 S1 AND S4 **4th Search (PatFull Dialog search)** **? s thuringiensis** S1 7443 THURINGIENSIS **? s (polypeptide or protein? or endotoxin)** 108046 POLYPEPTIDE 339003 PROTEIN? 21196 ENDOTOXIN S2 343404 (POLYPEPTIDE OR PROTEIN? OR ENDOTOXIN) **? s s1 and s2** 7443 S1 343404 S2 S3 6503 S1 AND S2 **? s s3 and (cry3? or cry7? or cryet?)** 6503 S3 448 CRY3? 83 CRY7? 65 CRYET? S4 440 S3 AND (CRY3? OR CRY7? OR CRYET?) **? s transgen? (1n) plant** 57938 TRANSGEN? 299104 PLANT S5 9881 TRANSGEN? (1N) PLANT **? s s4 and s5** 440 S4 9881 S5 S6 195 S4 AND S5 **? s s6 and (coleoptera? or weevil or cylas)** 195 S6 4496 COLEOPTERA? 1775 WEEVIL 68 CYLAS S7 181 S6 AND (COLEOPTERA? OR WEEVIL OR CYLAS) **? s s6 and coleoptera?** 195 S6 4496 COLEOPTERA? S8 181 S6 AND COLEOPTERA? **? s s7 and cl=800279000** 181 S7 1583 CL=800279000 S9 78 S7 AND CL=800279000 **5th Search (Plant Dialog search)** **? s (plasmid or vector or construct) and (gene? or nucleic or polynucleotide or nucleotide?)** 10504 PLASMID 73477 VECTOR 19065 CONSTRUCT 1480277 GENE? 57974 NUCLEIC 19747 POLYNUCLEOTIDE 61978 NUCLEOTIDE? S1 67823 (PLASMID OR VECTOR OR CONSTRUCT) AND (GENE? OR NUCLEIC OR

DB name	Dialog World Patent Index
	POLYNUCLEOTIDE OR NUCLEOTIDE?) ? s **thuringiensis** S2 1728 THURINGIENSIS ? s **(polypeptide or protein? or endotoxin?)** 42321 POLYPEPTIDE 111236 PROTEIN? 2443 ENDOTOXIN? S3 128353 (POLYPEPTIDE OR PROTEIN? OR ENDOTOXIN?) ? s **(transgen? or transform? or recombinant) (1n) plant?** 13700 TRANSGEN? 140882 TRANSFORM? 30865 RECOMBINANT 86847 PLANT? S4 6915 (TRANSGEN? OR TRANSFORM? OR RECOMBINANT) (1N) PLANT? ? s **s1 and s2** 67823 S1 1728 S2 S5 381 S1 AND S2 ? s **s5 and s3** 381 S5 128353 S3 S6 348 S5 AND S3 ? s **s6 and s4** 348 S6 6915 S4 S7 144 S6 AND S4 ? s s7 **and (coleoptera? or weevil or cylas)** 144 S7 384 COLEOPTERA? 103 WEEVIL 1 CYLAS S8 56 S7 AND (COLEOPTERA? OR WEEVIL OR CYLAS)
Results	Total patents searched: 274 (redundant) Relevant: 13

DB name	ESP@CENET Worldwide Database
Keywords	Thuringiensis Potato Cry or ET Gene
Search Strings	Thuringiensis and potato : 29 Thuringiensis and (cry or ET) and potato : 2 Thuringiensis and gene and potato : 8 Thuringiensis and (cry or ET) and gene : 15
Results	Total patents searched: 54 (redundant) Relevant: 3

DB name	WIPO Patent Database (PCR Publication)
Keywords	Thuringiensis

	Cry or ET
Search Strings	Thuringiensis and (cry or ET) : 197
Results	Total patents searched: 197 Relevant: 5

DB name	**Westlaw / LexisNexis Patent Database**
Search strings	**Westlaw** : thuringiensis & (sweet-potato) & (gene dna strain protein) & (recombinan! transgenic gmo) & (insecticid! pesticid!) & pas(monsanto bayer mycogen "plant genetic system" syngenta) & (cry et cyt) **LexisNexis** : thuringiensis and (sweet-potato) and (gene or dna or strain or protein) & (recombinan! or transgenic or gmo) & (insecticid! or pesticid!) and (cry or et or cyt) and ASSIGNEE (monsanto or bayer or mycogen or "plant genetic system" or syngenta)
Results	Westlaw : Total patents searched: 56 Relevant: 5 LexisNexis : Total patents searched: 42 Relevant: 2

DB name	**Delphion**
Search Strings	thuringiensis and (sweet potato or potato) and (gene or dna or strain or protein) and (recombinant* or transgenic or gmo) and (insecticide* or pesticide*) and (cry or cyt) :381
Results	Total patents searched: 381 Relevant: 10

DB name	**Micropatent** **Aureka**
Search Strings	Thuringiensis and (sweet potato or potato) and (gene or dna or strain or protein) and (recombinant* or transgenic or gmo) and (insecticide* or pesticide*) and (cry or cyt) and ASSIGNEE (monsanto or bayer or mycogen or "plant genetic system" or syngenta) : 270
Results	Total patents searched: 270 Relevant: 10

3.2.3 Team 2 Methodology Overview:

We premised the initial summer search on the USPTO because most international patent applicants apply for U.S. patent protection. From the innovation plan provided to us by Mark Ghislain, Ph.D., from CIP, we deduced two major concepts:

a. *Bacillus thuringiensis*
b. Sweet potato

From these two major concepts, Team 2 generated an initial list of keywords relating to the purpose, use, and composition of the disclosure and correlated these initial keywords with classifications and sub-classifications used in both patent and patent applications. The purpose in approaching the subject matter in this manner was aimed at focusing on the defined scope and simultaneously restricting the results to a manageable amount of relevant patents and patent applications. We then employed these keywords into the searches and obtained a list of patents. From this initial group of patents, Team 2 was able to derive additional keywords, relevant U.S. patent class/sub-classifications, International patent classifications, and assignee information that were employed in the remaining databases.

For finding patent literature, we searched the following database platforms:

1. **USPTO**: We utilized the seven-step strategy approach unique to this database by formulating an initial list of keywords and deriving relevant class/sub-classifications and performed a series of hybrid searches encompassing the keywords and class/sub-classifications. We then began the PATENT LIST.

2. **GenomeQuest**: Using the amino acid sequences of the Bt genes, we performed a GeneBLAST search through GenomeQuest database. Using this search result, we found patents which included the three sets of Bt cryproteins: Cry7Aa1, Cry3Ca1 and ET33-34. After analyzing the search results, we arranged the most relevant patents in our PATENT LIST.

3. **Westlaw**: Using keywords, classifications, and assignee information, we searched the databases for any additional relevant patents and listed any new patents in our PATENT LIST

4. **Lexis-Nexis**: Using the same keywords, classifications, and assignee information in various search strings previously employed in Westlaw, we searched the databases for any additional relevant patents and listed any new patents in our PATENT LIST

5. **Questel-Orbit**: We modified the hybrid searching previously used in Westlaw and Lexis to simpler search strings and employed the most relevant IPCs and simpler keywords.

6. **Delphion**: We modified the hybrid searching previously used in Westlaw and Lexis to simpler search strings and employed the most relevant IPCs and more specific and simpler hybrid searches.

7. **Dialog**: No hybrid searches were employed here because of the complexity of the database; instead, we performed separate searches utilizing either keyword or IPC for each search.

3.2.4 Team 2 Search Tables:

<table>
<tr><th>DB name</th><th>USPTO</th></tr>
<tr><td>Keywords</td><td>Initial keyword list
1. Bacillus thuringiensis concept: cryprotein, protein, insecticide, biocide, transgenic plants, toxicity, pesticide, weevils, gene, endotoxin, Bacillus thuringiensis, b. thuringiensis, Bt, bacillus, weevils resistant plants, insect inhibitor, transgenesis, transgenic, gene transfer, Bt genes, Bt toxins, toxin, insect, Cry ET33-34, Cry3Ca1, Cry7Aa1, Ipomoea Batatas

2. Sweet Potato concept: Sweet potato or sweet potato, potato, ipomoea batatas, tuber, root

Alternative list:
Insecticidal crystal proteins, delta endotoxins, parasporal crystals, weevil-toxic, Cry III coleopteran- specific, Cry IIIC, African weevils, Cylas puncticollis, C. puncticollis, Cylus brunneus, C. brunneus, Bacillus thuringiensis tenebrionis, Cry VII A</td></tr>
<tr><td>U.S. Classifications/sub-classifications</td><td>Bacillus thuringiensis Concept:

1. Class 530 (peptides and proteins) subclass 825 (proteins made from micro-organisms): Comprises proteins or peptides made from micro-organisms
2. Class 536 (organic compounds)/subclass 23.71 (Bacillus thuringiensis insect toxin): comprises organic compounds specifically identifying Bacillus thuringiensis insect toxin
3. Class 435 : Molecular biology and microbiology/ subclass 71.1 (using a micro-organism to make a protein or polypeptide; subclass 410 (plant or cell line per se: transgenic, mutant)
4. Class 800: (Multi-cellular living organisms and unmodified parts thereof and related processes)/ subclass 265 (breeding for pathogen or pest resistance or tolerance); subclass 302 (insect resistant plant which is transgenic or mutant)

Sweet Potato Concept:
1. Class 426: (Food or edible material)/Subclass 637 (potato, sweet potato, yam, tuber)</td></tr>
<tr><td>Search strings</td><td>Bacillus thuringiensis Concept:
a. 530/825 and Bacillus thuringiensis: yielded 29 patents and no published applications
b. 530/825 and Bacillus thuringiensis cryet33 and cryet34: yielded 3 patents and no published applications
c. 530/825 and cry protein: yielded 2 patents and no published applications
d. 530/825 and Bacillus thuringiensis or b.thuringiensis or thuringiensis: yielded 549 patents and no published applications
e. 530/825 and b.thuringiensis: yielded 1 patent and no published applications
f. 530/825 and thuringiensis: yielded 29 patents and no published applications</td></tr>
</table>

DB name	USPTO
	g. 530/825 and sweet potato: yielded 3 patents and no published applications h. 530/825 and bt: yielded 18 patents and no published applications i. 530/825 and cry7Aa1: 1 patent and no published applications j. 530/825 and cry3Ca1: 1 patent and no published applications k. 536/23.71 and *Bacillus thuringiensis*: yielded 257 patents and 5 published applications l. 536/23.71 and *Bacillus thuringiensis* cryet33 and cryet34: yielded 0 patents and no published applications m. 536/23.71 and cry proteins: yielded 41 patents and 5 published applications n. 536/23.71 and *Bacillus thuringiensis* or b. thuringiensis or thuringiensis: yielded 549 patents and no published applications o. 536/23.71 and b.thuringiensis: yielded 14 patents and no published applications p. 536/23.71 and thuringiensis: yielded 257 patents and 5 published applications q. 536/23.71 and cryet33 and cryet34: yielded 7 patents and no applications r. 536/23.71 and sweet potato: yielded 8 patents and no published applications s. 536/23.71 and bt: yielded 119 patents and 4 published applications t. 536/23.71 and ipomoea batatas: yielded 4 patents and no published applications u. 536/23.71 and cry7Aa1: yielded 6 patents and no published applications v. 536/23.71 and cry3Ca1: yielded 6 patents and no published applications **Sweet Potato Concept:** a. 426/637 and *Bacillus thuringiensis*: 1 patents and 1 published application b. 426/637 and *Bacillus thuringiensis* cryet33 and cryet34: no patents and no published applications c. 426/637 and cry protein: no patents and no published applications d. 426/637 and cryprotein: no patents and no published applications e. 426/637 and *Bacillus thuringiensis* or b.thuringiensis or thuringiensis: no patents and no published applications f. 426/637 and b.thuringiensis: no patents and no published applications g. 426/637 and thuringiensis: 1 patent and no published applications h. 426/637 and cryet33 and cryet34: no patents and no published applications i. 426/637 and bt: no patents and no published applications j. 426/637 and cry7Aa1: no patents and no published applications k. 426/637 and cry3Ca1: no patents and no published

DB name	USPTO
	applications **Combination of *Bacillus thuringiensis* Concept and Sweet Potato Concept: Hybrid Search** 1. 536/23.71 and "potato": yielded 177 patents 2. 536/23.71 and "sweet potato": yielded 8 patents 3. 536/23.71 and "sweet potato": yielded 5 patents 4. 536/23.71 and 111/908: yielded no patents 5. 536/23.71 and 426/637: yielded no patents 6. 530/825 and "potato": yielded 39 patents 7. 530/825 and "sweet potato": yielded 3 patents 8. 530/825 and "sweet potato": yielded 1 patent 9. 530/825 and 111/908: yielded no patents 10. 530/825 and 426/637: yielded no patents
Results	Total patents searched: 2143 (redundant) relevant: 15

DB name	GenomeQuest GeneBLAST
Keywords	1. Amino acid sequence given in the disclosure 2. Patent Assignee: Bayer and Monsanto 3. 85% or greater homology 4. Sweet Potato
U.S. Class/sub-classifications	None Used
Search Strings	See Keywords
Results	Patents Searched: 2056 Relevant: 4

DB Name	Westlaw US-PAT-ALL
Keywords	Cry3Ca1, CryIIIC, Cry III, Coleoptera, sweet potato, *Bacillus thuringiensis*, Cr7Aa1, Cry7AA, Cry7A, CryVIIA, Cry et 33-34 **Alternative keywords** Modified crops, transgenic crops, insect toxin, plant disease resistant genes, plant noxious proteins
U.S. Classifications/sub classifications (CLA)	• 435/252.3 • 800/302 • 435/418 • 514/2 • 536/23.71 • 424/93.461 • 435/69.1
Search Strings	1. CLA(435/252.3) "Cry3Ca1 or CryIIIC or CryIII" and "coleoptera" and "sweet potato" : yielded 14 results of which one was relevant: US PAT 6063597 2. CLA(800/302) "Cry3Ca1 or CryIIIC or CryIII" and "coleoptera" and "sweet potato": yielded 26 results of which only 1 was applicable The results were similar to search#1.

DB Name	Westlaw US-PAT-ALL
	3. CLA(435/418) " Cry3Ca1 or CryIIIC or CryIII" and "coleoptera" and "sweet potato": yielded 21 results of which all were too broad. Similar results from above searches. 4. CLA(514/2) " Cry3Ca1 or CryIIIC or CryIII" and "coleoptera" and "sweet potato": yielded 0 results 5. CLA(536/23.71) " Cry3Ca1 or CryIIIC or CryIII" and "coleoptera" and "sweet potato": yielded no results. 6. CLA (424/93.461) " Cry3Ca1 or CryIIIC or CryIII" and "coleoptera" and "sweet potato" " yielded 0 results 7. CLA (435/69.1) " Cry3Ca1 or CryIIIC or CryIII" and "coleoptera" and "sweet potato": yielded 0 results 8. CLA(435/252.3) "Cry3Ca1 or CryIIIC or CryIII" and "Bacillus-Thuringiensis" and "coleoptera" and "sweet potato": yielded 11 results all of which were already mentioned in the previous searches. All patents were too broad or not relevant. 9. CLA (800/302) "Cry3Ca1 or CryIIIC or CryIII" and "Bacillus-Thuringiensis" and "coleoptera" and "sweet potato": yielded 22 results all of which were also listed in the previous searches. 10. CLA (435/418) "Cry3Ca1 or CryIIIC or CryIII" and "Bacillus-Thuringiensis" and "coleoptera" and "sweet potato": yielded 10 results all of which were already previously listed. 11. CLA (514/2) "Cry3Ca1 or CryIIIC or CryIII" and "Bacillus-Thuringiensis" and "coleoptera" and "sweet potato": yielded 0 results as in the previous search 12. CLA (536/23.71) "Cry3Ca1 or CryIIIC or CryIII" and "Bacillus-Thuringiensis" and "coleoptera" and "sweet potato": yielded 0 results as in the previous searches 13. CLA(424/93.461) "Cry3Ca1 or CryIIIC or CryIII" and "Bacillus-Thuringiensis" and "coleoptera" and "sweet potato": yielded 0 results as in the previous searches 14. CLA (435/69.1) "Cry3Ca1 or CryIIIC or CryIII" and "Bacillus-Thuringiensis" and "coleoptera" and "sweet potato": yielded 0 results as in the previous searches. 15. "Cry7Aa1": yielded 5 results of which 3 were relevant. (see printed patents) **Cry7Aa1** 16. CLA(435/252.3) Bacillus-Thuringiensis! and Cry7AA! Or Cry7A! or CryVIIA! and coleoptera! and Sweet! +1 potato!: yielded 8 results of which one was relevant (same patent as seen in the search above) 17. CLA (800/302) Bacillus-Thuringiensis! and Cry7AA! Or Cry7A! or CryVIIA! and coleoptera! and Sweet! +1 potato!: yielded 8 results of which one was relevant (same as described above) 18. CLA (435/418) Bacillus-Thuringiensis! and Cry7AA! Or Cry7A! or CryVIIA! and coleoptera! and Sweet! +1 potato!: yielded 8 results (same patent list as above) 19. CLA (514/2) Bacillus-Thuringiensis! and Cry7AA! Or Cry7A! or CryVIIA! and coleoptera! and Sweet! +1 potato!: yielded the same 8 results as above 20. CLA (536/23.71) Bacillus-Thuringiensis! and Cry7AA! Or Cry7A! or CryVIIA! and coleoptera! and Sweet! +1 potato!: yielded the same results as above. Note that in the Cry3Ca1 and Cry Et33-34 there were no results for this class/subclass 21. CLA (424/93.461) Bacillus-Thuringiensis! and Cry7AA! Or Cry7A! or CryVIIA! and coleoptera! and Sweet! +1 potato!: yielded the same

DB Name	Westlaw US-PAT-ALL
	as described in # 6 search. 22. CLA (435/69.1) Bacillus-Thuringiensis! and Cry7AA! Or Cry7A! or CryVIIA! and coleoptera! and Sweet! +1 potato!: yielded the same as above **Cry ET 33-34** 23. CLA(435/252.3) "Cry et 33-34" and "Coleoptera" and "sweet potato": yielded 14 results which were all listed in the Cry3Ca1 search results. 24. CLA (435/252.3) "Cry et 33-34" and "Bacillus-Thuringiensis" and "Coleoptera" and "sweet potato": yielded 11 results which were already listed in the previous searches. 25. CLA(800/302) "Cry et 33-34" and "Coleoptera" and "sweet potato": yielded 14 results 26. CLA (800/302) "Cry et 33-34" and "Bacillus-Thuringiensis" and "Coleoptera" and "sweet potato": yielded 22 results all of which were already listed in the previous searches. 27. CLA (435/418) " Cry et 33-34" and "*Bacillus thuringiensis*" and "Coleoptera" and "sweet potato": 10 results all of which were also listed in the previous searches.
Results	Total patents searched: 212 (most redundant) Relevant: 7

DB Name	Westlaw WIPO PCT
Keywords	Cry3CA1, CryIIIC, CryIII, *Bacillus thuringiensis*, Cry7Aa1, Cry7A, CryVIIA, Cry et 33-34, Coleoptera, Sweet potato
International Classifications (IC)	**IC (C12N) MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q) **IC (CO7H) SUGARS; DERIVATIVES THEREOF; NUCLEOSIDES; NUCLEOTIDES; NUCLEIC ACIDS** (derivatives of aldonic or saccharic acids C07C, C07D; aldonic acids, saccharic acids C07C 59/105, C07C 59/285; cyanohydrins C07C 255/16; glycals C07D; compounds of unknown constitution C07G; polysaccharides, derivatives thereof C08B; DNA or RNA concerning genetic engineering, vectors, e.g. plasmids, or their isolation, preparation or purification C12N 15/00; sugar industry C13)
Search Strings	1. IC(C12N) Cry3ca1! Or CryIIIC! Or CryIII! and Coleoptera! and "sweet potato!": yielded 105 filings. 2. IC(C12N) Cry3ca1! Or CryIIIC! Or CryIII! and Bacillus-Thuringiensis! Coleoptera! and "sweet potato!": yielded 71 filings two of which were relevant filing (see printout) a. WIPO PCT: WO #2005063996: Plant activation of insect toxin (Pioneer Hi-Bred International)

DB Name	Westlaw WIPO PCT
	b. WIPO PCT: WO # 2005038032: A delta endotoxin gene and methods for its use 3. IC (C12N) Bacillus-Thuringiensis! and Cry7AA1! Or Cry7A! or CryVIIA! and Coleoptera! and Sweet! +1 Potato!: yielded 10 results one of which is relevant a. WIPO PCT: WO#2006119457: AXMI-028 and AXMI-o29, Family of novel delta-endotoxin genes and methods for their use 4. IC(C12N) "Cry et 33-34" and " Coleoptera" and Sweet potato!": yielded 76 filings. 5. IC(C12N) "Cry et 33-34" and " Coleoptera" and Bacillus-Thuringiensis! and "Sweet potato!": yielded 48 filings. (Filing list is the same as in the Cry3Ca1 search. None specified Cry et33-34) 6. IC(CO7H) "cryet33-34" or "ET33/34" & bacillus-thuringiensis! & "coleoptera" & "sweet potato!" a. WIPO PCT: WO #20072776: Insecticidal compositions and methods for making insect-resistant transgenic plants
Results	Total patents searched: 310 Relevant: 4

DB Name	Westlaw PCT-PAT
Keywords	Cry3CA1, CryIIIC, CryIII, *Bacillus thuringiensis*, Cry7Aa1, Cry7A, CryVIIA, Cry et 33-34, Coleoptera, Sweet potato
International Classifications (IC)	**IC (C12N) MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	7. IC(C12N) Cry3ca1! Or CryIIIC! Or CryIII! and Bacillus-Thuringiensis! Coleoptera! and "sweet potato!": yielded 33 filings one of which was relevant. a. WIPO PCT: WO #2005063996: Plant activation of insect toxin (Pioneer Hi-Bred International) (this patent is also listed for WIPO PCT *Note that WIPO PCT provided us one more patent (listed above in WIPO PCT section) that PCT-PAT did not. 8. IC (C12N) Bacillus-Thuringiensis! and Cry7AA1! Or Cry7A! or CryVIIA! and Coleoptera! and Sweet! +1 Potato!: yielded 21 filings one of which was relevant (same filing listed in WIPO PCT) a. WIPO PCT: WO#2006119457: AXMI-028 and AXMI-o29, Family of novel delta-endotoxin genes and methods for their use 9. IC(C12N) "Cry et 33-34" and " Coleoptera" and Bacillus-Thuringiensis! and "Sweet potato!": yielded 21 results none of which

DB Name	Westlaw PCT-PAT
	are relevant. This search did not yield the same relevant patent found in WIPO PCT
Results	Total patents searched: 75 Relevant: 2

DB Name	Westlaw Derwent World Patent Index (DWPI)
Keywords	Cry3CA1, CryIIIC, CryIII, *Bacillus thuringiensis*, Cry7Aa1, Cry7A, CryVIIA, Cry et 33-34, Coleoptera, Sweet potato
International Classifications	**IC (C12N) MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	IC(C12N) Cry3ca1! Or CryIIIC! Or CryIII! and Bacillus- Thuringiensis! Coleoptera! and "sweet potato!": produced 2 results one of which is applicable to ET33-34. 2. IC (C12N) Bacillus-Thuringiensis! and Cry7AA1! Or Cry7A! or CryVIIA! and Coleoptera! and Sweet! +1 Potato!: yielded 0 results 3. IC(C12N) "Cry et 33-34" and " Coleoptera" and Bacillus-Thuringiensis! and "Sweet potato!": yielded 1 result
Results	Total patents searched: 3 Relevant: 3

DB Name	Westlaw Japanese Patents (JAPIO)
Keywords	Cry3CA1, CryIIIC, CryIII, *Bacillus thuringiensis*, Cry7Aa1, Cry7A, CryVIIA, Cry et 33-34, Coleoptera, Sweet potato
International Classifications (IC)	**IC (C12N) MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	IC(C12N) Cry3ca1! Or CryIIIC! Or CryIII! and Coleoptera! and "sweet potato!": yielded 1 result
Results	Total patents searched: 1 Relevant: 0

DB name	LEXIS US PAT-ALL Patent Database
Keywords	*Bacillus thuringiensis*, cry3Ca1, cry3C, cry3, cry7Aa1, cry7A, cry7, Cry ET 33-34, Cryet, Et 33/34, Et33/34, Et, Sweet potato, Coleoptera, CryIIIC, CryIII, Cry 7AA, Cry7A, CryVIIA, Cryet33, Cryet34
U.S. Classifications/sub-classifications	*Bacillus thuringiensis* Concept: 5. **Class 530** (peptides and proteins) **subclass 825** (proteins made from micro-organisms): Comprises proteins or peptides made from micro-organisms 6. **Class 536** (organic compounds)/**subclass 23.71** (*Bacillus thuringiensis* insect toxin): comprises organic compounds specifically identifying *Bacillus thuringiensis* insect toxin 7. **Class 435** : Molecular biology and microbiology/ **subclass** 71.1 (using a micro-organism to make a protein or polypeptide; **subclass 410** (plant or cell line per se: transgenic, mutant) 8. **Class 800**: (Multi-cellular living organisms and unmodified parts thereof and related processes)/ **subclass 265** (breeding for pathogen or pest resistance or tolerance); **subclass 302** (insect resistant plant which is transgenic or mutant) 9. **Class 514**: (Drug, Bio-Affecting and Body Treating Compositions): Class 514 is an integral part of Class 424. It incorporates all the definitions and rules as to subject matter of Class 424. 10. **Class 424**: (Drug, Bio-Affecting and Body Treating Compositions): Controlling or protecting an environment or living body by attracting, disabling, inhibiting, killing, modifying, repelling or retarding an animal or micro-organism: Biocides including antibiotics of undetermined structure.
Search Strings	1. CL(435) "Cry3Ca1or CryIIIC or CryIII" and "*Bacillus thuringiensis*" and "coleopteran" and sweet-potato": yielded 24 results; two of which were also found in Westlaw US-PAT-ALL: US PAT #6642030 and US pat app#20050271642 2. CL (800) "Cry3Ca1or CryIIIC or CryIII" and "*Bacillus thuringiensis*" and "coleopteran" and sweet-potato": yielded 22 most of which were identical to the results above. One relevant patent found which was also found in Westlaw US-PAT-ALL: # 7227056 Bayer patent for CryIII: #5659123: Diabrotica toxins 3. CL (514) "Cry3Ca1or CryIIIC or CryIII" and "*Bacillus thuringiensis*" and "coleopteran" and sweet-potato": yielded 12 results one of which is a listed relevant patent found in Westlaw: #6063597 4. CL (536) "Cry3Ca1or CryIIIC or CryIII" and "*Bacillus thuringiensis*" and "coleopteran" and sweet-potato" yielded 19 results most of which are the same listed in the results list for the above searches 5. CL (424) "Cry3Ca1or CryIIIC or CryIII" and "*Bacillus thuringiensis*" and "coleopteran" and sweet-potato": yielded 8 results all of which are listed in the above searches Cry7Aa1 1. CL (435) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! and Coleoptera! and sweet w/N potato!: yielded 6 results one of which was a relevant patent application found in Westlaw: # 20050271642 2. CL (800) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 7

DB name	LEXIS US PAT-ALL Patent Database
	results which are already listed in the above search 3. CL (514) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 3 results all of which are already listed in the above searches 4. CL (536) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 7 results all of which are listed in the above searches 5. CL (424) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 3 results all of which are listed in the above searches. **Cry et33-34** 1. CL (435) and "Cryet33!" and "Cryet34!" and "Bacillus-Thuringiensis!" and coleopteran! and "sweet-potato!": yielded 5 results none of which are narrow enough to cover our disclosure 2. CL (800) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 4 patents which are the same listed above and are too broad for our disclosure 3. CL (514) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 2 patents none of which are relevant 4. CL (536) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 6 patents all of which are already listed in the above searches and are too broad for our disclosure. 5. CL (424) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 0 results
Results	Total patents searched:128 (redundant) Relevant: 4

Many of the searches produced redundant results already found in the Westlaw searches.

DB Name	LEXIS European Patents Full Text, Japanese Patent Abstracts and WIPO
Keywords	Cry3Ca1, CryIIIC, CryIII, *Bacillus thuringiensis*, Cry7AA, Cry7A, CryVIIA, CryVII, Cryet33, Cryet34, coleopteran, Sweet potato
International Classifications (INT-CL/ IPC)	**INT-CL/IPC (C12N)** **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	1. INT-CL(C12N) and Cry3Ca1! Or CryIIIC! Or CryIII! and "Bacillus-Thuringiensis!" and coleoptera! and "sweet-potato!": yielded 6 results all of which were already listed in Westlaw searches. The list here is relatively small and the patents and patent applications listed are too

DB Name	LEXIS **European Patents Full Text, Japanese Patent Abstracts and WIPO**
	broad or do not pertain to our disclosure 2. INT-CL(C12N) and "Bacillus-Thuringiensis!" and Cry7AA! or Cry7a! or CryVIIA! or CryVII! And Coleoptera! and sweet w/N potato!: yielded 7 results all of which are mentioned in Westlaw with the corresponding relevant patents in the printed tab section 3. INT-CL(C12N) and "cryet33!" and "cryet34!" and "*Bacillus thuringiensis*!" and coleopteran! and "sweet-potato!": yielded 2 results none of which are relevant or are too broad
Results	Total patents searched: 15 Relevant: 7

The above searches yielded redundant results previously found in Westlaw searches.

DB Name	**LEXIS** **INPADOC**
Keywords	Cry3Ca1, CryIIIC, CryIII, *Bacillus thuringiensis*, Cry7AA, Cry7A, CryVIIA, CryVII, Cryet33, Cryet34, coleopteran, Sweet potato
International Classifications (IPC)	IPC (C12N) **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	1. IPC(C12N) and Cry3Ca1! or CryIIIC! Or CryIII! and "Bacillus-Thuringiensis": yielded one result with the basic patent originating in Canada. The patent was not relevant to our disclosure. 2. "Bacillus-Thuringiensis!" or Cry7aa1! or Cry7a! or CryVIIA! or CryVII! Or Cry7! and "coleoptera": We had to run this search string without the IPC because the use of the IPC was not yielding any results. In addition, we had to omit "sweet-potato" from the search. Yielded 55 documents one of which seemed relevant 3. "Bacillus-Thuringiensis!" or Cry7aa1! or Cry7a! or CryVIIA! or CryVII! Or Cry7! and "coleoptera" and "yam": because the above 2 searches did not allow "sweet-potato", we decided to use "yam" instead and obtained one document that may be relevant. 4. "Cry et33!" and "Cry et34!": we had to cull the search string down to the specific cry proteins because INPADOC was not accepting the IPC, Bacillus-Thuringiensis," "coleoptera," "sweet-potato" and "yam" for this protein. This search yielded 2 results one of which is relevant.
Results	Total patents searched: 58 Relevant: 3

DB name	**Questel Orbit** **FamPat Worldwide Patent Database**

DB name	Questel Orbit FamPat Worldwide Patent Database
Keywords	*Bacillus thuringiensis*, cry3Ca1, cry3C, cry3, cry7Aa1, cry7A, cry7, Cry ET 33-34, Cryet+, Et 33/34, Et33/34, Et+, Sweet potato, Coleoptera
Class (IPC)	IPC (C12N) **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	(*Bacillus thuringiensis*) and (cry3Ca1 or cry3C or cry3) and (Sweet potato or coleoptera) and (C12N) – 1 relevant patent. (*Bacillus thuringiensis*) and ("cry et 33-34" or "cryet+" or "et 33/34" or "ET33/34" or ET+) and (sweet potato or coleoptera) and (C12N) – 1 relevant patent. (*Bacillus thuringiensis*) and (cry7Aa1 or cry7A or cry7) and (sweet potato or coleoptera) and (C12N) – 1 relevant patent.
Results	Total patents searched : 45 Relevant: 3

DB name	Questel Orbit FamPat Worldwide Patent Database
Keywords	*Bacillus thuringiensis*, cry3Ca1, cry3C, cry3, cry7Aa1, cry7A, cry7, Cry ET 33-34, Cryet+, Et 33/34, Et33/34, Et+, Sweet potato, Coleoptera
Class (IPC)	IPC (C12N) **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	(*Bacillus thuringiensis*) and (cry3Ca1 or cry3C or cry3) and (Sweet potato or coleoptera) and (C12N) – 1 relevant patent. (*Bacillus thuringiensis*) and ("cry et 33-34" or "cryet+" or "et 33/34" or "ET33/34" or ET+) and (sweet potato or coleoptera) and (C12N) – 1 relevant patent. (*Bacillus thuringiensis*) and (cry7Aa1 or cry7A or cry7) and (sweet potato or

	coleoptera) and (C12N) – 1 relevant patent.
Results	Total patents searched : 45 Relevant: 3

DB name	**Questel-Orbit: PCT, EP, & US (Published Applications) Patent Database**
Keywords	*Bacillus thuringiensis*, cry3Ca1, cry3C, cry3, cry7Aa1, cry7A, cry7, Cry ET 33-34, Cryet+, Et 33/34, Et33/34, Et+, Sweet potato, Coleoptera
Class (IPC)	IPC (C12N) **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	(*Bacillus thuringiensis*) and (cry3Ca1 or cry3C or cry3) and (Sweet potato or coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and ("cry et 33-34" or "cryet+" or "et 33/34" or "ET33/34" or ET+) and (sweet potato or coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and (cry7Aa1 or cry7A or cry7) and (sweet potato or coleoptera) and (C12N) – 0 relevant patents.
Results	Total patents searched: 26 Relevant: 0

DB name	**Questel-Orbit EP & US Patents Databases**
Keywords	*Bacillus thuringiensis*, cry3Ca1, cry3C, cry3, cry7Aa1, cry7A, cry7, Cry ET 33-34, Cryet+, Et 33/34, Et33/34, Et+, Sweet potato, Coleoptera
Class (IPC)	IPC (C12N) **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	(*Bacillus thuringiensis*) and (cry3Ca1 or cry3C or cry3) and (Sweet potato or

	coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and ("cry et 33-34" or "cryet+" or "et 33/34" or "ET33/34" or ET+) and (sweet potato or coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and (cry7Aa1 or cry7A or cry7) and (sweet potato or coleoptera) and (C12N) – 0 relevant patents.
Results	Total patents searched: 26 Relevant: 0

DB name	**Delphion** **US & EP (Applications and Patents), WIPO PCT Publications, Patent Abstracts of Japan, INPADOC Patents Databases**
Keywords	*Bacillus thuringiensis*, cry3*, cryIII*, cry7*, cryVII*, CryET*, Cry et*, Sweet potato, Coleoptera
Class (IPC)	IPC (C12N) **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	(*Bacillus thuringiensis*) and (cry3* or cryIII*) and (Sweet potato and coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and ("cryet*" or "cry et*") and (sweet potato and coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and (cry7* or cryVII*) and (sweet potato and coleoptera) and (C12N) – 0 relevant patents.
Results	Total patents searched: 18 Relevant: 0

DB name	**Delphion** **Switzerland (CH+) Patent Database**
Keywords	*Bacillus thuringiensis*, cry3*, cryIII*, cry7*, cryVII*, CryET*, Cry et*, Sweet potato, Coleoptera
Class (IPC)	**IPC C12N** **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00;

	food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	(*Bacillus thuringiensis*) and (cry3* or cryIII*) and (Sweet potato and coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and ("cryet*" or "cry et*") and (sweet potato and coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and (cry7* or cryVII*) and (sweet potato and coleoptera) and (C12N) – 0 relevant patents.
Results	Total patents searched: 33 Relevant:0

DB name	**Delphion** **Derwent World Patent Index (DWPI) Patent Database**
Keywords	*Bacillus thuringiensis*, cry3*, cryIII*, cry7*, cryVII*, CryET*, Cry et*, Sweet potato, Coleoptera
Class (IPC)	IPC (C12N) **MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF** (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
Search Strings	(*Bacillus thuringiensis*) and (cry3* or cryIII*) and (Sweet potato and coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and ("cryet*" or "cry et*") and (sweet potato and coleoptera) and (C12N) – 0 relevant patents. (*Bacillus thuringiensis*) and (cry7* or cryVII*) and (sweet potato and coleoptera) and (C12N) – 0 relevant patents.
Results	Total patents searched: 20 Relevant: 0

We did not use hybrid searching with IPCs and keywords in this database because of the number of variations of names for the cryproteins as well as the complexity of the subject matter, which would cause our results to be narrowed too much (many of the hits were already small to begin with).

DB name	**DIALOG Classic Patent Database**
Keywords	Thuringiensis, cry?, cry3?, cryIII?, sweet potato, yam, coleoptera.

DB name	DIALOG Classic Patent Database
Class (IPC)	NONE
Search Strings	thuringiensis and (cry? or cry3? Or cryIII?) and (Sweet potato and coleoptera) – 0 relevant patents. thuringiensis and cry? and "sweet potato" and "coleoptera" – 0 relevant patents. thuringiensis and cry? and yam? and coleoptera – 1 relevant patent.
Results	Total patents searched: 4 Relevant: 1

3.2.5 Conclusion to Summer Search:

At the conclusion of the summer search, both Teams reviewed the other's report in an attempt to ascertain similar findings and ensure the success of the Iterative Process Approach: by mining each database, we modified our searches according to the information that became available. Though both Teams' style differed, we were able to compile a list of patents common to each Team's search report and subsequently compiled them into one MASTER PATENT LIST. This MASTER PATENT LIST would then serve as the starting point for a more refined and narrow Fall search. The patents highlighted in yellow reflect common patents found between both Teams.

MASTER PATENT LIST: summer search

Team 1 Relevant Patents	Team 2 Relevant Patents
General Patents	**General Patents**
1. US 6727409	1. US 6015891
2. US 6706860	2. US 6831062
3. US 6501009	3. US6603063
4. US 6468523	4. US 5837526
Cry7Aa1	5. US 5567600
1. US 5286486	6. US 5380831
2. EP 0458819131	7. US 6280720
Cry3Ca1	8. US 6180775
1. US 5495071	9. US 5187091
2. US 5659123	10. US 6150156
3. US 6013523	11. US APP 2004 0250313
4. US 6284949	12. US 7169971
5. US 7030295	13. US 7049491
6. US 7030295	
7. US 7230167	**Monsanto Patents**
CryET 33-34	1. US 6063756
1. US 6063756	2. US 6399330
2. US 6248536	3. US 6326351
3. US 6326351	4. US 7214788
4. US 6399330	
5. US 7214788	**Bayer Patents**
	1. US 6727409

3.3 Fall Search

The Fall search report commenced on August 31, 2007, comprising one Fall search Team that included Bum Rae Cho, Natalia Pence, and John Kenyon (three of the four persons whom comprised the summer search Team). Kerry Swift's professional obligations impeded her from continuing. The starting point for the fall search was the Master Patent List generated during the Summer search. The Fall search ended on December 5, 2007. The Fall search comprised the following narrow and specific searches:

1. Codon-optimization search using LexisNexis
2. Native and codon-optimized DNA sequence search in GenomeQuest using GenePAST and GeneBLAST
3. Nomenclature Shift search using LexisNexis
4. Accession numbers and inventor name search using Delphion
5. OAPI and ARIPO search using Esp@cenet
6. OAPI, ARIPO, Uganda, and Kenya search using INPADOC through Delphion
7. National Peruvian search
8. National Ugandan and Kenyan search

These specific searches were done based on the results obtained from the Summer search. Although many patents were found and reviewed in the Summer search, no searches were particularly focused on codon-optimization. Additionally, our research yielded a discovery encompassing a shift in cry protein nomenclature and as a result, we performed a search utilizing the new nomenclature. In an effort to provide an all encompassing report, we performed a native and codon-optimized DNA sequence search because of potential gaps in results of those patents claiming the native DNA sequence and those claiming the codon-optimized sequence. Accession number searches were performed to uncover patents that might obfuscate the DNA sequences by using accession numbers. Because the technology is being implemented in Peru and CIP's plans are to deploy these transgenic sweet potatoes to Sub-Saharan Africa, a national search of Uganda, Kenya, and Peru, and a regional search of OAPI and ARIPO patents were also performed.

Weeks 1-3

The first two weeks of the Fall search were spent planning the methods for refined and focused searches. To familiarize each Team member to the different summer search approaches, Team 1 and Team 2 summarized their summer search methods in a presentation. The purpose of this mutual exploration was to discover weaknesses in the Summer search approaches, to understand the technology of *Bacillus thuringiensis* specified in the Innovation Plan, to refine the search methods, and to brainstorm new patent search approaches and concepts so as to ensure thoroughness in the mining of pertinent data. Professor Jon Cavicchi aided the Team in formulating ideas for new search methods.

In order for the project to rapidly progress, it was important to educate the Team members about the concepts of agro-biotechnology, the impact of bio-technology in developing countries, and the pivotal role of the Gene Revolution in transgenic crops. Dr. Stan Kowalski, a visiting scholar and faculty advisor for the present project supplied the fall Team members with articles on the Bt cryproteins, the history of agro-biotechnology, and the principles and technology behind codon-optimization. In preparation for a teleconference with CIP, the fall Team reread the Innovation Plan in an effort to ascertain the intellectual property rights and project goals delineated in the project. Part of understanding the intellectual property rights affecting the project was identifying potential patent holders of the cryproteins. We also familiarized ourselves with the missions of CIP and PIPRA to better understand and appreciate the agro-biotechnological contributions made by both entities. Consequently, we compiled a list of questions for our teleconference with Marc Ghislain, Ph.D, Head, Applied Biotechnology Lab, International Potato Center (CIP). The teleconference took place on week 3. Below is the list of our questions (with the answers in red) provided to us by Dr. Ghislain during the teleconference.

1. Are the cry-proteins mentioned in the disclosure in the native state or are they codon - optimized? Codon-optimized and the process took place in Germany and were given to CIP for research purposes only.

2. Are we to look for patent literature for such cry-proteins for their use in the sweet potato against the specific weevils mentioned in the disclosure? Do they want the search this specific? (a lot of the patents we researched were this specific) Yes, better to search the use against coleoptera.

3. Is our focus for patent literature in Peru, Uganda, and Kenya specifically because the research and development per the disclosure is occurring in Peru with plans to implement the technology in Uganda? No, the focus should also extend these additional African states: Tanzania, Rwanda, Mozambique, and Congo.

4. What are their licensing plans? CIP's strategy is to deploy the transgenic sweet potatoes in jurisdictions where not patented. There are public domain plans for sub-Saharan Africa.

5. Can we get the full innovation plan with more details than in the current plan? NO because we have the most complete printout.

6. Do we need to do a patent literature search on the general process of codon -optimization or do we need to be more specific and do the patent literature search on the specific optimized or native cry-protein? Probably need to do both patent literature searches on native and codon-optimized DNA sequences because the amino acid sequences do not change with codon-optimization.

7. Per the disclosures, it appears that the three cry-proteins were purchased as codon-optimized proteins from a lab in Germany, so does CIP have licensing for these cry-proteins and how will this affect our patent literature search? German company provided codon-optimized sequences for the sweet potato without restrictions.

8. How do we find the native sequences? Check accession #s from EPO 458819 for Cry7Aa1 cryprotein.

9. Can you explain to us what codon-optimization is? Mark explained this to us in great detail. Specifically of interest to us: Normally, native Bt genes don't efficiently express Bt toxin in sweet potato, so codon-optimization increases expression of Bt toxin to levels harmful for weevil.

10. Can you give us the names of the companies that you think are relevant to this project? Bayer and Monsanto

11. What patents are you relying on presently regarding the disclosure?
    a. Cry7Aa1: EPO 458 819 B1 (patent application concerns the native DNA sequence)
    b. Cry3Ca1: US 5723756
    c. ET 33-34: US 2004/002375 A1

Based on the teleconference with Dr. Ghislain, we were better able to define the scope of our Fall search. Initially, we though to focus on *Bacillus thuringiensis*, the three cryproteins, sweet potato, and coleopteran or weevils, but because some patents may claim the use of the cryproteins in other crops or may not mention sweet potato at all, the crux of the searches ultimately focused on *Bacillus thuringiensis*, the three cryproteins and coleopteran or weevils. Utilizing the sweet potato within the search string greatly narrowed the search. In addition, we read the patents provided to us by Dr. Ghislain and determined that they were relevant. As such, these were added to the Master Patent List. (See Questions and Answers above for the patent numbers)

Week 4

Prior to commencing the Fall search, we reread all of the patents in the Master Patent List and began a process of color-coding according to relevancy. Particular focus was placed on the specifications and the claims. Each Team member was given a stack of patents to review and instructed to highlight the relevant keywords within the patents and place a preliminary color-coding relevancy categorization to each patent.

Keywords to be searched within the patents claims and specifications:

1. Sweet potato
2. Weevils or any arthropods
3. *Bacillus thuringiensis*
4. Cryproteins: cry 3CA1, Cry7Aa1, or CryET33-34
5. Codon-optimization
6. Specific sequences given in the Innovation Plan

Preliminary color-coding scheme:

1. **RED**: If the patent claimed any one of the specific Bt cryproteins or if the patent had three or more of the keywords highlighted, it was given a Red mark
2. **YELLOW:** If a patent did not claim one of the specific cryproteins, but encompassed 3 or more keywords, it was given a yellow.
3. **GREEN**: If the patent did not claim any one of the cryproteins and had one or two of the keywords highlighted, it was given a green mark.

Each stack of patents was initially color-coded by the student Team members. These were subsequently reviewed by individual Team members and Dr. Kowalski and categorized according to the final color-coding scheme. Later, these patents were added to the Master Patent List. (See PIPRA DVD for the patent search spreadsheet file "CIP Africa Work-product.XLS"). This process was followed for all the Fall searches.

Because the GenomeQuest searches were not premised on keywords but on codon-optimized and native DNA sequences pertaining to each of the three cryproteins, the color-coding scheme was based on homology. Each patent found was color coded according to the percentage of homology to the sequences of each cryprotein. Below is the finalized color-coding scheme for GenomeQuest and the color coding scheme for all non-GenomeQuest searches.

GenomeQuest Color Coding Scheme

RED	Any patents found in GenomeQuest having a claimed sequence with 90% or greater homology to the native or codon-optimized sequences in the Innovation Plan were automatically placed in the Red.
YELLOW	Any other GenomeQuest patents with less than 90% homology underwent the traditional color coding scheme described below in the Permanent Color Coding Scheme
GREEN	Any other GenomeQuest patents with less than 90% homology underwent the traditional color coding scheme described below in the Permanent Color Coding Scheme

Non-GenomeQuest Color Coding Scheme

RED	The most important factor categorizing a patent Red is the claiming of anyone of the three cryproteins themselves. Additionally, patents categorized here include: 1. The use of the cryprotein against any type of insect or associated pest infestation, and 2. The use of the cryproteins in any related crop against pest infestation. 3. Three or more keywords are present and connected in the claims
YELLOW	Patent categorized here: 1.Patents claiming obfuscated sequences and having assignees such as Bayer, Monsanto, Plant Genetic Systems; 2. Patents having claims that identify 2 or more keywords plus specific assignees such as Bayer, Monsanto, Plant Genetic Systems; or 3. Patents having three or more keywords in the claims. Due to the press of business, the Team was faced with time constraints that limited the ability to analyze in depth sequence claims. These sequences claimed may or may not be relevant and due to this uncertainty, we chose to place them into the "yellow" category. These patents and patent applications should therefore be subjected to subsequent analysis in order to ascertain their status.
GREEN	Patents categorized here: 1. Patents having 2 or less keywords in the claims 2. Patents not claiming any of the specific cryproteins. These patents are deemed not relevant to the disclosure within the Innovation Plan.

Week 5

1. Codon-optimization search:

The first search of the Fall was focused on mining for codon-optimization patents. Within this search we employed a search string that encompassed all the major concepts denoted above. The search was performed in LexisNexis covering all U.S. patent and patent applications, European Patent, Patent abstracts of Japan, PCT patents and U.K. patents. The search yielded two sets of patents, both of which underwent the color coding method for relevancy. Both sets were added to the Master Patent List. The following table shows the list of patents obtained from the search. We only listed the red and yellow patents in the table below. The green patents are incorporated into the Master patent list along with the red and yellow patents below. (See PIPRA DVD for the patent search spreadsheet file "CIP Africa Work-product.XLS)

Codon-optimization Search

Database Name:	**LexisNexis**
Search string:	codon /s optimiz! & BT /p cry! & weevil
RED	• US6063756 • US6326351 • US6399330 • US6949626
YELLOW	• US7091177 • US7214788 • US7227056 • US6605462 • US6077824 • US6166302 • US5369027 • US5422106 • US5506099 • US5187091 • US5204100 • US5264364 • US5359048 • US5366892 • US5378625 • US5382429 • US5466597 • US5683691 • US5707619 • US5723756 • US5747450 • US5824878 • US5837237 • US2004210965 • US2004197916 • US7253343 • US7060264 • US6372480 • US6048838 • US2007044178 • US2004216186
Results	Total patents searched: 111

	Relevant: 35 Patents Red: 4 Yellow: 31

2. Native and codon-optimized DNA sequence search in GenomeQuest using GenePAST and GeneBLAST:

The following table shows the combination of the Summer and Fall searches in GenomeQuest. The Summer Search was performed using the amino acid sequences provided in the Innovation Plan. However, because amino acid sequences do not change with the process of codon-optimization, we needed to perform additional searches using the native and codon-optimized DNA sequence for each of the three cryproteins. The native DNA sequences for Cry3Ca1 and Cry7Aa1 were found using the accession numbers in the Innovation Plan. With these accession numbers in hand, we went to PubMed and found the native DNA sequence for both cryproteins. The native DNA sequence for CryET33-34 was found using the patent given to us by Dr. Ghislain during our first teleconference: ET 33-34: US 2004/002375 A1. In this patent we found that there were more than one sequence containing ET33-34 genes; therefore, we chose the sequence ID #11 as the native DNA sequence and employed it in the search. (See PIPRA DVD for Summer and Fall GenomeQuest located in the "GenomeQuest search report folder") The searches below are as follows:

1. Amino acid sequence search using GeneBLAST and GenePAST for Cry3CA1, Cry7Aa1, and CryET33-34.
2. Native and codon-optimized DNA sequence searches using GeneBLAST and GenePAST for Cry3CA1, Cry7Aa1, and CryET33-34. The following are the native DNA sequences used in the search for the three cryproteins:

1. Cry7Aa1:

Native DNA sequence

```
   1 tttggattgt gagcatgtac aggtttgtga tttacaagca aaaccaatct gcgaagattg
  61 ttgtcatttt ataaaggtaa caggatattt tcaaatttgt accgattaaa taaaaaatat
 121 ttagattaac actgttgttt tttacaacta tccgtatgga caaatttaac aaggagtgaa
 181 aatatgaatt taaataattt agatggatat gaagatagta atagaacatt aaataattct
 241 ctcaattatc ctactcaaaa agcattatca ccatcattaa agaatatgaa ctaccaggat
 301 tttttatcta taactgagag ggaacaacct gaagcactcg ctagtggtaa tacagctatt
 361 aatactgtag ttagtgttac gggggctaca ctaagtgcgt taggtgtccc aggtgcaagt
 421 tttatcacta acttttacct gaaaattgca ggccttttat ggccagaaaa tggaaaaatt
 481 tgggatgaat ttatgacaga agtagaagca cttattgatc aaaaaataga agaatatgta
 541 agaaataaag cgattgcaga attagatgga ttaggatcag ccttagataa atatcaaaaa
 601 gcacttgcag attggctggg caaacaagat gatccagaag ctatactttc tgtggcaact
 661 gaatttcgta taatagattc tctttttgaa tttagtatgc cttcatttaa ggttactgga
 721 tatgaaatac cattactaac agtttacgca caagcggcaa accttcatct agctttatta
 781 agagattcta ctctttatgg agataaatgg ggattcactc agaacaacat tgaggaaaat
 841 tataatcgtc aaaagaaacg catttctgaa tattcagacc attgcaccaa gtggtataat
 901 agtggtctta gcagattgaa cggttccact tatgaacaat ggataaatta taatcgtttt
 961 cgtagagaaa tgatattaat ggcattagat cttgtcgctg tatttccttt tcatgaccct
1021 cgaaggtatt caatggaaac aagtacgcag ttaacgagag aagtgtatac cgatccagtt
1081 agcttgtcaa ttagcaatcc agatataggt ccaagttttt ctcagatgga aaatactgca
1141 attagaacac cacaccttgt tgattattta gatgagcttt atatatatac atcaaaatat
1201 aaagcatttt cacatgagat tcaaccagac ctattttatt ggagtgcaca taaggttagc
1261 tttaaaaaat cggagcaatc caatttatat acaacaggca tatatggtaa aacaagtgga
```

1321 tatatttcat caggggcata ttcatttcat gggaatgata tctatagaac attagcagct
1381 ccatcagttg tagtttatcc gtatactcag aattatggtg tcgagcaagt tgagttttac
1441 ggtgtaaaag ggcatgtaca ttatagagga gataacaaat atgatctgac gtatgattct
1501 attgatcaat tacccccaga cggagaacca atacacgaaa aatacactca tcgattatgt
1561 catgctacag ctatatttaa atcaactccg gattatgata atgctactat cccgatcttt
1621 tcttggacgc atagaagtgc ggagtattac aatagaatct atccaaacaa aatcacaaaa
1681 attccagctg taaaaatgta taaactagat gatccatcta cagttgtcaa agggcctgga
1741 tttacaggtg gagatttagt taagagaggg agtactggtt atataggaga tataaaggct
1801 accgtaaact ctccactttc tcaaaaatat cgtgttagag ttcgatacgc tactaatgtt
1861 tctggacaat tcaacgtgta tattaatgat aaaataacgc ttcaaacaaa gtttcaaaat
1921 actgtagaaa caataggtga aggaaaagat ttaacctatg gttcatttgg atatatagaa
1981 tattctacga ccattcaatt tccggatgag catccaaaaa tcactcttca tttaagcgat
2041 ttgagtaaca attcatcatt ttatgtagat tcaatcgaat ttatccctgt agatgtaaat
2101 tatgctgaaa aagaaaaact agaaaaagca cagaaagccg tgaatacctt gtttacagag
2161 ggaagaaatg cactccaaaa agacgtgaca gattataaag tggaccaggt ttcaatttta
2221 gtggattgta tatcagggga tttatatccc aatgagaaac gcgaactaca aaatctagtc
2281 aaatacgcaa aacgtttgag ctattcccgt aatttacttc tagatccaac attcgattct
2341 attaattcat ctgaggagaa tggttggtat ggaagtaatg gtattgtgat tggaaatggg
2401 gattttgtat tcaaaggtaa ctatttaatt ttttcaggta ccaatgatac acaatatcca
2461 acatatctct accaaaaaat agatgaatcc aaactcaaag aatatacacg ctataaactg
2521 aaaggtttta tcgaaagtag tcaggattta gaagcttatg tgattcgcta tgatgcaaaa
2581 catagaacat tggatgtttc tgataatcta ttaccagata ttctccctga gaatacatgt
2641 ggagaaccaa atcgctgcgc ggcacaacaa tacctggatg aaaatccaag tccagaatgt
2701 agttcgatgc aagatggaat ttgtctgat tcgcattcat tttctcttaa tatagataca
2761 ggttctatca atcacaatga gaatttagga atttgggtgt tgtttaaaat ttcgacatta
2821 gaaggatatg cgaaatttgg aaatctagaa gtgattgaag atggcccagt tattggagaa
2881 gcattagccc gtgtgaaacg ccaagaaacg aagtggagaa acaagttagc ccaactgaca
2941 acggaaacac aagcgattta tacacgagca aaacaagcgc tggataatct tttgcgaat
3001 gcacaagact ctcacttaaa aagagatgtt acatttgcgg aaattgcggc tgcaagaaag
3061 attgtccaat caatacgcga agcgtatatg tcatggttat ctgttgttcc aggtgtaaat
3121 caccctattt ttacagagtt aagtgggcga gtacaacgag catttcaatt atatgatgta
3181 cgaaatgttg tgcgtaatgg tcgattcctc aatggcttat ccgattggat tgtaacatct
3241 gacgtaaagg tacaagaaga aaatgggaat aacgtattag ttcttaacaa ttgggatgca
3301 caagtattac aaaacgtaaa actctatcaa gaccgtgggt atatcttaca tgtaacagcg
3361 cgcaagatag gaattgggga aggatatata acgattacgg atgaagaagg gcatacagat
3421 caattgagat ttactgcatg tgaagagatt gatgcatcta atgcgtttat atccggttat
3481 attacaaaag aactggaatt cttcccagat acagagaaag tgcatataga aataggcgaa
3541 acagaaggaa tattcctggt agaaagtata gagttatttt tgatggaaga gctatgttaa
3601 tagggagatt attcaacaaa tatttgtttg attcaaaata aaataaaatg catacaatcc
3661 tctttatcag acggtatttc taataattat aaatataggt tgaaagttaa aaaataaaaa
3721 cacgctattc ccattactag aaggagggag taacgtgttt tttcatgagt aaaaaaacaa
3781 ttagctatat ttatctattc tctatagaag aagcggattg ataagaaccg taagtgacag
3841 gaatagcatt tatatcttat agtgcaagtc caaacaaatg agggtagtag agtgacaaaa
3901 acgcttgaag ttttccaaaa aagaaatcaa gtacaaattg aaattagtac aacaaatgtt
3961 atttctttag tagaacgtat agaattatta tgtttggaag atga

II.Cry3Ca1

Native DNA sequence

1 cctgtatata atatgccaat acattgttac aattaatatt taatctaatg aaatgttaat
61 tatatatata aatatatcta tgataagtgc atgaataatt aagtttgaaa ggggggatgt
121 gttaaaagaa agaatattaa aatcttgtgt ttgtaccgtc taatggattt atgggaaatt
181 attttatcag attgaaagtt atgtattatg acaagaaagg gaggaagaaa aatgaatccg
241 aacaatcgaa gtgaacatga tacaataaaa gctactgaaa ataatgaggt atcaaataac
301 catgctcaat atcctttagc agatactcca acactggaag aattaaatta taaagagttt

361 ttaagaagga ctacagataa taatgtggaa gcactagaca gctcaacaac aaaagatgcc
421 attcaaaaag ggatttccat aataggtgat ctcctaggtg tagtaggttt cccatatggt
481 ggagcgcttg tttcttttta tacaaactta ttaaacacta tctggccagg tgaagaccct
541 ttaaaggctt ttatgcaaca agtagaagca ttgatagacc agaaaatagc ggattatgcg
601 aaagataaag caactgcaga gttacaagga cttaaaaatg ttttcaaaga ttatgttagt
661 gcattggatt catgggacaa aactcctttg actttacgag atggacgaag ccaagggcgc
721 ataagagagc tattttctca agcagaaagt cattttcgtc gttcaatgcc gtcgtttgca
781 gtctctggat acgaagttct atttctgcca acatatgcac aggccgcgaa cacacattta
841 ttactattaa aagacgctca aatttatgga acggattggg gatattctac agatgatctt
901 aatgagtttc acacaaaaca aaaggatctt acgatagaat atacaaatca ttgtgccaaa
961 tggtataagg caggattaga taaattaaga ggttcgactt atgaagagtg ggtaaaattt
1021 aatcgttatc gcagagagat gacattaaca gtattagatt taattacgct gtttccattg
1081 tatgatgttc gaacatacac taaaggagtt aaaactgaat taacaagaga cgttttaact
1141 gatccaattg ttgccgtcaa caatatgaat ggctatggaa caaccttctc taatatagaa
1201 aattatatcc gaaaaccgca tctatttgac tatttgcatg cgattcaatt tcactcgcgc
1261 ttacaacctg gatattttgg aacggactct ttcaattatt ggagtggtaa ttatgtttca
1321 actagatcta gcataggatc agatgaaata atccgatctc cattctatgg aaataaatct
1381 actttagatg ttcaaaattt agaatttaac ggggaaaaag tctttagagc tgtagcaaat
1441 ggtaatctgg cagtctggcc ggtgggtaca ggaggtacca aaatacattc tggtgttaca
1501 aaagtacaat tcagtcagta caatgatcga aaagatgaag taagaacaca aacgtatgac
1561 tcaaaaagaa atgttggtgg tatcgtcttt gattccattg atcaattgcc tccaataaca
1621 acagatgaat ctctagaaaa agcatatagt catcaactca attacgtaag gtgcttctta
1681 ttgcagggtg gaagaggaat aatcccagtg tttacttgga cacataagag tgtagacttt
1741 tataatacgc ttgattcaga aaaaattacg caaatccctt tcgtaaaggc atttatttta
1801 gtaaatagta cttccgttgt cgcaggtcct ggattcacag gcggagacat aataaaatgt
1861 acgaatggat ctggattaac tttatatgtt acaccggcac cggacttgac gtattctaaa
1921 acatataaaa ttcgaattcg ttatgcttct acatctcagg tgagatttgg aattgactta
1981 ggcagttaca ctcatagtat ttcgtatttc gataaaacga tggataaagg aaatacatta
2041 acgtataatt catttaattt atcaagtgtc agcagaccaa ttgaaatatc aggagggaat
2101 aaaatcgggg tatccgtcgg aggtattggc tctggggatg aagtttatat agacaaaatc
2161 gaatttattc caatggatta aatttactta aagagcaaag tagtattaac cacttaggat
2221 aataagaatc gggtacaaaa gtaagtttat aaaatgaata aaacagtgtt cttcatcctt
2281 cgctttttga aggtagacaa agaacactgt ttttactttt agaataaata ttttttgtgt
2341 aatcacataa agggagcaaa gaaagtaggg atatgtcact agcaattaga attagtagat
2401 ccagtaagta attaa

III. ET33-34

Native DNA sequence

(SEQ ID 11) ET33-GGGS3-ET34

atg ggt atc atc aac att caa gat gag att aac aat tac atg aag gaa gtt tac ggt gct act act gtt aag tct act tac gat cct tct ttc aag gtt ttc aat gaa tct gtt act cct caa ttc act gaa att cct act gaa cct gtc aac aac cag ctt act act aag agg gtc gac aat act ggt tct tac cct gtt gaa tct act gtt tct ttc act tgg act gaa act cat act gaa act tct gct gtt act gaa ggt gtt aag gct ggt act tct att tct act aag caa tct ttc aag ttc ggt ttc gtg aac tct gat gtt act ctt act gtt tct gct gag tac aac tac tct act act aac act act act act act gaa act cat act tgg tct gat tct act aag gtt act att cct cct aag act tac gtt gaa gct gct tac atc atc cag aat ggt act tac aat gtt cct gtt aat gtt gaa tgc gat atg tct ggt act ctg ttc tgt cga ggt tat cgt gat ggt gct ctt att gct gct gtt tac gtt tct gtt gct gat ctt gct gat tac aat cct aat ctt aat ctt act aat aag ggt gat ggt att gct cat ttc aag ggt tct gga ttc att gaa ggt gct caa ggt ctt aga tct gtg atc caa gtt act gaa tac cct ctt gat gat aat aag ggt agg tct act cct att acg tac ctt atc aac ggt tct ctt gct cct aat gtt act ctt aag aat tct aat att aag ttc gga tcc ggt gga ggt tcc ggt gga ggt tcc ggt gga ggt tcc gct agc atg act gtg tac aat gct act ttc act atc aac ttt tac aat gaa ggt gaa tgg ggt ggt cct gaa cct tac ggt tac atc aag gca tac ctt act aat cct gat cat gat ttc gag att tgg aag caa gat gat tgg ggt aag tct act cct gag agg tct act tac act caa act att aag ata tct tct gat act ggt tct cct atc aac cag atg tgc ttc tac ggt gac gtc aag gaa tac gat gtc ggc aac gct gat gat att ctt gct tac cct tct caa aag gtt tgc tct act cct ggt gtt act gtt agg ctt gat ggt gat gag aag ggt tct tac gtt act att aag tac tct ctt act cct gct

We deduced that using GenePAST for sequence searches is more favorable than GeneBLAST as GeneBLAST has no restrictions on homology and searches long sequences based only on biological similarity. This resulted in a large number of irrelevant patents. The service is ideal for shorter sequences in that it provides a shorter alignment of high homology. GenePAST, on the other hand, restricts the homology and yields a greater number of relevant patents and few irrelevant patents.

Cry3Ca1	**GenomeQuest**	
GeneBLAST	Amino acid sequence	Red: US5466597
GeneBLAST	Codon-optimized DNA sequence	No relevant patents
GeneBLAST	Native DNA sequence	Red: US5466597 Yellow: • US6284949 • US5495071 • JP2001112490
GenePAST	Native DNA sequence	Red: • US5466597 • USRE39580 • EP0382990 Yellow: • WO8901515 • WO8808880 • US6284949 • US5495071 • US5264364 • US7230167 • US7030295
GenePAST	Amino acid sequence	Red: • USRE39580 • US6023013 • US7253343 • US20070044178 • US20040216186

		• US20040210965 • US20040197916 • US20040197917 Yellow: • US7230167 • US7030295 • US5495071 • US6013523 • US6284949 • WO8808880 • WO8901515
GenePAST	Codon-optimized DNA sequence	Red: US5466597 Yellow: • US6284949 • US5495071 • WO8901515 • WO8808880 • US7230167 • US7030295
Cry7Aa1		
GenePAST	Codon-optimized DNA sequence	No relevant patents
GeneBLAST	Native DNA sequence	Red: • EP0382990 • US2007044178 Yellow: US5286486
GenePAST	Native DNA sequence	Red: EP0382990 Yellow: US5286486
GenePAST	Codon-optimized DNA sequence	Red: EP0382990 Yellow: US5286486
GenePAST	Amino acid sequence	Red: • US7253343 • US20070044178 • US20040216186 • US20040210965

		• WO2004074462 • US20040197916 • US20040197917 • EP0382990 Yellow: US5286486
CryET33-34		
GenePAST	Codon-optimized DNA sequence	Red: • US7214788 • US6399330 • US7214788 Yellow: None
GenePAST	Amino acid sequence	Red: • US7214788 • US6399330 • US6063756 Yellow: None
GenePAST	Native DNA sequence	Red: • US7214788 • US6399330 Yellow: None
GeneBLAST	Native DNA sequence	Red: US7214788

<u>Week 6 and 7</u>:

3. Shift in Nomenclature Search Using LexisNexis:

As we read the number of patents from the codon-optimization and GenomeQuest Fall search, we noted an interchangeable use of nomenclature for Cry3Ca1 and Cry7Aa1. While some patents described the cryproteins by Cry3Ca1 or Cry7Aa1, other patents described the cryproteins as CryIIIC (for cry7Aa1) and CryIIID (for Cry3Ca1). However, this shift in nomenclature was not noted for CryET33-34. Research into the nomenclature articles confirmed our findings. CryIIIC and CryIIID are old nomenclature and were replaced by Cry3Ca1 and Cry7Aa1. As a result, we ran a broad search using the old nomenclature so as to ensure complete results. We searched the claims and the specifications of the patents for this shift in nomenclature. (See Appendix A for Nomenclature Tables)

Shift in nomenclature search for Cry7Aa1 = CryIIIC

Database Name:	LexisNexis
Search string:	cryIIIC
RED	• EP1015592 • EP606110 • WO9114778A3 (PCT)
YELLOW	• US 5187091
Results	Total patents searched: 49 Relevant: 4 Red: 3 Yellow: 1

Shift in nomenclature search for Cry3Ca1 = CryIIID

Database Name:	LexisNexis
Search string:	CryIIID
RED	• US7214788 • US6326351
YELLOW	• US5382429 • US6605462
Results	Total patents searched: 34 Relevant: 4 Red: 2 Yellow: 2

Week 7-8

4. Accession Numbers and Inventor Name Search Using Delphion:

The following search was done because many patents that were previously reviewed had not used the nomenclature for each cryprotein and instead used the accession numbers in the claims or in the specifications. To ensure that we were capturing all relevant patents claiming the three cryproteins, we searched using the accession numbers and read through the claims and specifications of the patents to determine relevancy. The following are the accession numbers for the cryproteins:

a. Cry3Ca1: X59797
b. Cry7Aa1: M64478
c. CryET33-34: Does not have an accession number as of yet

Additionally, we searched using the inventor name. As we reviewed the patents of previous searches, we noted that certain inventors had many granted patents. We wanted to focus on these particular inventors for any additional relevant patents. The database used for these searches was Delphion and the search encompassed U.S. patents and patent applications, European patents and granted applications, WIPO-PCT publications, Japanese abstracts, German granted patents and patent applications and INPADOC. The following tables show all the patents and patent applications retrieved from the searches. The color-coding is in accordance with the color-coding scheme previously described. As a synopsis, the colors mean the following:
a. Red: Very relevant
b. Yellow: Mostly relevant; requires further analysis of claims and specifications
c. Green: Not relevant

Accession Number Searches

Cry3Ca1 Accession No	Cry7Aa1 Accession No
EP1012294B1	EP1012294B1
US5879906	US5879906
US6063597	US6063597
US6063756	US6063756
US6171864	US6171864
US6177615	US6177615
US6194636	US6194636
US6221649	US6221649
US6232526	US6232526
US6281016	US6281016
US6307123	US6307123
US6313378	US6313378
US6326169	US6326169
US6326351	US6326351
US6391547	US6391547
US6423828	US6423828
US6429292	US6429292
US6429357	US6429357
US6468523	US6468523
US6500617	US6500617
US6521442	US6521442
US6538109	US6538109
US6555655	US6555655
US6620988	US6620988
US6641996	US6641996
US6642030	US6642030
US6645497	US6645497
US6746871	US6746871
US6747189	US6747189
US6750379	US6750379
US6809078	US6809078
US6825006	US6825006
US6998229	US6998229
US7141719	US7141719
US7176006	US7176006
US2003143709A1	US2003143709A1
US2003157684A1	US2003157684A1
US2003229921A1	US2003229921A1
WO0026378A1	WO0026378A1
WO0055325A2	WO0055325A2

WO0066742A2	WO0066742A2
WO0070066A1	WO0070066A1
WO0070067A1	WO0070067A1
WO0070068A1	WO0070068A1
WO0073474A1	WO0073474A1
WO0166780A2	WO0166780A2
WO0170778A2	WO0170778A2
WO02057471A2	WO02057471A2
WO05010142A2	WO05010142A2
WO05010187A1	WO05010187A1
WO05070214A2	WO05070214A2
WO05083096A1	WO05083096A1
WO06089388A1	WO06089388A1
WO9749813A2	WO9749813A2
WO9810734A2	WO9810734A2
WO9813497A1	WO9813497A1
WO9813498A1	WO9813498A1
WO9822595A1	WO9822595A1
WO9823641A1	WO9823641A1
WO9913085A2	WO9913085A2
WO9931248A1	WO9931248A1
WO9932642A2	WO9932642A2
WO9957128A1	WO9957128A1
WO9958659A2	WO9958659A2
WO9960129A1	WO9960129A1
WO27030510A2	WO27030510A2
	WO27045160A1

Inventor Name Search

Donovan & Thuringiensis	Lambert	Lambert & Peferoen
US4277564	US5466597	US5369027
US5024837	US5683691	US5422106
US5073632	US5723756	US5466597
US5187091	US5837237	US5683691
US5196342	US5885571	US5723756
US5264364	US6028246	US5837237
US5322687	US6143550	US5861543
US5338544	US6448226	US5885571
US5378625	US6727409	US6028246
US5382429	US2005097635A1	US6143550

US5616319
US5679343
US5759538
US5854053
US5942658
US5962264
US6063756
US6093695
US6248536
US6326351
US6399330
US6482636
US6537756
US6555655
US6593293
US6686452
US6949626
US7078509
US7078592
US7186893
US2002128192A1
US2003144192A1
US2003167521A1
US2003237111A1
US2006051822A1
US2006191034A1
US2007061919A1
US2007163000A1

US6448226
US6727409
US2005097635A1

5. OAPI and ARIPO Search Using Esp@cenet:

The following searches of ARIPO and OAPI through Esp@cenet were conducted simultaneously with another set of searches of ARIPO and OAPI through INPADOC in Delphion. The reason for the dual search was to ensure that we captured all relevant patents and to ascertain what the keywords were most effective in the OAPI and ARIPO databases. We noted that both OAPI and ARIPO databases work better with very limited search strings that use broad keywords such as "Thuringiensis." This was seen when we compared the results of both the INPADOC and Esp@cenet searches.

Esp@cenet search of ARIPO AND OAPI

Keywords	Result
ARIPO ("thuringiensis")	**1. Photoprotected *Bacillus thuringiensis***
	Publication number: AP498 Publication date: 1996-05-29 Inventor: BREBNER DIANA KIRSTY (ZA); OVENS SAMANTHA (ZA); HERRERA VERONICA ESTELA (ZA) Applicant: AECI LTD (ZA) Application number: AP19940000646 19940513 Priority number(s): ZA19930003451 19930518
OAPI ("Monsanto"-assignee)	**1. Fluid loss control additives and subterranean treatment fluids containing the same.** Inventor: NGUYEN NINA (US); SIFFERMAN THOMAS R(US)(+3) Applicant: MONSANTO CO (US); NAT STARCH CHEM INVEST (US) Publication info: OA11282 - 2002-11-19 **2 New use of n-(phosphonomethyl) glycine and derivatives thereof** Inventor: BRANTS IVO (BE); GRAHAM WILLIAM (BE) Applicant: MONSANTO EUROPE SA (BE) Publication info: OA10888 - 2003-02-18
OAPI("Mycogen"-assignee)	**None**
OAPI("Bayer" – assignee)	**1. Synergistic insecticidal mixtures.** Inventor: ANDERSCH WOLFRAM (DE); JESCHKE PETER (DE)(+1) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12773 - 2006-07-04 **2. Synergistic insecticidal mixtures.** Inventor: ANDERSCH WOLFRAM (DE); BRETSCHNEIDER THOMAS (DE)(+2) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12772 - 2006-07-04 **3. Alkylamine derivatives as antifouling agents.** Inventor: BERNARD DANIEL (FR); BRAEKMAN JEANCLAUDE (BE)(+5) Applicant: BAYER AG (DE); UNIV BRUXELLES (BE) Publication info: OA12691 - 2006-06-21 **4. Oil-based suspension concentrates.** Inventor: VERMEER RONALD (DE); BAUR PETER (DE) (+1) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12634 - 2006-06-15 **5. Use of fatty alcohol ethoxylates as penetration promoters.** Inventor: ROSENFELDT FRANK (DE); BAUR PETER (DE) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12558 - 2006-06-07 **6. Pesticidal composition.** Inventor: HUART GERALD MICHEL YVON (FR); MARTIN THIBAUD JEAN ROBERT (FR) Applicant: BAYER CROPSCIENCE SA (FR) Publication info: OA12455 - 2006-05-24 **7. Composition pesticide.** Inventor: KNAUF WERNER; HUART GERALD MICHEL YVON (FR)(+1) Applicant: BAYER CROPSCIENCE GMBH (DE) Publication info: OA12402 - 2006-04-18 **8. Granulé à disperser dans l'eau contenant de la deltaméthrine.** Inventor: NOEDING GUNNAR (DE); NIED AGNES (DE) (+3) Applicant: BAYER CROPSCIENCE GMBH (DE) Publication info: OA12398 - 2006-04-18 **9. Active substance combinations having insecticidal and acaricidal**

	properties. Inventor: ERDELEN CHRISTOPH (DE); FISCHER REINER (DE) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12265 - 2006-05-11
OAPI("Plant Genetic Systems"-assignee)	None
OAPI("Syngenta"-assignee)	**1. Phosphonates and derivatives thereof as enhancers of the activity of insecticides.** Inventor: STOCK DAVID (GB); PIPER CATHERINE JULIA (GB)(+4) Applicant: SYNGENTA LTD (GB); SYNGENTA PARTICIPATIONS AG (CH) Publication info: OA12821 - 2006-07-10 **2. Herbicidal composition.** Inventor: CORNES DEREK (CH) Applicant: SYNGENTA PARTICIPATIONS AG (CH) Publication info: OA12662 - 2006-06-19 **3. Insecticidal mixture containing gamma-cyhalothrin.** Inventor: CLOUGH MARTIN STEPHEN (CH) Applicant: SYNGENTA LTD (GB) Publication info: OA12644 - 2006-06-16 **4. Composition containing paraquat and/or diquat an alginate and an emetic and/or purgative.** Inventor: ASHFORD EMMA JANE (GB); HEYLINGS JONATHAN ROY (GB)(+1) Applicant: SYNGENTA LTD (GB) Publication info: OA12463 - 2006-05-24 **5. Agrochemical composition.** Inventor: BEAN MICHAEL JOHN (GB); CUTLER JULIA LYNNE (GB)(+1) Applicant: SYNGENTA LTD (GB) Publication info: OA11857 - 2006-03-02
OAPI("insecticidal")	**1. Synergistic insecticidal mixtures.** Inventor: ANDERSCH WOLFRAM (DE); JESCHKE PETER (DE)(+1) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12773 - 2006-07-04 **2. Synergistic insecticidal mixtures.** Inventor: ANDERSCH WOLFRAM (DE); BRETSCHNEIDER THOMAS (DE)(+2) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12772 - 2006-07-04 **3. Insecticidal mixture containing gamma-cyhalothrin.** Inventor: CLOUGH MARTIN STEPHEN (CH) Applicant: SYNGENTA LTD (GB) Publication info: OA12644 - 2006-06-16 **4. Active substance combinations having insecticidal and acaricidal properties.** Inventor: ERDELEN CHRISTOPH (DE); FISCHER REINER (DE) Applicant: BAYER CROPSCIENCE AG (DE) Publication info: OA12265 - 2006-05-11 **.5. Insecticidal compositions and methods** Inventor: CLOUGH MARTIN STEPHEN (GB); EARLEY FERGUS GERARD (GB)(+1) Applicant: ZENECA LTD (GB) Publication info: OA11053 - 2003-03-10 **6. Insecticidal n-(substituted arylmethyl)-4-Äbis(substituted phenyl)**

	methylÜpiperidines Inventor: SILVERMAN IAN R (US); COHEN DANIEL H (US)(+3) Applicant: FMC CORP (US) Publication info: OA10725 - 2002-12-04 **7. Dihalopropene compounds insecticidal/acaricidal agents containing same and intermediates for their production** Inventor: SAKAMOTO NORIYASU (JP); MATSUO SANSHIRO (JP)(+4) Applicant: SUMITOMO CHEMICAL CO (JP) Publication info: OA10412 - 2001-12-04
OAPI("Pesticidal")	**1. Pesticidal composition comprising a lactate ester as crystal growth inhibitor.** Inventor: LEVI-RUSO GANIT (IL); SASSON YOEL (IL) (+1) Applicant: MAKHTESHIM CHEM WORKS LTD (IL) Publication info: OA12786 - 2006-07-10 **2. Pesticidal blanket.** Inventor: FRANDSEN MIKKEL VESTERGAARD (DK); SKOVMAND OLE (FR) Applicant: DCT APS (DK) Publication info: OA12751 - 2006-07-03 **3. Pesticidal compositions containing silicon compounds.** Inventor: GUZMAN JOSEF (IL); PAZ ASAF (IL)(+1) Applicant: KIDRON AGROCHEM LTD (IL) Publication info: OA12556 - 2006-06-07 **4. Pesticidal composition.** Inventor: HUART GERALD MICHEL YVON (FR); MARTIN THIBAUD JEAN ROBERT (FR) Applicant: BAYER CROPSCIENCE SA (FR) Publication info: OA12455 - 2006-05-24 **5. Pesticidal composition** Inventor: GODOY FERNANDO AUGUSTO (BR); NETTO CLAUDIO TOLEDO (BR)(+1) Applicant: RHONE POULENC AGROCHIMIE (FR) Publication info: OA10900 - 2003-02-21 **6. Pesticidal 1-aryl-3-iminopyrazoles** Inventor: MANNING DAVID TREADWAY (US); WU TAITEH (US) Applicant: RHONE POULENC AGROCHIMIE (FR) Publication info: OA11301 - 2003-08-22 **7. Pesticidal 1-arylpyrazoles** Inventor: LOWDER PATRICK DOYLE (US); MANNING DAVID TREADWAY (US)(+4) Applicant: RHONE POULENC AGROCHIMIE (FR) Publication info: OA11299 - 2003-08-21 **8. Pesticidal 1-arylpyrazoles** Inventor: WU TAI-TEH (US); MANNING DAVID TREADWAY (US) Applicant: RHONE POULENC AGROCHIMIE (FR) Publication info: OA11194 - 2003-05-21 **9. Pesticidal 1-arylpyrazoles** Inventor: PHILLIPS JENNIFER (US); PILATO MICHAEL (US)(+1) Applicant: RHONE POULENC AGROCHIMIE (FR) Publication info: OA11133 - 2003-04-25 **10. (4,4-Difluorobut-3-enylthio)-substituted heterocyclic or carbocyclic ring compounds having pesticidal activity** Inventor: TURNBULL MICHAEL DRYSDALE (GB); BANSAL HARJINDER SINGH (GB)(+5) Applicant: ZENECA LTD (GB)

	Publication info: OA10374 - 2001-11-14
OAPI("thuringiensis")	**1. A bioinsecticide formulation consisting of *Bacillus thuringiensis* var israelensis, and its concerning manufacture proceedings.** Inventor: SANCHES ELIZABETH GOMES (BR); SILVA ANA CRISTINA BATISTA DA (BR)(+3) Applicant: FUNDACAO OSWALDO CRUZ (BR) Publication info: OA11992 - 2006-04-18
Results	**OAPI patents searched:**

6. OAPI, ARIPO, Uganda, and Kenya Search Using INPADOC Through Delphion:

This search was run simultaneously with search #5 in an effort to denote differences or similarities in using two different patent databases in searching Regional and National patents. The results indicate that searching OAPI, ARIPO, Uganda, and Kenya requires the use of broad search terms. Although we were able to retrieve a number of patents, none were relevant to our project. The Ugandan search specifically did not yield any results. As such, we had to obtain the assistance of a Ugandan attorney for a national patent search. The Kenyan search yielded a number of hits but the results were outside the scope of the project. To ensure thoroughness in the search efforts, we also sought the aid of a Kenyan attorney for the national search. Likewise, the OAPI and ARIPO searches provided more hits and allowed the use of more keywords, but the results were outside the scope of our project. Our concern was that we were not capturing relevant patents because of the limitations imposed by these databases. As such, we contacted a representative at OAPI and ARIPO to aid our search.

DB name	**Delphion INPADOC** **KENYA**
Keywords	• Insecticide • Plants • Coleoptera • Weevil • Bacteria • Ipomoea batatas • *Bacillus thuringiensis* • Microorganism • Insect • thuringiensis
U.S. Class/sub-classification	NOT RELEVANT

Search Strings	• insecticide AND KENYA in Priority Country • plants AND KENYA in Priority Country • Coleoptera AND KENYA in Priority Country • Weevil AND KENYA in Priority Country • Bacteria and plants AND KENYA in Priority Country • Insecticide AND plants AND KENYA in Priority Country • Ipomoea batatas AND KENYA in Priority Country • Insecticide AND plant AND *Bacillus thuringiensis* AND KENYA in Priority Country • Microorganism AND KENYA in Priority Country • *Bacillus thuringiensis* AND KENYA in Priority Country • Insect AND KENYA in Priority Country • Thuringiensis AND KENYA in Priority Country
Results	79 hits; 0 relevant documents

DB name	**Delphion INPADOC UGANDA**
Keywords	• Weevil • Insecticide • Uganda • Thuringiensis • Insect • Plant • Pest
U.S. Class/sub-classification	NOT RELEVANT
Search Strings	• Weevil AND UGANDA in Country of Publication • Insecticide AND UGANDA in Country of Publication • Thuringiensis AND UGANDA in Country of Publication • Insect AND UGANDA in Country of Publication

	• Plant and UGANDA in Country of Publication • Pest and UGANDA in Country of Publication
Results	0 hits; 0 relevant documents

DB name	**Delphion INPADOC OAPI**
Keywords	• Plants • OAPI • Coleoptera • Insecticide • Ipomoea batatas • Plant • *Bacillus thuringiensis* • Microorganism • Insect • Thuringiensis • Weevil • Bacteria
U.S. Class/sub-classification	NOT RELEVANT
Search Strings	• Plants AND OAPI in Priority Country • Coleoptera AND OAPI in Priority Country • Insecticide AND plant AND OAPI in Priority Country • Ipomoea batatas AND OAPI in Priority Country • Insecticide and plant and *Bacillus thuringiensis* AND OAPI in Priority Country • Microorganism AND OAPI in Priority Country • *Bacillus thuringiensis* AND OAPI in Priority Country • Insect AND OAPI in Priority Country • Thuringiensis AND OAPI in Priority Country

	• Insecticide AND OAPI in Priority Country • Weevil AND OAPI in Priority Country • Bacteria AND plants AND OAPI in Priority Country
Results	77 hits; 0 relevant documents

DB name	**Delphion INPADOC ARIPO**
Keywords	• Thuringiensis • ARIPO • Potato • Weevil • Insecticide • Insect • Plant • Pest
U.S. Class/sub-classification	NOT RELEVANT
Search Strings	• Thuringiensis AND ARIPO in Priority Country • Potato AND ARIPO in Priority Country • Weevil AND ARIPO in Priority Country • Insecticide AND ARIPO in Priority Country • Insect AND ARIPO in Priority Country • Plant AND ARIPO in Priority Country • Pest AND ARIPO in Priority Country
Results	152 hits; 0 relevant documents

Weeks 4-7

7. National Peruvian Search:

The national Peruvian search was performed by attorney Gisella Barreda Moller, a Franklin Pierce Alum with offices in Lima, Peru. We opted to have her perform the searches as our efforts in searching INDECOPI (the Peruvian Patent Office) online were unsuccessful. (See Appendix B for Description of Databases used). Moreover, because Dr. Ghislain requested that Peru be a main focus of our search, we found it best to utilize a Peruvian attorney so as to ensure a thorough search. We sent Ms. Barreda Moller a search string encompassing the following:

1. Bacillus thuringiensis
2. B.Thuringiensis
3. B. Thuringiensis
4. B Thuringiensis
5. BThuringiensis
6. Thuringiensis

We decided to keep the search terms broad so as to capture as many relevant patents. This search yielded 3 patents of which one was denied, one was expired and the other was not relevant. Coincidentally, the irrelevant patent was the same patent found in the ARIPO and OAPI searches. (See Appendix G for National and Regional Patent Reports)

Weeks 4-13

8. National Ugandan and Kenyan Patent Searches:

Per our teleconference with Dr. Marc Ghislain, our African patent search was limited to ARIPO, Uganda, and Kenya. During our exhaustive search for these patents, we realized that INPADOC could not provide us with complete electronic access to ARIPO patents. As such, we posted an inquiry on the "Patent Information Users Group" (PIUG-listserv) as to how to search for ARIPO regional patents and patent applications as well as domestic patents and patent applications in Uganda and Kenya. We also made inquiries with Franklin Pierce Law Center alumni Rose Ndegwa, of the *International Livestock Research Institute's Intellectual Property Management Unit*, who suggested that we contact David Njuguna, an examiner at the Kenyan Industrial Property Institute (national Kenyan Patent Office). We also solicited the assistance of Christopher Kiige, the Technical Director of ARIPO, and John Magezi, a Ugandan patent attorney, in conducting a national Ugandan patent search. All searches conducted by these individuals used the same list of terms:

1. Bacillus thuringiensis
2. B.Thuringiensis
3. B. Thuringiensis
4. B Thuringiensis
5. BThuringiensis
6. Thuringiensis

National Kenyan Patent Office Search

Mr. Njuguna conducted a national Kenyan and a regional ARIPO patent search for the term "thuringiensis" and found two ARIPO patents: AP 430 entitled "Insecticidal compositions containing a delta-endotoxin" and AP 498 entitled "Photoprotected *Bacillus thuringiensis*" (see the e-mail reference dated October 18, 2007 2:18 AM in Appendix Section H "E-mails"). His correspondence affirmed an exhaustive search of both the national Kenyan and regional ARIPO patent landscapes. Upon reviewing these patents, we determined that they were both not relevant. (see Appendix G for National and Regional Patent Reports).

National Ugandan Patent Office Search

We utilized the patent search expertise of Christopher Kiige, Technical Director of ARIPO, to conduct a national Ugandan patent search for patents and patent applications with the term "thuringiensis." Director Kiige found two ARIPO patents relating to thuringiensis and designating Uganda: AP 498 entitled "Photoprotected *Bacillus thuringiensis*" and AP 1613 entitled "A Bioinsecticide Formulation Consisting of *Bacillus thuringiensis var israelensis*, and its Concerning Manufacture Proceedings" (see the e-mail reference dated November 6, 2007 3:06 AM in Appendix Section H "E-mails").

Due to the difference in ARIPO patents found by Mr. Kiige and Mr. Njuguna, both with ARIPO, we decided to hire a local Ugandan patent attorney. During the end of the fourteen week fall search, Ugandan Attorney John Magezi provided us with a copy of Mr. Kiige's search results, which represented Mr. Magezi's search contributions to this project.

Conclusion:

The Summer and Fall searches did not specifically locate a patent claiming the use of any of the Cry proteins in the sweet potato against weevils. However, because of the complexity of the bio-technology and popularity of the bacteria, we did find a large number of RED and YELLOW patent that should probably be reviewed with closer scrutiny in that they claimed some biotechnological application of relevance to the Innovation Plan. These results are located in the PIPRA DVD for the patent search spreadsheet file "CIP Africa Work-product." Within these spreadsheets there are hyperlinked publication numbers allowing the viewer to access the PDF version of the patent publication. The spreadsheets additionally track publication numbers, title, abstract, assignee and inventor information and patent family information.[43] A summary of the contents of these spreadsheets follows.

[43] The patent family definition varies between *Derwent* and *INPADOC*. If protection is sought in more than one country, or through more than one patenting authority, this will result in what is known as a family of patents. Derwent gathers all of the patent documents relating to an invention into a single database record. In general, one record in Derwent WPI (Files 350/351/352) on Dialog represents one invention and shows you all the patent documents that Derwent has collected relating to that invention. See *Patent Family Searching Using Derwent World Patents Index* PDF article for more information. However, according to ESPACENET, INPADOC defines a patent family as all of the documents that are directly or indirectly linked via a priority document. (See Appendix J for the definitions of Patent Family)

3.4 Patent Search Spreadsheet Summary

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6949626	*Bacillus thuringiensis* cryET33 and cryET34 compositions and uses therefor	Monsanto Technology LLC	Donovan; William P.|Donovan; Judith C.|Slaney; Annette C.
WO0222662A2	INSECT INHIBITORY *BACILLUS THURINGIENSIS* PROTEINS, FUSIONS, AND METHODS OF USE THEREFOR	MONSANTO TECHNOLOGY LLC	GOUZOV, Victor, M.|MALVAR, Thomas, M.|ROBERTS, James, K.|SIVASUPRAMANIAM, Sakuntala
EP606110A1	Method of enhancing the insecticidal activity of an insecticidal composition containing a coleopteran-toxic protein	ECOGEN INC	Donovan, William P.|Rupar, Mark J.|Slaney, Annette C.|Johnson, Timothy B.
US7041815	Sporamin promoter and uses thereof	Sinon Corporation	Yeh; Kai-Wun|Wang; Shu-Jen

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6130775	*Bacillus thuringiensis* isolates active against weevils	Mycogen Corporation	Bradfisch; Gregory A.|Schnepf; H. Ernest|Kim; Leo
US6399330	*Bacillus thuringiensis* cryet33 and cryet34 compositions and uses thereof	Monsanto Technology LLC	Donovan; William P.|Donovan; Judith C.|Slaney; Annette C.
US6326351	*Bacillus thuringiensis* CryET33 and CryET34 compositions and uses therefor	Monsanto Technology LLC	Donovan; William P.|Donovan; Judith C.|Slaney; Annette C.
US7208168A1	Insect inhibitory *Bacillus thuringiensis* proteins, fusions, and methods of use therefor	GUZOV VICTOR M.|MALVAR THOMAS M.|ROBERTS JAMES K.|SIVASUPRAMANIAM SAKUNTALA	Guzov, Victor M.|Malvar, Thomas M.|Roberts, James K.|Sivasupramaniam, Sakuntala
US6063756	*Bacillus thuringiensis* cryET33 and cryET34 compositions and uses therefor	Monsanto Company	Donovan; William P.|Donovan; Judith C.|Slaney; Annette C.
WO9815567A2	GENE SYNTHESIS METHOD	VITALITY BIOTECHNOLOGIES LTD.	STRIZHOV, Nicolai|KONCZ, Csaba|SCHELL, Jeff

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2002128192A1	*Bacillus thuringiensis* cryET33 and cryET34 compositions and uses therefor	Monsanto Technology LLC	Donovan, William P.|Donovan, Judith C.|Slaney, Annette C.
WO9114778A3	(*BACILLUS THURINGIENSIS* CRYIIIC) GENE AND PROTEIN TOXIC TO COLEOPTERAN INSECTS	ECOGEN INC.	DONOVAN, WILLIAM, P.|RUPAR, MARK, J.|SLANEY, ANNETTE, C.|JOHNSON, TIMOTHY, B.
EP1015592B1	*BACILLUS THURINGIENSIS* CRYET33 AND CRYET34 COMPOSITIONS AND USES THEREFOR	Monsanto Technology LLC	DONOVAN, William, P.|DONOVAN, Judith, C.|SLANEY, Annette, C.
WO9114778A2	*BACILLUS THURINGIENSIS* cryIIIC GENE AND PROTEIN TOXIC TO COLEOPTERAN INSECTS	ECOGEN INC.	DONOVAN, William, P.|RUPAR, Mark, J.|SLANEY, Annette, C.|JOHNSON, Timothy, B.
EP0382990	Strains of *Bacillus thuringiensis*	Plant Genetic Systems, N.V.	

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US5466597	*Bacillus thuringiensis* strains and their genes encoding insecticidal toxins	Plant Genetic Systems, N.V.	Peferoen; Marnix|Lambert; Bart|Van Audenhove; Katrien
US7253343	AXMI-003, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi; Nadine|Hargiss; Tracy|Koziel; Michael G.|Duck; Nicholas B.|Carr; Brian
US20070044178A1	AXMI-028 and AXMI-029, a family of novel delta-endotoxin genes and methods for their use	Athenix Corporation	Carozzi; Nadine|Koziel; Michael G.|Hargiss; Tracy|Duck; Nicholas B.|Kahn; Theodore W.
US20040216186A1	AXMI-006, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US20040210965A1	AXMI-007, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian
US20040250311A1	AXMI-008, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian
US7214788	Insect inhibitory <i>*Bacillus thuringiensis* </i>proteins, fusions, and methods of use therefor	Monsanto Technology LLC	Guzov; Victor M.|Malvar; Thomas M.|Roberts; James K.|Sivasupramaniam; Sakuntala
US6023013	Insect-resistant transgenic plants	Monsanto Company|Ecogen, Inc.	English; Leigh H.|Brussock; Susan M.|Malvar; Thomas M.|Bryson; James W.|Kulesza; Caroline A.|Walters; Frederick S.|Slatin; Stephen L.|Von Tersch; Michael A.|Romano; Charles

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US20040197916A1	AXMI-004, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian
US20040197917A1	AXMI-014, delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian
USRE039580	Insect-resistant transgenic plants	Monsanto Technology LLC	English; Leigh H.|Brussock; Susan M.|Malvar; Thomas M.|Bryson; James W.|Kulesza; Caroline A.|Walters; Frederick S.|Slatin; Stephen L.|Von Tersch; Michael A.|Romano; Charles
WO04074462A2	DELTA-ENDOTOXIN GENES AND METHODS FOR THEIR USE	ATHENIX CORPORATION	CAROZZI, Nadine|HARGISS, Tracy|KOZIEL, Michael, G.|DUCK, Nicholas, B.|CARR, Brian

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US5369027	*Bacillus thuringiensis* strains toxic to diabrotica species	Plant Genetic Systems, N.V.	Lambert; Bart J.|Jansens; Stefan K.|Peferoen; Marnix
US5422106	Method of controlling coleotera using *Bacillus thuringiensis* strains MG P-14025 and LMG P-14026	Plant Genetic Systems, N.V.	Lambert; Bart J.|Jansens; Stefan K.|Peferoen; Marnix
US5506099	Method for characterizing insecticidal properties of unknown bacillus strains	Ciba-Geigy Corporation	Carozzi; Nadine G.|Kramer; Vance C.|Warren; Gregory W.|Evola; Stephen V.|Koziel; Michael G.
US5187091	*Bacillus thuringiensis* cryIIIC gene encoding toxic to coleopteran insects	Ecogen Inc.	Donovan; William P.|Rupar; Mark J.|Slaney; Annette C.|Johnson; Timothy B.
US5204100	Baciullus thuringiensis strains active against coleopteran insects	Ciba-Geigy Corporation	Carozzi; Nadine B.|Kramer; Vance C.|Warren; Gregory W.|Koziel; Michael G.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US5264364	*Bacillus thuringiensis* cryIIIc(B) toxin gene and protein toxic to coleopteran insects	Ecogen Inc.	Donovan; Willam P.|Rupar; Mark J.|Slaney; Annette C.
US5359048	Polynucleotide encoding a toxin with activity against coleopterans	Mycogen Corporation	Ohba; Michio|Iwahana; Hidenori|Sato; Ryoichi|Suzuki; Nobukazu|Ogiwara; Katsutoshi|Sakanaka; Kazunobu|Hori; Hidetaka|Asano; Shouji|Kawasugi; Tadaaki
US5366892	Gene encoding a coleopteran-active toxin	Mycogen Corporation	Foncerrada; Luis|Sick; August J.|Payne; Jewel M.
US5378625	*Bacillus thuringiensis* cryIIIC, (b) protein toxic to coleopteran insects	Ecogen, Inc.	Donovan; William P.|Rupar; Mark J.|Slaney; Annette C.
US5683691	*Bacillus thuringiensis* insecticidal toxins	Plant Genetic Systems, N.V.	Peferoen; Marnix|Lambert; Bart|Joos; Henk

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US5707619	*Bacillus thuringiensis* isolates active against weevils	Mycogen Corporation	Bradfisch; Gregory A.|Schnepf; H. Ernest|Kim; Leo
US5723756	*Bacillus thuringiensis* strains and their genes encoding insecticidal toxins	Plant Genetic Systems, N.V.	Peferoen; Marnix|Lambert; Bart|Van Audenhove; Katrien
US5747450	Microorganism and insecticide	Kubota Corporation	Ohba; Michio|Iwahana; Hidenori|Sato; Ryoichi|Suzuki; Nobukazu|Ogiwara; Katsutoshi|Sakanaka; Kazunobu|Hori; Hidetaka|Asano; Shouji|Kawasugi; Tadaaki

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US5824878	Microorganism and insecticide	Kubota Corporation	Ohba; Michio|Iwahana; Hidenori|Sato; Ryoichi|Suzuki; Nobukazu|Ogiwara; Katsutoshi|Sakanaka; Kazunobu|Hori; Hidetaka|Asano; Shouji|Kawasugi; Tadaaki
US5837237	*Bacillus thuringiensis* strains and their genes encoding insecticidal toxins	Plant Genetic Systems, N.V.	Peferoen; Marnix|Lambert; Bart|Van Audenhove; Katrien
US5382429	*Bacillus thuringiensis* protein toxic to coleopteran insects	Ecogen Inc.	Donovan; William P.|Rupar; Mark J.|Slaney; Annette C.|Johnson; Timothy B.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6077824	Methods for improving the activity of .delta.-endotoxins against insect pests	Ecogen, Inc.	English; Leigh H.|Brussock; Susan M.|Malvar; Thomas M.|Bryson; James W.|Kulesza; Caroline A.|Walters; Frederick S.|Slatin; Stephen L.|Von Tersch; Michael A.
US6166302	Modified *Bacillus thuringiensis* gene for lepidopteran control in plants	Dow AgroSciences LLC	Merlo; Donald J.|Folkerts; Otto
US6605462	*Bacillus thuringiensis* isolates active against weevils	Mycogen Corp.	Bradfisch; Gregory A.|Schnepf; H. Ernest|Kim; Leo
US7091177	<i>*Bacillus thuringiensis* </i>isolates active against weevils	Mycogen Corporation	Bradfisch; Gregory A.|Schnepf; H. Ernest|Kim; Leo

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US7227056	Coleopteran-resistant transgenic plants and methods of their production	Monsanto Technology LLC	English; Leigh H.|Brussock; Susan M.|Malvar; Thomas M.|Bryson; James W.|Kulesza; Caroline A.|Walters; Frederick S.|Slatin; Stephen L.|Von Tersch; Michael A.|Romano; Charles
WO8808880A1	COLEOPTERAN ACTIVE MICROORGANISMS, RELATED INSECTICIDE COMPOSITIONS AND METHODS FOR THEIR PRODUCTION AND USE	ECOGEN, INCORPORATED	DONOVAN, William, Preston|GONZALES, Jose, Manuel, Jr.|LEVINSON, Barry, Lewis|MACALUSO, Anthony

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6372480	Pesticidal proteins	Mycogen Corporation	Narva; Kenneth E.|Schnepf; H. Ernest|Knuth; Mark|Pollard; Michael R.|Cardineau; Guy A.|Schwab; George E.|Michaels; Tracy Ellis|Lee; Stacey Finstad|Burmeister; Paula|Dojillo; Joanna
WO8901515A2	PLANTS TRANSFORMED WITH A DNA SEQUENCE FROM *BACILLUS THURINGIENSIS*	PLANT GENETIC SYSTEMS N.V.|VAECK, Mark|HOFTE, Hermanus|BOTTERMAN, Johan	VAECK, Mark|HOFTE, Hermanus|BOTTERMAN, Johan
US5380831	Synthetic insecticidal crystal protein gene	Mycogen Plant Science, Inc.	Adang; Michael J.|Rocheleau; Thomas A.|Merlo; Donald J.|Murray; Elizabeth E.
US5837526	Bacillus strain and harmful organism controlling agents	Nissan Chemical Industries, Ltd.	Iizuka; Toshihiko|Tagawa; Michito|Arai; Satoshi|Niizeki; Masatsugu|Miyake; Toshiro

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US5286486	Coleopteran-active *Bacillus thuringiensis* isolates and genes encoding coleopteran-active toxins	Mycogen Corporation	Payne; Jewel M.|Fu; Jenny M.
US5567600	Synthetic insecticidal crystal protein gene	Mycogen Plant Sciences, Inc.	Adang; Michael J.|Rocheleau; Thomas A.|Merlo; Donald J.|Murray; Elizabeth E.
US6013523	Transgenic plants comprising a synthetic insecticidal crystal protein gene having a modified frequency of codon usage	Mycogen Plant Science, Inc.	Adang; Michael J.|Murray; Elizabeth E.
US5495071	Insect resistant tomato and potato plants	Monsanto Company	Fischhoff; David A.|Fuchs; Roy L.|Lavrik; Paul B.|McPherson; Sylvia A.|Perlak; Frederick J.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6855873	Recombinant plant expressing non-competitively binding Bt insecticidal cryatal proteins	Bayer BioScience, N.V.	Van Mellaert; Herman|Botterman; Johan|Van Rie; Jeroen|Joos; Henk
US7030295	Modified Cry3A toxins and nucleic acid sequences coding therefor	Syngenta Participations AG	Chen; Eric|Stacy; Cheryl
US7230167	Modified Cry3A toxins and nucleic acid sequences coding therefor	Syngenta Participations AG	Chen; Eric|Stacy; Cheryl
US6727409	*Bacillus thuringiensis* strains and their insecticidal proteins	Bayer BioScience N.V.	Lambert; Bart|Jansens; Stefan|Van Audenhove; Katrien|Peferoen; Marnix
US6706860	Toxins	Bayer BioScience N.V.	Boets; Annemie|Arnaut; Greta|Van Rie; Jeroen|Damme; Nicole

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6603063	Plants and cells transformed with a nucleic acid from *Bacillus thuringiensis* strain KB59A4-6 encoding a novel SUP toxin	Mycogen Corp.	Feitelson; Jerald S.|Schnepf; H. Ernest|Narva; Kenneth E.|Stockhoff; Brian A.|Schmeits; James|Loewer; David|Dullum; Charles Joseph|Muller-Cohn; Judy|Stamp; Lisa|Morrill; George|Finstad-Lee; Stacey
US5736131	Hybrid toxin	Sandoz Ltd.	Bosch; Hendrik Jan|Stiekema; Willem Johannes
US6657046	Insect inhibitory lipid acyl hydrolases	Monsanto Technology LLC	Alibhai; Murtaza F.|Rydel; Timothy J.
US7060264	Insect inhibitory lipid acyl hydrolases	Monsanto Technology LLC	Alibhai; Murtaza F.|Rydel; Timothy J.
US6284949	Insect-resistant plants comprising a *Bacillus thuringiensis* gene	Monsanto Company	Fischhoff; David A.|Fuchs; Roy L.|Lavrik; Paul B.|McPherson; Sylvia A.|Perlak; Frederick J.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6468523	Polypeptide compositions toxic to diabrotic insects, and methods of use	Monsanto Technology LLC	Mettus; Anne-Marie Light|Baum; James A.
US5866784	Recombinant plant expressing non-competitively binding insecticidal crystal proteins	Plant Genetic Systems N.V.	Van Mellaert; Herman|Botterman; Johan|Van Rie; Jeroen|Joos; Henk
WO0026378A1	POLYPEPTIDE COMPOSITIONS TOXIC TO DIABROTICA INSECTS, OBTAINED FROM *BACILLUS THURINGIENSIS*; CryET70, AND METHODS OF USE	MONSANTO COMPANY	METTUS, Anne-Marie, Light|BAUM, James, A.
US6218188	Plant-optimized genes encoding pesticidal toxins	Mycogen Corporation	Cardineau; Guy A.|Stelman; Steven J.|Narva; Kenneth E.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6172281	Recombinant plant expressing non-competitively binding BT insecticidal crystal proteins	Aventis CropScience N.V.	Van Mellaert; Herman|Botterman; Johan|Van Rie; Jeroen|Joos; Henk
US2004197916A1	AXMI-004, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian
US6048838	Insecticidal protein toxins from xenorhabdus	Dow AgroSciences LLC	Ensign; Jerald C.|Bowen; David J.|Tenor; Jennifer L.|Ciche; Todd A.|Petell; James K.|Strickland; James A.|Orr; Gregory L.|Fatig; Raymond O.|Bintrim; Scott B.|Ffrench-Constant; Richard H.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2004250313A1	Insecticidal proteins and synergistic combinations thereof	VINCENT JASON LEIGH|VINER RUSSELL	Vincent, Jason Leigh|Viner, Russell

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6500617	Optimization of pest resistance genes using DNA shuffling	Maxygen, Inc.	Stemmer; Willem P. C.|Castle; Linda A.|Yamamoto; Takashi
US7166465	Constitutive promoter from <i>Arabidopsis </i>	Rhobio	Thomas; Terry|Nuccio; Michael|Hsieh; Tzung-Fu
US5436391	Synthetic insecticidal gene, plants of the genus oryza transformed with the gene, and production thereof	Mitsubishi Corporation|Mitsubishi Kasei Corporation	Fujimoto; Hideya|Ito; Kimiko|Yamamoto; Mikihiro|Shimamoto; Ko
US5914318	Transgenic plants expressing lepidopteran-active .delta.-endotoxins	Ecogen, Inc.	Baum; James A.|Gilmer; Amy Jelen|Mettus; Anne-Marie Light
US6033874	CRY1C polypeptides having improved toxicity to lepidopteran insects	Ecogen, Inc.	Baum; James A.|Gilmer; Amy Jelen|Mettus; Ann-Marie Light

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6093695	*Bacillus thuringiensis* CryET29 compositions toxic to coleopteran insects and ctenocephalides SPP	Monsanto Company	Rupar; Mark J.|Donovan; William P.|Tan; Yuping|Slaney; Annette C.
US6153814	Polypeptide compositions toxic to lepidopteran insects and methods for making same	Monsanto Company	Baum; James A.|Gilmer; Amy Jelen|Mettus; Anne-Marie Light
US6177615	Lepidopteran-toxic polypeptide and polynucleotide compositions and methods for making and using same	Monsanto Company	Baum; James A.
US6313378	Lepidopteran-resistent transgenic plants	Monsanto Technology LLC	Baum; James A.|Gilmer; Amy Jelen|Mettus; Anne-Marie Light
US6423828	Nuclei acid and polypeptide compositions encoding lepidopteran-toxic polypeptides	Monsanto Technology LLC	Baum; James A.|Gilmer; Amy Jelen|Mettus; Anne-Marie Light

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6537756	*Bacillus thuringiensis* CryET29 compositions toxic to coleopteran insects and Ctenocephalides SPP	Monsanto Technology, LLC	Rupar; Mark J.|Donovan; William P.|Tan; Yuping|Slaney; Annette C.
US6686452	*Bacillus thuringiensis* CryET29 compositions toxic to coleopteran insects and ctenocephalides SPP	Monsanto Technology LLC	Rupar; Mark J.|Donovan; William P.|Tan; Yuping|Slaney; Annette C.
US6809078	Compositions encoding lepidopteran-toxic polypeptides and methods of use	Monsanto Technology LLC	Baum; James A.|Gilmer; Amy Jelen|Mettus; Anne-Marie Light
US6815579	Plant long chain fatty acid biosynthetic enzyme	The University of British Columbia	Kunst; Ljerka|Clemens; Sabine
US7087420	Microbial β-glucuronidase genes, gene products and uses thereof	Cambia	Jefferson; Richard A|Mayer; Jorge E
US7141719	Microbial β-Glucuronidase genes, gene production and uses thereof	Cambia	Jefferson; Richard A.|Harcourt; Rebecca L.|Kilian; Andrzej|Keese; Paul Konrad

Publication Number	Title	Assignee/Applicant Name	Inventor Name
[redacted]	Plants transformed with CryET29-encoding nucleic acids	Monsanto Technology LLC	Rupar; Mark J.|Donovan; William P.|Tan; Yuping|Slaney; Annette C.
[redacted]	Methods for generating lepidopteran-toxic polypeptides	Monsanto Technology LLC	Baum; James A.|Gilmer; Amy Jelen|Mettus; Anne-Marie Light
[redacted]	Cloning and expression of *Bacillus thuringiensis* toxin gene encoding a protein toxic to beetles of the order Coleoptera	Mycogen Corporation	Herrnstadt; Corinna|Wilcox; Edward

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US7247613	Pesticidal proteins	Mycogen Corporation	Narva; Kenneth E.|Schnepf; H. Ernest|Knuth; Mark|Pollard; Michael R.|Cardineau; Guy A.|Schwab; George E.|Michaels; Tracy Ellis|Lee; Stacey Finstad|Diehl; Paula|Dojillo; Joanna|Stamp; Lisa|Herman; Rod
US7122715	In vitro method to create circular molecules for use in transformation	Monsanto Technology LLC	Korte; John A.|Lowe; Brenda A.
US6962977	Protein having pesticidal activity, DNA encoding the protein, and noxious organism-controlling agent and method	SDS Biotech K.K.	Asano; Shinichiro|Yamanaka; Satoshi|Takeuchi; Katsuyoshi

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US5736514	Bacillus strain and harmful organism controlling agents	Nissan Chemical Industries, Ltd.	Iizuka; Toshihiko|Tagawa; Michito|Arai; Satoshi|Niizeki; Masatsugu|Miyake; Toshiro
US20030166093A1	Pesticidal proteins	Mycogen Corporation	Narva, Kenneth E.|Schnepf, H. Ernest|Knuth, Mark|Pollard, Michael R.|Cardineau, Guy A.|Schwab, George E.|Michaels, Tracy Ellis|Lee, Stacey Finstad|Burmeister, Paula|Dojillo, Joanna

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2004139497A1	Pesticidal proteins	Mycogen Corporation	Narva, Kenneth E.|Schnepf, H. Ernest|Knuth, Mark|Pollard, Michael R.|Cardineau, Guy A.|Schwab, George E.|Michaels, Tracy Ellis|Lee, Stacey Finstad|Diehl, Paula|Dojillo, Joanna|Stamp, Lisa|Herman, Rod
US5770431	*Bacillus thuringiensis* strains active against lepidopteran and coleopteran pests	Abbott Laboratories	Liu; Chi-Li|Adams; Lee Fremont|Lufburrow; Patricia A.|Thomas; Michael David

Publication Number	Title	Assignee/Applicant Name	Inventor Name
WO0066742A2	COLEOPTERAN.ndash.TOXIC POLYPEPTIDE COMPOSITIONS AND INSECT.ndash.RESISTANT TRANSGENIC PLANTS	MONSANTO COMPANY	RUPAR, Mark, J.|DONOVAN, William, P.|CHU, Chih-Rei|PEASE, Elizabeth|TAN, Yuping|SLANEY, Annette, C.|MALVAR, Thomas, M.|BAUM, James, A.
EP0318143	Anti-coleopteran toxin and gene	Lubrizol Genetics, Inc.	Sekar, Vaithlingham, et. Al.
US5659123	Diabrotica toxins	Plant Genetic Systems, N.V.	Van Rie; Jeroen|Jansens; Stefan|Peferoen; Marnix
AP 498	Photoprotected *Bacillus thuringiensis* toxin	AECI Limited	
AP 430	Insecticidal Compositions Containing A Delta-Endotoxin	AECI Limited	

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US7169971	DNA encoding insecticidal Cry1Bf <i>*Bacillus thuringiensis* </i>proteins and recombinant hosts expressing same	Bayer Bioscience N.V.	Arnaut; Greta|Boets; Annemie|Damme; Nicole|Van Rie; Jeroen
US6831062	*Bacillus thuringiensis* toxins with improved activity	Mycogen Corporation	Thompson; Mark|Knuth; Mark|Cardineau; Guy
US7049491	Plants made insect resistant by transformation with a nucleic acid encoding a modified Cry1Ab protein and methods for making same	Bayer Bioscience N.V.	Jansens; Stefan|Van Houdt; Sara|Reynaerts; Arlette
EP1778714A2	METHODS FOR MAKING AND USING RECOMBINANT *BACILLUS THURINGIENSIS* SPORES	PHYLLOM LLC	GOLDMAN, STANLEY|LIBS, JOHN

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2006212964A9	Methods for enhancing insect resistance in plants	Pioneer Hi-Bred International, Inc.|E.I. duPont de Nemours and Company	McCutchen; Billy F.|Abad; Andre R.
US2006212965A1	AXMI-018, AXMI-020, and AXMI-021, a family of delta-endotoxin genes and methods for their use	Athenix Corporation	Carozzi; Nadine|Hargiss; Tracy|Koziel; Michael G.|Duck; Nicholas B.
US2006242732A1	Axmi-027, axmi-036 and axmi-038, a family of delta endotoxin genes and methods for their use	Athenix Corporation	Carozzi; Nadine|Hargiss; Tracy|Koziel; Michael G.|Duck; Nicholas B.|Kahn; Theodore W.
WO9943835A3	METHODS FOR PRODUCING A POLYPEPTIDE IN A BACILLUS CELL	NOVO NORDISK BIOTECH, INC.	WIDNER, WILLIAM|SLOMA, ALAN|THOMAS, MICHAEL, D.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
WO9413785A2	NOVEL *BACILLUS THURINGIENSIS* STRAINS ACTIVE AGAINST LEPIDOPTERAN AND COLEOPTERAN PESTS	NOVO NORDISK ENTOTECH, INC.	LIU, Chi-Li|ADAMS, Lee, Fremont|LUFBURROW, Patricia, A.|THOMAS, Michael, David
WO9002801A2	PLANTS TRANSFORMED WITH A DNA SEQUENCE FROM *BACILLUS THURINGIENSIS* LETHAL TO LEPIDOPTERA	PLANT GENETIC SYSTEMS, N.V.|BOTTERMAN, Johan|PEFEROEN, Marnix|HOFTE, Herman|JOOS, Henk	BOTTERMAN, Johan|PEFEROEN, Marnix|HOFTE, Herman|JOOS, Henk
US6015891	Synthetic insecticidal crystal protein gene having a modified frequency of codon usage	Mycogen Plant Science, Inc.	Adang; Michael J.|Murray; Elizabeth E.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US20050261188A1	Genes encoding proteins with pesticidal activity	E.I. du PONT de NEMOURS and COMPANY	Abad; Andre R.|Flannagan; Ronald D.|Herrmann; Rafael|Kahn; Theodore W.|Lu; Albert L.|McCutchen; Billy Fred|Presnail; James K.|Wong; James F.H.|Yu; Cao-Guo
US6204246	Hybrid toxin	Novartis AG	Bosch; Hendrik Jan|Stiekema; Willem Johannes
US6297427	Insect resistant use of sweet potato sporamin gene and method for controlling pests using the gene	National Science Council	Yeh; Kai-Wun|Lin; Mei-In|Tuan; Shu-Jen|Chen; Yih-Ming|Lin; Chu-Yung|Kao; Suey-Sheng
US6307123	Methods and compositions for transgene identification	Dekalb Genetics Corporation	Kriz; Alan L.|Spencer; T. Michael

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US20040006785A1	*BACILLUS THURINGIENSIS* TOXINS AND GENES FOR CONTROLLING COLEOPTERAN PESTS	Mycogen Corporation	Bradfisch, Gregory A.|Muller-Cohn, Judy|Narva, Kenneth E.|Fu, Jenny M.|Thompson, Mark
WO0066742A3	COLEOPTERAN-TOXIC POLYPEPTIDE COMPOSITIONS AND INSECT-RESISTANT TRANSGENIC PLANTS	MONSANTO COMPANY	RUPAR, MARK, J.|DONOVAN, WILLIAM, P.|CHU, CHIH-REI|PEASE, ELIZABETH|TAN, YUPING|SLANEY, ANNETTE, C.|MALVAR, THOMAS, M.|BAUM, JAMES, A.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6077148	Pesticidal proteins	Mycogen Corporation	Narva; Kenneth E.|Schnepf; H. Ernest|Knuth; Mark|Pollard; Michael R.|Cardineau; Guy A.|Schwab; George E.|Michaels; Tracy Ellis|Lee; Stacey Finstad|Diehl; Paula|Dojillo; Joanna|Stamp; Lisa|Herman; Rod
US6150156	*Bacillus thuringiensis* isolates active against sucking insects	Calgene, Inc.	Riazuddin; Sheikh
US6280720	Formation of and methods for the production of large *Bacillus thuringiensis* crystals with increased pesticidal activity	Valant BioSciences, Inc.|Libertyville, Inc.	Adams; Lee Fremont|Thomas; Michael David|Sloma; Alan P.|Widner; William R.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6248536	*Bacillus thuringiensis* CryET33 and CryET34 compositions and uses thereof	Monsanto Company	Donovan; William P.|Donovan; Judith C.|Slaney; Annette C.
US6501009	Expression of Cry3B insecticidal protein in plants	Monsanto Technology LLC	Romano; Charles P.
US5824792	*Bacillus thuringiensis* toxins active against hymenopteran pests	Mycogen Corporation	Payne; Jewel M.|Kennedy; M. Keith|Randall; John Brookes|Meier; Henry|Uick; Heidi Jane|Foncerrada; Luis|Schnepf; H. Ernest|Schwab; George E.|Fu; Jenny
US6433252	Maize L3 oleosin promoter	Dekalb Genetics Corporation	Kriz; Alan L.|Griffor; Mathew
US6278041	Peroxidase gene sequences	Syngenta Participations AG	Lagrimini; Lawrence Mark|Desai; Nalini M
US6329574	High lysine fertile transgenic corn plants	Dekalb Genetics Corporation	

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6344553	*Bacillus thuringiensis* toxins and genes for controlling coleopteran pests	Mycogen Corporation	Bradfisch; Gregory A.|Muller-Cohn; Judy|Narva; Kenneth E.|Fu; Jenny M.|Thompson; Mark
US6379946	Insecticidal protein toxins from Xenorhabdus	Wisconsin Alumn Research Foundation	Ensign; Jerald C.|Bowen; David J.|Tenor; Jennifer L.|Petell; James K.|Orr; Gregory L.|Bintrim; Scott B.|Ciche; Todd A.|Strickland; James A.|Fatig; Raymond O.|Ffrench-Constant; Richard H.
US6399370	Compositions and methods for use of defensin	The Trustees of the University of Pennsylvania|Magainin Pharmaceuticals, Inc.	Wilson; James M.|Goldman; Mitchell|Bals; Robert|Stolzenberg; Ethan D.|Anderson; Mark|Zasloff; Michael|Kari; Prasad

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6399861	Methods and compositions for the production of stably transformed, fertile monocot plants and cells thereof	Dekalb Genetics Corp.	
US6528484	Insecticidal protein toxins from Photorhabdus	Wisconsin Alumni Research Foundation	Ensign; Jerald C.|Bowen; David J.|Petell; James|Fatig; Raymond|Schoonover; Sue|ffrench-Constant; Richard H.|Rocheleau; Thomas A.|Blackburn; Michael B.|Hey; Timothy D.|Merlo; Donald J.|Orr; Gregory L.|Roberts; Jean L.|Strickland; James A.|Guo; Lining|Ciche; Todd A.|Sukhapinda; Kitisri

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6710027	*Bacillus thuringiensis* toxins and genes for controlling coleopteran pests	Mycogen Corporation	Bradfisch; Gregory A.|Muller-Cohn; Judy|Narva; Kenneth E.|Fu; Jenny M.|Thompson; Mark
US6777589	Methods and compositions for the production of stably transformed, fertile monocot plants and cells thereof	DeKalb Genetics Corporation	
US6803499	Methods and compositions for the production of stably transformed, fertile monocot plants and cells thereof	DeKalb Genetics Corporation	

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US6900371	Pesticidal proteins	Mycogen Corp.	Narva; Kenneth E.|Schnepf; H. Ernest|Knuth; Mark|Pollard; Michael R.|Cardineau; Guy A.|Schwab; George E.|Michaels; Tracy Ellis|Lee; Stacey Finstad|Burmeister; Paula|Dojillo; Joanna
US7105332	Genes encoding proteins with pesticidal activity	E.I. Du Pont de Nemours and Company	Abad; Andr?Flannagan; Ronald D.|Herrmann; Rafael|Kahn; Theodore W.|Lu; Albert L.|McCutchen; Billy F.|Presnail; James K.|Wong; James F. H.|Yu; Cao-Guo

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2002078473A1	Plant pest control	ESTRUCH JUAN JOSE|WARREN GREGORY WAYNE|DESAI NALINI MANOJ|KOZIEL MICHAEL GENE|NYE GORDON JAMES	Estruch, Juan Jose|Warren, Gregory Wayne|Desai, Nalini Manoj|Koziel, Michael Gene|Nye, Gordon James
US2002147148A1	Insecticidal protein toxins from xenorhabdus	ENSIGN JERALD C.|BOWEN DAVID J.|TENOR JENNIFER L.|CICHE TODD A.|PETELL JAMES K.|STRICKLAND JAMES A.|ORR GREGORY L.|FATIG RAYMOND O.|BINTRIM SCOTT B.|FFRENCH-CONSTANT RICHARD H.	Ensign, Jerald C.|Bowen, David J.|Tenor, Jennifer L.|Ciche, Todd A.|Petell, James K.|Strickland, James A.|Orr, Gregory L.|Fatig, Raymond O.|Bintrim, Scott B.|Ffrench-Constant, Richard H.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2002151709A1	Genes encoding novel proteins with pesticidal activity against coleopterans	ABAD ANDRE R.|DUCK NICHOLAS B.|FENG XIANG|FLANNAGAN RONALD D.|KAHN THEODORE W.|SIMS LYNNE E.	Abad, Andre R.|Duck, Nicholas B.|Feng, Xiang|Flannagan, Ronald D.|Kahn, Theodore W.|Sims, Lynne E.
US2003100077A1	In vitro method to create circular molecules for use in transformation	KORTE JOHN A.|LOWE BRENDA A.	Korte, John A.|Lowe, Brenda A.
US2003144192A1	*Bacillus thuringiensis* cryET33 and cryET34 compositions and insect-resistant transgenic plants	Monsanto Technology LLC.	Donovan, William P.|Donovan, Judith C.|Slaney, Annette C.
US2003177528A1	Genes encoding novel proteins with pesticidal activity against Coleopterans	E.I. du Pont de Nemours and Company	Abad, Andre R.|Duck, Nicholas B.|Feng, Xiang|Flannagan, Ronald D.|Kahn, Theodore W.|Sims, Lynne E.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2003207806A1	Insecticidal protein toxins from Photorhabdus	ENSIGN JERALD C.|BOWEN DAVID J.|PETELL JAMES|FATIG RAYMOND|SCHOONOVER SUE|FFRENCH-CONSTANT RICHARD H.|ROCHELEAU THOMAS A.|BLACKBURN MICHAEL B.|HEY TIMOTHY D.|MERLO DONALD J.|ORR GREGORY L.|ROBERTS JEAN L.|STRICKLAND JAMES A.|GUO LINING|CICHE TODD A.|SUKHAPINDA KITISRI	Ensign, Jerald C.|Bowen, David J.|Petell, James|Fatig, Raymond|Schoonover, Sue|Ffrench-Constant, Richard H.|Rocheleau, Thomas A.|Blackburn, Michael B.|Hey, Timothy D.|Merlo, Donald J.|Orr, Gregory L.|Roberts, Jean L.|Strickland, James A.|Guo, Lining|Ciche, Todd A.|Sukhapinda, Kitisri

Publication Number	Title	Assignee/Applicant Name	Inventor Name
[redacted]	Genes encoding proteins with pesticidal activity	E.I du Pont de Nemours and Company	Abad, Andre R.|Flannagan, Ronald D.|Herrmann, Rafael|Kahn, Theodore W.|Lu, Albert L.|McCutchen, Billy Fred|Presnail, James K.|Wong, James F.H.|Yu, Cao-Guo
[redacted]	Genes encoding proteins with pesticidal activity	Pioneer Hi-Bred International, Inc.|E.I. du PONT de NEMOURS and COMPANY	Abad, Andre|Dong, Hua|Herrmann, Rafael|Lu, Albert|McCutchen, Billy F.|Rice, Janet A.|Schepers, Eric J.|Wong, James F.
[redacted]	AXMI-009, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2004214290A1	Plant artificial chromosomes, uses thereof and methods of preparing plant artificial chromosomes	PEREZ CARL|FABIJANSKI STEVEN|PERKINS EDWARD	Perez, Carl|Fabijanski, Steven|Perkins, Edward
US2004253690A1	Insect inhibitory lipid acyl hydrolases	ALIBHAI MURTAZA F.|RYDEL TIMOTHY J.	Alibhai, Murtaza F.|Rydel, Timothy J.
US2005049410A1	AXMI-003, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi, Nadine|Hargiss, Tracy|Koziel, Michael G.|Duck, Nicholas B.|Carr, Brian
US2005138685A1	Bacillus Cry9 family members	E.I du Pont de Nemours and Company	Flannagan; Ronald D.|Abad; Andre R.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2005155112A1	Pesticidal proteins	Mycogen Corporation	Narva; Kenneth E.|Schnepf; H. Ernest|Knuth; Mark|Pollard; Michael R.|Cardineau; Guy A.|Schwab; George E.|Michaels; Tracy Ellis|Lee; Stacey Finstad|Burmeister; Paula|Dojillo; Joanna
US2005183161A1	AXMI-010, a delta-endotoxin gene and methods for its use	Athenix Corporation	Carozzi; Nadine|Hargiss; Tracy|Koziel; Michael G.|Duck; Nicholas B.|Carr; Brian
US2005188439A1	Methods for enhancing insect resistance in plants	Pioneer Hi-Bred International, Inc.|E.I. duPont de Nemours and Company	McCutchen; Billy F.|Abad; Andre R.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2005261483A1	Genes encoding proteins with pesticidal activity	E.I. duPont de Nemours and Company	Abad; Andre R.|Flannagan; Ronald D.|Herrmann; Rafael|Kahn; Theodore W.|Lu; Albert L.|McCutchen; Billy Fred|Presnail; James K.|Wong; James F.H.|Yu; Cao-Guo
US2005287647A9	Plant artificial chromosomes, uses thereof and methods of preparing plant artificial chromosomes		Perez; Carl|Fabijanski; Steven|Perkins; Edward
US2006080747A1	Constitutive expression cassettes for regulation of plant expression	SunGene GmbH & Co. KGaA	Keetman; Ulrich|Linemann; Ute|Herbers; Karin|Hillebrand; Helke
US2006112452A1	Expression cassettes for seed-preferential expression in plants	BASF Plant Science GmbH	Keetman; Ulrich|Duwenig; Elke|Loyall; Linda Patricia|Herbers; Karin|Hillebrand; Helke

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US20060117415A1	Expression cassettes for root-preferential expression in plants	SunGene GmbH & Co. KGaA	Keetman; Ulrich|Linemann; Ute|Herbers; Karin|Hillebrand; Helke
US20060130178A1	Expression cassettes for meristem-preferential expression in plants	SunGene GmbH & Co. KGaA	Keetman; Ulrich|Linemann; Ute|Herbers; Karin|Hillebrand; Helke
US20060143732A1	Plant artificial chromosomes, uses thereof and methods of preparing plant artificial chromosomes		Perez; Carl|Fabijanski; Steven|Perkins; Edward
US20060156429A1	Expression cassettes for mesophyll- and/or epidermis-preferential expression in plants	SunGene GmbH	Keetman; Ulrich|Herbers; Karin|Hillebrand; Helke
US20060162025A1	Expression cassettes for vascular tissue-preferential expression in plants	SunGene GmbH	Keetman; Ulrich|Herbers; Karin|Hillebrand; Helke

Publication Number	Title	Assignee/Applicant Name	Inventor Name
JP21112490A2	PLANT RESISTANT TO INSECT INJURY	MONSANTO CO	FISCHHOFF DAVID A|FUCHS ROY L|LAVRIK PAUL B|MCPHERSON SYLVIA A|PERLAK FREDERICK J
WO9913835A2	METHODS FOR PRODUCING A POLYPEPTIDE IN A BACILLUS CELL	NOVO NORDISK BIOTECH, INC.	WIDNER, William|SLOMA, Alan|THOMAS, Michael, D.
WO9815630A2	SYNTHETIC *BACILLUS THURINGIENSIS* GENE ENCODING CRYLCA (CRYLC) TOXIN	VITALITY BIOTECHNOLOGIES LTD.	STRIZHOV, Nicolai|KONCZ, Csaba|SCHELL, Jeff|ZILBERSTEIN, Aviah|KELLER, Menachem|SNEH, Baruch
WO9815567A3	GENE SYNTHESIS METHOD	VITALITY BIOTECHNOLOGIES LTD.|STRIZHOV, NICOLAI|KONCZ, CSABA|SCHELL, JEFF	STRIZHOV, NICOLAI|KONCZ, CSABA|SCHELL, JEFF

Publication Number	Title	Assignee/Applicant Name	Inventor Name
WO9413785A3	NOVEL *BACILLUS THURINGIENSIS* STRAINS ACTIVE AGAINST LEPIDOPTERAN AND COLEOPTERAN PESTS	NOVO NORDISK ENTOTECH, INC.	LIU, Chi-Li|ADAMS, Lee, Fremont|LUFBURROW, Patricia, A.|THOMAS, Michael, David
WO9012889A1	METHOD OF ANALYSIS, REAGENT COMPOSITION AND USE THEREOF FOR GLUCOSE DETERMINATION	MIGRATA UK LTD|LILJA, Jan, Evert|NILSSON, Sven-Erik, Lennart	LILJA, Jan, Evert|NILSSON, Sven-Erik, Lennart
WO9002801A1	PLANTS TRANSFORMED WITH A DNA SEQUENCE FROM *BACILLUS THURINGIENSIS* LETHAL TO LEPIDOPTERA	PLANT GENETIC SYSTEMS, N.V.	BOTTERMAN, JOHAN|PEFEROEN, MARNIX|HOFTE, HERMAN|JOOS, HENK

Publication Number	Title	Assignee/Applicant Name	Inventor Name
WO8901515A3	PLANTS TRANSFORMED WITH A DNA SEQUENCE FROM *BACILLUS THURINGIENSIS*	PLANT GENETIC SYSTEMS N.V.	VAECK, MARK|HOFTE, HERMANUS|BOTTERMAN, JOHAN
WO0004033A1	CALCIUM (3S) TETRAHYDRO.ndash.3.ndash.FURANYL(1S,2R).ndash.3.ndash.[[(4.ndash.AMINOPHENYL) SULFONYL] (ISOBUTYL) AMINO] .ndash.1.ndash.BENZYL.ndash.2.ndash. (PHOSPHONOOXY) PROPYLCARBAMATE	GLAXO GROUP LIMITED	ARMITAGE, Ian, Gordon|SEARLE, Andrew, David|SINGH, Hardev
US2006242733A1	Bacillus Cry9 family members	E.I. du PONT de NEMOURS and COMPANY|Pioneer Hi-Bred International, Inc.	Flannagan; Ronald D.|Abad; Andre R.

Publication Number	Title	Assignee/Applicant Name	Inventor Name
US2006241044A1	Bacillus Cry9 family members	E.I. du PONT de NEMOURS and COMPANY|Pioneer Hi-Bred International, Inc.	Flannagan; Ronald D.|Abad; Andre R.
US2006241043A1	Bacillus Cry9 family members	E.I.du PONT de NEMOURS and COMPANY|Pioneer Hi-Bred International, Inc.	Flannagan; Ronald D.|Abad; Andre R.
US6156308	*Bacillus thuringiensis* strains active against lepidopteran and coleopteran pests	Valent BioSciences, Inc.	Liu; Chi-Li|Adams; Lee Fremont|Lufburrow; Patricia A.|Thomas; Michael David

Publication Number	Title	Assignee/Applicant Name	Inventor Name
[illegible]	A BIOINSECTICIDE FORMULATION CONSISTING OF *BACILLUS THURINGIENSIS* VAR ISRAELENSIS, AND ITS CONCERNING MANUFACTURE PROCEEDINGS	FUNDA 플 O OSWALDO CRUZ - FIOCRUZ	GOMES SANCHES, Elizabeth|BATISTA DA SILVA, Ana, Cristina|ABREU CAMPOS, Fl?ia, Maria|PINHEIRO ROBERG, Renata, Alves|DE ASSUN 플 O, Fernando, Justino

3.4.1 Understanding Worldwide Bt Related Patent Landscape

We conducted a basic search using the Micropatent database for thuringiensis to gauge the worldwide scientific interest on this subject matter and found 14,461 patent hits. We graphed the resulting data by assignee, patent count, and publication year to better explain the international patent landscape.

According to Figure 1, from 1981 to the Present, the patents relating to thuringiensis have gradually increased.

2D Bar Chart (Patent count vs. Year)

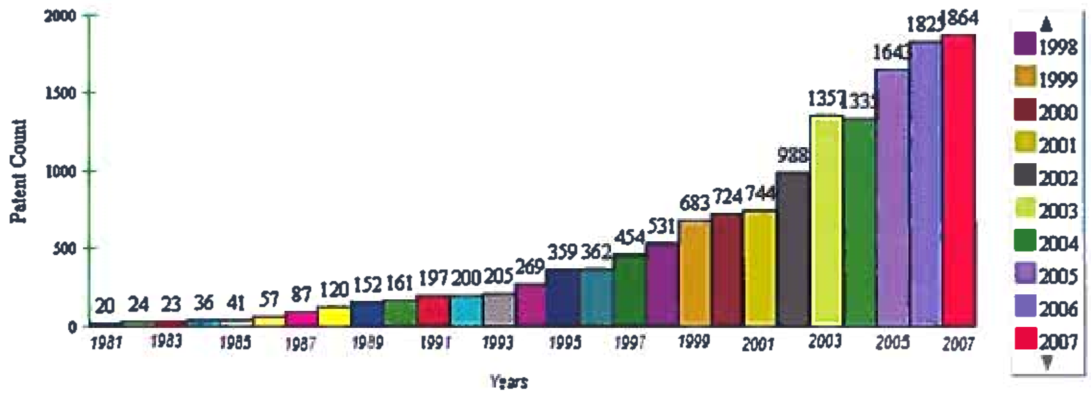


Figure 1: Patent count versus publication year: The number of thuringiensis patents has increased over the last twenty-six years

According Figure 2, Bayer and Pioneer Hi Bred International each have more than a thousand patents to their name. This suggests that these companies are powerhouses in research and development projects addressing thuringiensis.

2D Bar Chart (Patent count vs. Assignee)

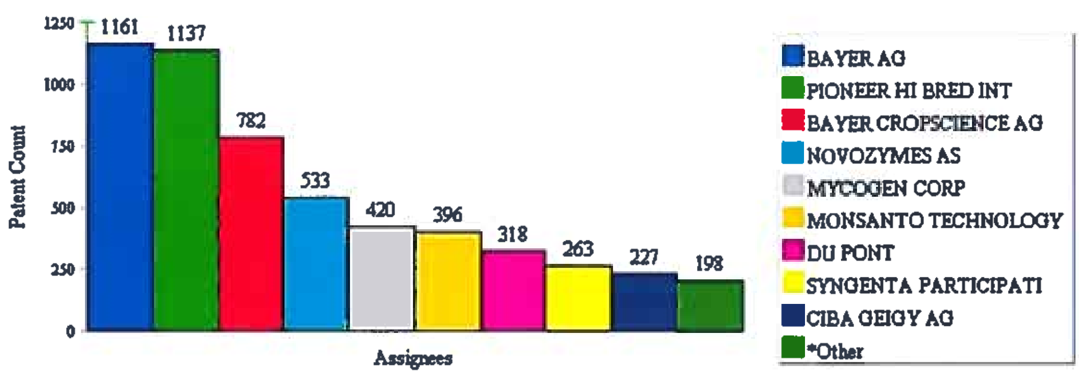


Figure 2: Patent count versus assignee: the top two assignees for thuringiensis related patents are Bayer and Pioneer Hi Bred International.

According to Figure 3, Bayer AG likely transferred their research to Bayer CropScience AG around 2003 due to the decrease in the Bayer AG patent count and a simulataneous increase in the Bayer CropScience patent count. Recently, Pioneer Hi Bred International drastically increased its patent filings circa 2003.

3D Bar Chart (Patent count vs. Assignee vs. Publication Date)

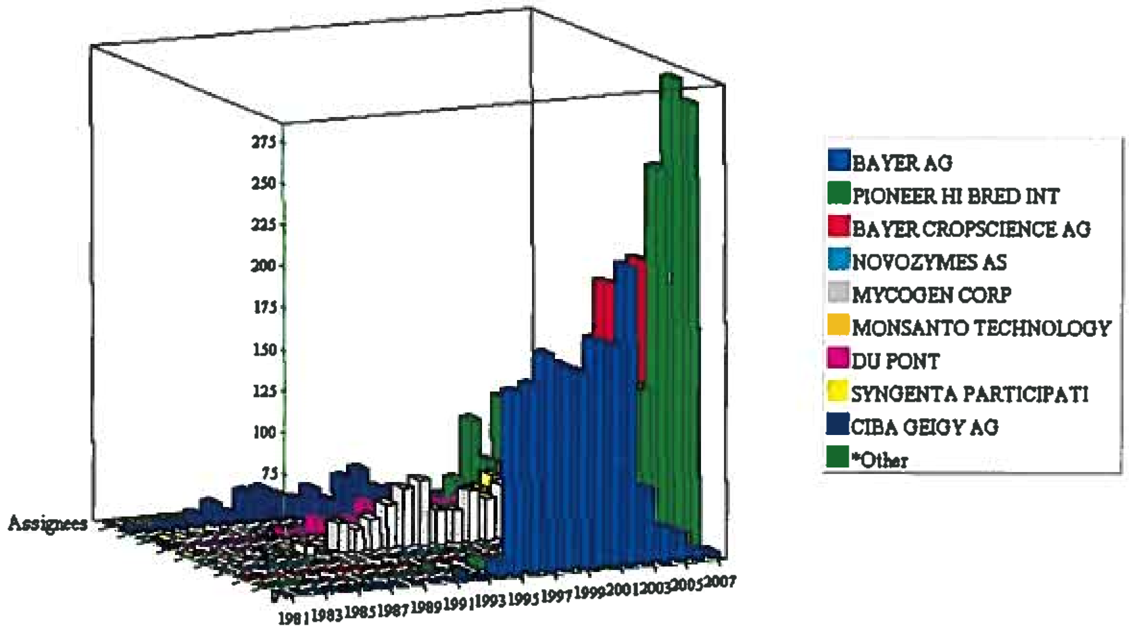


Figure 3: Patent count versus assignee versus publication date: From 2003 onwards, Pioneer Hi Bred International and Bayer CropScience AG were the most active filers in the thuringiensis subject matter.

According to Figure 4, it appears that Bayer and Pioneer Hi Bred International combined have more than 50% of the worldwide thuringiensis patents. Furthermore, Novozyme AS, Mycogen Corporation, Monsanto Technology, Du Pont, Syngenta Participati, Ciba-Geigy AG also have substantial numbers of thuringiensis patents.

Pie Chart (Patent count vs. Assignee)

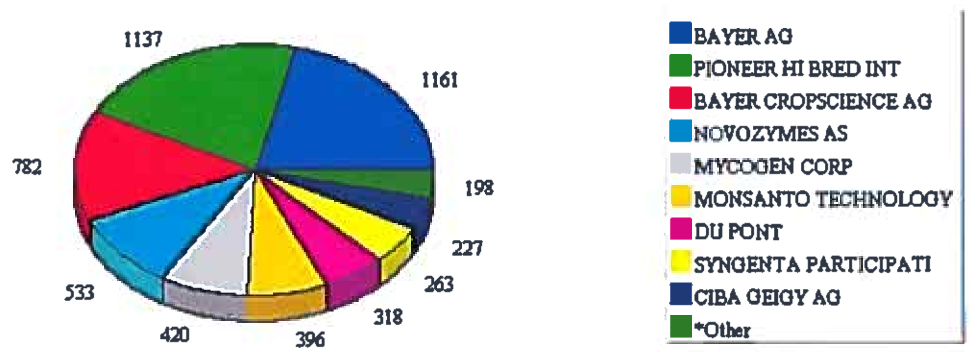


Figure 4: Patent count versus assignee: The top 9 assignees of "thuringiensis" patents.

3.4.2 Patent Landscape for the Specific Bt Gene Used By CIP

As we finalized our specific search for each of the three cry proteins disclosed in the Innovation Plan, we graphed the patent count, assignee, publication year, and IPC Count for all the Red and Yellow patents color coded according to relevancy. We conducted our specific search during the summer and fall of 2007 using various databases.

According to Figure 5, during the period from 1991 to 2007, there is a gradual increase in the number of patents filed claiming anyone of the cryproteins.

2D Bar Chart (Patent count vs. Year)

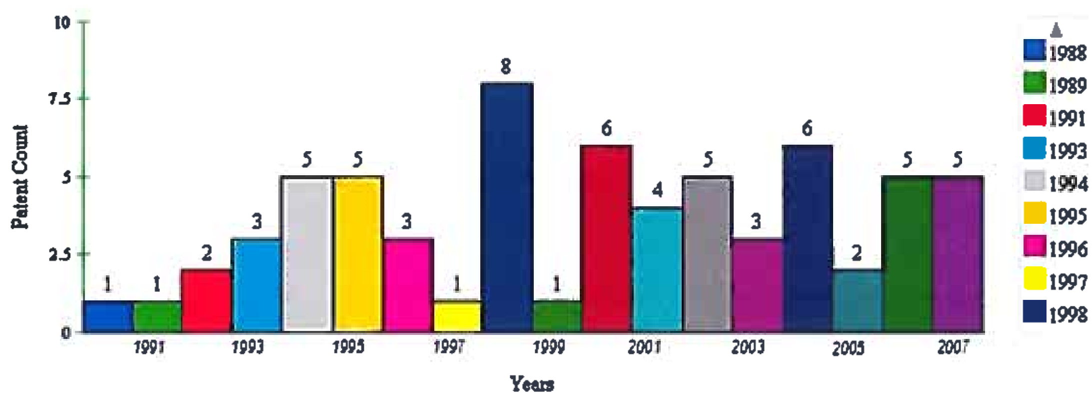


Figure 5: Patent count versus publication year: There is an upward trend in the number of patents filed from 1991 to 2007.

According to Figure 6, the top assignees and key players include Monsanto Technology, Mycogen Corporation, and Ecogen Incorporated.

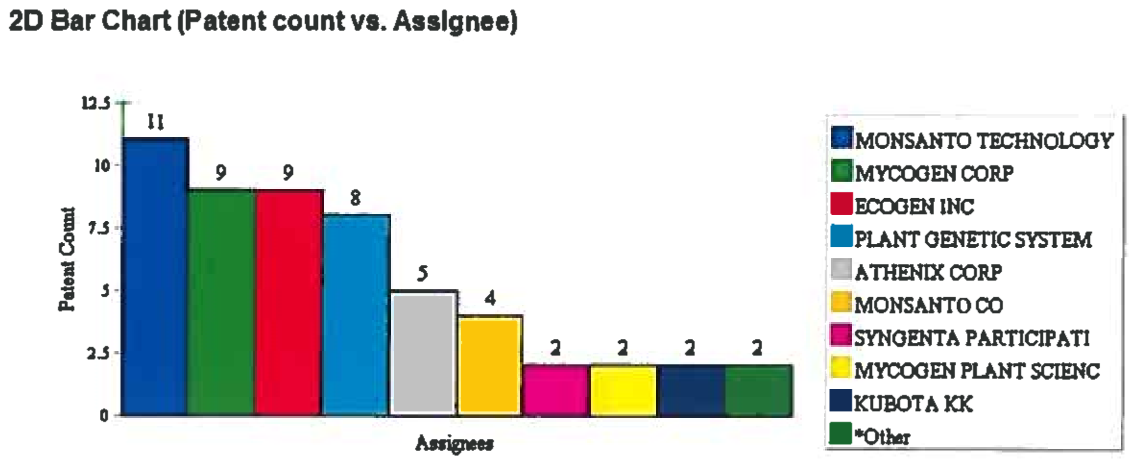


Figure 6: Patent count versus assignee: The top assignees are Monsanto Technology, Ecogen Incorporated, and Mycogen Corporation, unlike Figure 2.

According to Figure 7, the most frequently cited international classification numbers include A01N and C07K. (See Appendix C for Definitons of these classifications)

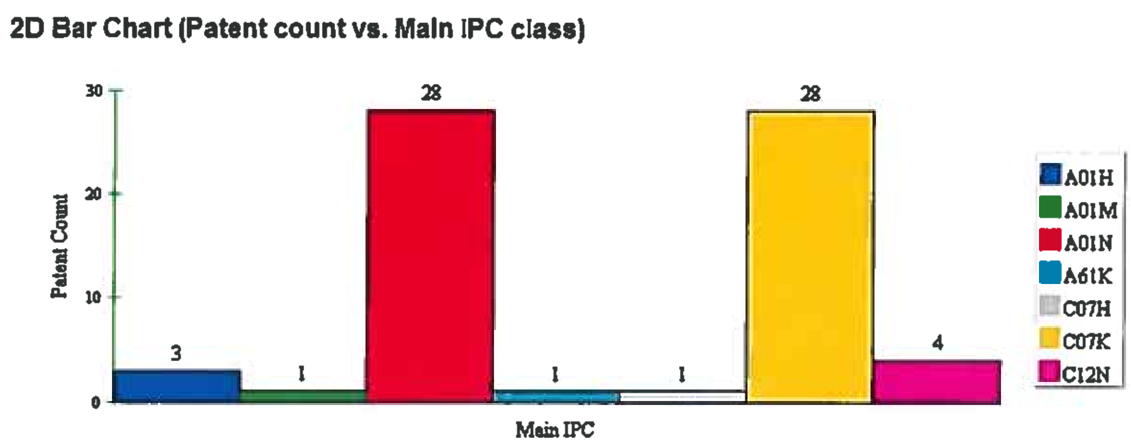


Figure 7: Patent count versus Main IPC Class: The most popular international classifications include A01N and C07K.

According to Figure 8, the top three assignees include Monsanto Technology, Mycogen Corporation, and Ecogen Corporation.

Pie Chart (Patent count vs. Assignee)

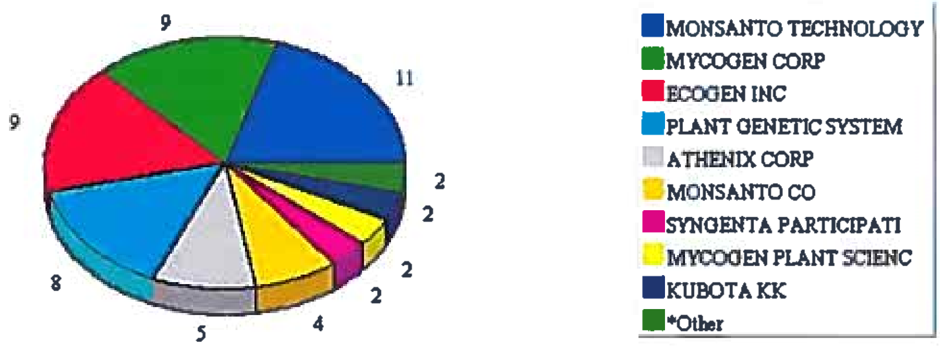


Figure 8: Patent count versus assignee: As in Figure 6, the top three assignees include Monsanto Technology, Mycogen Corporation, and Ecogen Corporation.

According to Figure 9, Plant Genetic Systems stopped filing patents as of 2000. However, Monsanto Technology started to file patents from 2000 onwards.

3D Bar Chart (Patent count vs. Assignee vs. Publication Date)

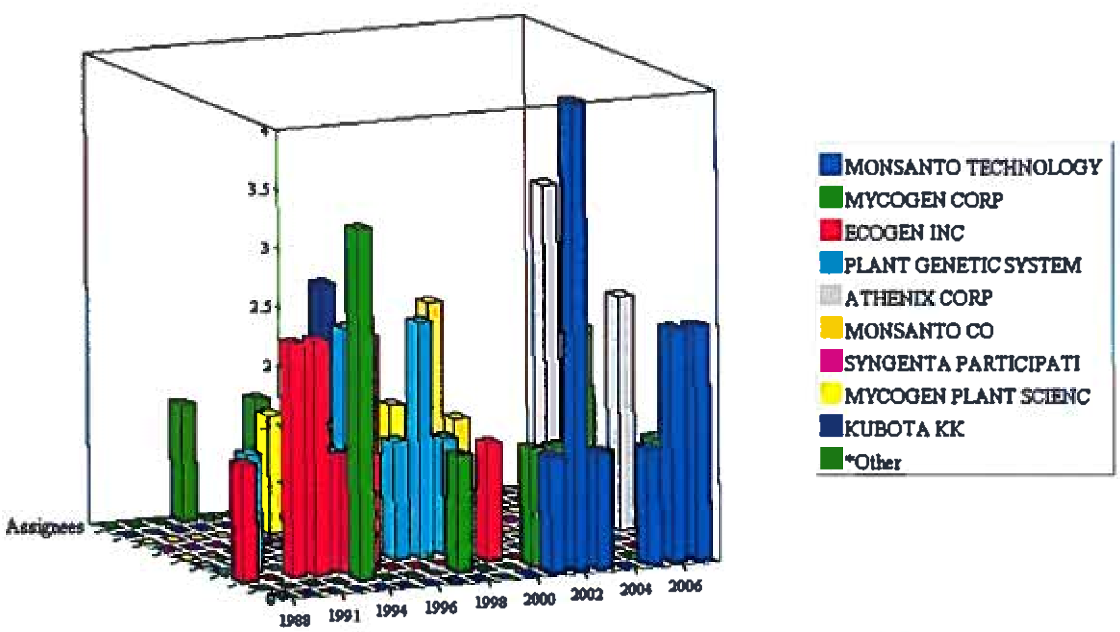


Figure 9: Patent count versus assignee versus publication date: Monsanto Technology was a top assignee from 2000 onwards.

APPENDIX A: Nomenclature Tables

A. Full Toxin List of *Bacillus thuringiensis*[44]

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry1Aa1	M11250	Schnepf et al	1985	Bt kurstaki HD1	
Cry1Aa2	M10917	Shibano et al	1985	Bt sotto	
Cry1Aa3	D00348	Shimizu et al	1988	Bt aizawai IPL7	
Cry1Aa4	X13535	Masson et al	1989	Bt entomocidus	
Cry1Aa5	D17518	Udayasuriyan et al	1994	Bt Fu-2-7	
Cry1Aa6	U43605	Masson et al	1994	Bt kurstaki NRD-12	
Cry1Aa7	AF081790	Osman et al	1999	Bt C12	
Cry1Aa8	I26149	Liu	1996		
Cry1Aa9	AB026261	Nagamatsu et al	1999	Bt dendrolimus T84A1	
Cry1Aa10	AF154676	Hou and Chen	1999	Bt kurstaki HD-1-02	
Cry1Aa11	Y09663	Tounsi et al	1999	Bt kurstaki	
Cry1Aa12	AF384211	Yao et al	2001	Bt Ly30	
Cry1Aa13	AF510713	Zhong et al	2002	Bt sotto	
Cry1Aa14	AY197341	Yingbo et al	2002	unpublished	
Cry1Aa15	DQ062690	Sauka et al	2005	Bt INTA Mol-12	
Cry1Ab1	M13898	Wabiko et al	1986	Bt berliner 1715	
Cry1Ab2	M12661	Thorne et al	1986	Bt kurstaki	
Cry1Ab3	M15271	Geiser et al	1986	Bt kurstaki HD1	
Cry1Ab4	D00117	Kondo et al	1987	Bt kurstaki HD1	
Cry1Ab5	X04698	Hofte et al	1986	Bt berliner 1715	
Cry1Ab6	M37263	Hefford et al	1987	Bt kurstaki NRD-12	
Cry1Ab7	X13233	Haider & Ellar	1988	Bt aizawai IC1	
Cry1Ab8	M16463	Oeda et al	1987	Bt aizawai IPL7	
Cry1Ab9	X54939	Chak & Jen	1993	Bt aizawai HD133	
Cry1Ab10	A29125	Fischhoff et al	1987	Bt kurstaki HD1	
Cry1Ab11	I12419	Ely & Tippett	1995	Bt A20	
Cry1Ab12	AF059670	Silva-Werneck et al	1998	Bt kurstaki S93	
Cry1Ab13	AF254640	Tan et al	2002	Bt c005	
Cry1Ab14	U94191	Meza-Basso & Theoduloz	2000	Native Chilean Bt	
Cry1Ab15	AF358861	Li, Zhang et al	2001	Bt B-Hm-16	
Cry1Ab16	AF375608	Yu et al	2002	Bt AC-11	
Cry1Ab17	AAT46415	Huang et al	2004	Bt WB9	
Cry1Ab18	AAQ88259	Stobdan et al	2004	Bt	
Cry1Ab19	AY847289	Zhong et al	2005	Bt X-2	

[44] Crickmore, N., Zeigler, D.R., Schnepf, E., Van Rie, J., Lereclus, D., Baum, J, Bravo, A. and Dean, D.H. "*Bacillus thuringiensis* toxin nomenclature" (2007)
http://www.lifesci.sussex.ac.uk/Home/Neil_Crickmore/Bt/

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry1Ab20	DQ241675	Liu et al	2006	BtC008	
Cry1Ab21	EF683163	Swiecicka et al	2007	Bt IS5056	
Cry1Ab22	ABW87320	Wu and Feng	2008	BtS2491Ab	
Cry1Ab-like	AF327924	Nagarathinam et al	2001	Bt kunthala RX24	uncertain sequence
Cry1Ab-like	AF327925	Nagarathinam et al	2001	Bt kunthala RX28	uncertain sequence
Cry1Ab-like	AF327926	Nagarathinam et al	2001	Bt kunthala RX27	uncertain sequence
Cry1Ab-like	DQ781309	Lin and Fang	2006	Bt ly4a3	insufficient sequence
Cry1Ac1	M11068	Adang et al	1985	Bt kurstaki HD73	
Cry1Ac2	M35524	Von Tersch et al	1991	Bt kenyae	
Cry1Ac3	X54159	Dardenne et al	1990	Bt BTS89A	
Cry1Ac4	M73249	Payne et al	1991	Bt kurstaki PS85A1	
Cry1Ac5	M73248	Payne et al	1992	Bt kurstaki PS81GG	
Cry1Ac6	U43606	Masson et al	1994	Bt kurstaki NRD-12	
Cry1Ac7	U87793	Herrera et al	1994	Bt kurstaki HD73	
Cry1Ac8	U87397	Omolo et al	1997	Bt kurstaki HD73	
Cry1Ac9	U89872	Gleave et al	1992	Bt DSIR732	
Cry1Ac10	AJ002514	Sun and Yu	1997	Bt kurstaki YBT-1520	
Cry1Ac11	AJ130970	Makhdoom & Riazuddin	1998		
Cry1Ac12	I12418	Ely & Tippett	1995	Bt A20	
Cry1Ac13	AF148644	Qiao et al	1999	Bt kurstaki HD1	
Cry1Ac14	AF492767	Yao et al	2002	Bt Ly30	
Cry1Ac15	AY122057	Tzeng et al	2001	Bt from Taiwan	
Cry1Ac16	AY730621	Zhao et al	2005	Bt H3	
Cry1Ac17	AY925090	Hire et al	2005	Bt kenyae HD549	
Cry1Ac18	DQ023296	Kaur et al	2005	Bt	
Cry1Ac19	DQ195217	Gao et al	2005	Bt C-33	
Cry1Ac20	DQ285666	Tan et al	2005		
Cry1Ac21	DQ062689	Sauka et al	2005	INTA Mol-12	
Cry1Ac22	EU282379	Xuanjun et al	2007	Bt	
Cry1Ad1	M73250	Payne & Sick	1993	Bt aizawai PS81I	
Cry1Ad2	A27531		1995	Bt PS81RR1	
Cry1Ae1	M65252	Lee & Aronson	1991	Bt alesti	
Cry1Af1	U82003	Kang et al	1997	Bt NT0423	
Cry1Ag1	AF081248	Mustafa	1999		
Cry1Ah1	AF281866	Tan et al	2000		
Cry1Ah2	DQ269474	Qi et al	2005	Bt alesti	
Cry1Ai1	AY174873	Wang et al	2002		

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry1A-like	AF327927	Nagarathinam et al	2001	Bt kunthala nags3	uncertain sequence
Cry1Ba1	X06711	Brizzard & Whiteley	1988	Bt thuringiensis HD2	
Cry1Ba2	X95704	Soetaert	1996	Bt entomocidus HD110	
Cry1Ba3	AF368257	Zhang et al	2001		
Cry1Ba4	AF363025	Mat Isa et al	2001	Bt entomocidus HD9	
Cry1Ba5	BI 884418	Song et al	2007	Bt sfw-12	
Cry1Ba6	ABL60921	Martins et al	2006	Bt S601	
Cry1Bb1	L32020	Donovan et al	1994	Bt EG5847	
Cry1Bc1	Z46442	Bishop et al	1994	Bt morrisoni	
Cry1Bd1	U70726	Kuo et al	2000	Bt wuhanensis HD525	
Cry1Bd2	AY138457	Isakova et al	2002	Bt 834	
Cry1Be1	AF077326	Payne et al	1998	Bt PS158C2	
Cry1Be2	AAQ52387	Baum et al	2003		
Cry1Bf1	AX189649	Arnaut et al	2001		
Cry1Bf2	AAQ52380	Baum et al	2003		
Cry1Bg1	AY176063	Wang et al	2002		
Cry1Ca1	X07518	Honee et al	1988	Bt entomocidus 60.5	
Cry1Ca2	X13620	Sanchis et al	1989	Bt aizawai 7.29	
Cry1Ca3	M73251	Feitelson	1993	Bt aizawai PS81I	
Cry1Ca4	A27642	Van Mellaert et al	1990	Bt entomocidus HD110	
Cry1Ca5	X96682	Strizhov	1996	Bt aizawai 7.29	
Cry1Ca6 [1]	AF215647	Yu et al	2000	Bt AF-2	
Cry1Ca7	AY015492	Aixing et al	2000		
Cry1Ca8	AF362020	Chen et al	2001		
Cry1Ca9	AY078160	Kao et al	2003	Bt G10-01A	
Cry1Ca10	AF540014	Lin et al	2003	Bt	
Cry1Ca11	AY955268	Cai et al	2005	Bt C-33	
Cry1Cb1	M97880	Kalman et al	1993	Bt galleriae HD29	
Cry1Cb2	AY007686	Song et al	2000		
Cry1Cb-like	AAX63901	Thammasittirong et al	2005	Bt TA476-1	insufficient sequence
Cry1Da1	X54160	Hofte et al	1990	Bt aizawai HD68	
Cry1Da2	I76415	Payne & Sick	1997		
Cry1Db1	Z22511	Lambert	1993	Bt BTS00349A	
Cry1Db2	AF358862	Li et al	2001	Bt B-Pr-88	
Cry1Dc1	EF059913	Lertwiriyawong et al	2006		
Cry1Ea1	X53985	Visser et al	1990	Bt kenyae 4F1	
Cry1Ea2	X56144	Bosse et al	1990	Bt kenyae	
Cry1Ea3	M73252	Payne & Sick	1991	Bt kenyae PS81F	

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry1Ea4	U94323	Barboza-Corona et al	1998	Bt kenyae LBIT-147	
Cry1Ea5	A15535	Botterman et al	1994		
Cry1Ea6	AF202531	Sun et al	1999		
Cry1Ea7	AAW72936	Huehne et al	2005	Bt JC190	
Cry1Ea8	ABX11258	Huang et al	2007	Bt HZM2	
Cry1Eb1	M73253	Payne & Sick	1993	Bt aizawai PS81A2	
Cry1Fa1	M63897	Chambers et al	1991	Bt aizawai EG6346	
Cry1Fa2	M73254	Payne & Sick	1993	Bt aizawai PS81I	
Cry1Fb1	Z22512	Lambert	1993	Bt BTS00349A	
Cry1Fb2	AB012288	Masuda & Asano	1998	Bt morrisoni INA67	
Cry1Fb3	AF062350	Song & Zhang	1998	Bt morrisoni	
Cry1Fb4	I73895	Payne et al	1997		
Cry1Fb5	AF336114	Li et al	2001	Bt B-Pr-88	
Cry1Ga1	Z22510	Lambert	1993	Bt BTS0349A	
Cry1Ga2	Y09326	Shevelev et al	1997	Bt wuhanensis	
Cry1Gb1	U70725	Kuo & Chak	1999	Bt wuhanensis HD525	
Cry1Gb2	AF288683	Li et al	2000	Bt B-Pr-88	
Cry1Gc	AAQ52381	Baum et al	2003		
Cry1Ha1	Z22513	Lambert	1993	Bt BTS02069AA	
Cry1Hb1	U35780	Koo et al	1995	Bt morrisoni BF190	
Cry1H-like	AF182196	Srifah et al	1999	Bt JC291	insufficient sequence
Cry1Ia1	X62821	Tailor et al	1992	Bt kurstaki	
Cry1Ia2	M98544	Gleave et al	1993	Bt kurstaki	
Cry1Ia3	L36338	Shin et al	1995	Bt kurstaki HD1	
Cry1Ia4	L49391	Kostichka et al	1996	Bt AB88	
Cry1Ia5	Y08920	Selvapandiyan	1996	Bt 61	
Cry1Ia6	AF076953	Zhong et al	1998	Bt kurstaki S101	
Cry1Ia7	AF278797	Porcar	2000	Bt	
Cry1Ia8	AF373207	Song et al	2001		
Cry1Ia9	AF521013	Yao et al	2002	Bt Ly30	
Cry1Ia10	AY262167	Espindola	2003	Bt thuringiensis	
Cry1Ia11	AJ315121	Tounsi	2003	Bt kurstaki BNS3	
Cry1Ia12	AAV53390	Grossi de Sa	2005	Bt	
Cry1Ia13	ABF83202	Martins et al	2006	Bt	
Cry1Ib1	U07642	Shin et al	1995	Bt entomocidus BP465	
Cry1Ib2	ABW88019	Guan et al	2007	Bt PP61	
Cry1Ic1	AF056933	Osman et al	1998	Bt C18	
Cry1Ic2	AAE71691	Osman et al	2001		
Cry1Id1	AF047579	Choi	2000		
Cry1Ie1	AF211190	Song et al	2000	Bt BTC007	

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry1If1	AAQ52382	Baum et al	2003		
Cry1I-like	I90732	Payne et al	1998		insufficient sequence
Cry1I-like	DQ781310	Lin & Fang	2006	Bt ly4a3	insufficient sequence
Cry1Ja1	L32019	Donovan et al	1994	Bt EG5847	
Cry1Jb1	U31527	Von Tersch & Gonzalez	1994	Bt EG5092	
Cry1Jc1	I90730	Payne et al	1998		
Cry1Jc2	AAQ52372	Baum et al	2003		
Cry1Jd1	AX189651	Arnaut et al	2001		
Cry1Ka1	U28801	Koo et al	1995	Bt morrisoni BF190	
Cry1La1	AAS60191	Je et al	2004	Bt kurstaki K1	
Cry1-like	I90729	Payne et al	1998		insufficient sequence
Cry2Aa1	M31738	Donovan et al	1989	Bt kurstaki	
Cry2Aa2	M23723	Widner & Whiteley	1989	Bt kurstaki HD1	
Cry2Aa3	D86064	Sasaki et al	1997	Bt sotto	
Cry2Aa4	AF047038	Misra et al	1998	Bt kenyae HD549	
Cry2Aa5	AJ132464	Yu & Pang	1999	Bt SL39	
Cry2Aa6	AJ132465	Yu & Pang	1999	Bt YZ71	
Cry2Aa7	AJ132463	Yu & Pang	1999	Bt CY29	
Cry2Aa8	AF252262	Wei et al	2000	Bt Dongbei 66	
Cry2Aa9	AF273218	Zhang et al	2000		
Cry2Aa10	AF433645	Yao et al	2001		
Cry2Aa11	AAQ52384	Baum et al	2003		
Cry2Aa12	DQ977646	Tan et al	2006	Bt Rpp39	
Cry2Ab1	M23724	Widner & Whiteley	1989	Bt kurstaki HD1	
Cry2Ab2	X55416	Dankocsik et al	1990	Bt kurstaki HD1	
Cry2Ab3	AF164666	Chen et al	1999	Bt BTC002	
Cry2Ab4	AF336115	Li et al	2001	Bt B-Pr-88	
Cry2Ab5	AF441855	Yao et al	2001		
Cry2Ab6	AY297091	Wang et al	2003	Bt WZ-7	
Cry2Ab7	DQ119823	Varathajalu et al	2005		
Cry2Ab8	DQ361266	Huang et al	2006	Bt WB2	
Cry2Ab9	DQ341378	Zhang et al	2005		
Cry2Ab10	EF157306	Lin et al	2006		
Cry2Ab11	AM691748	Saleem and Shakoori	2007	Bt CMBL-BT1	
Cry2Ab12	ABM21764	Lin et al	2007	Bt LyD	
Cry2Ac1	X57252	Wu et al	1991	Bt shanghai S1	
Cry2Ac2	AY007687	Song et al	2000		
Cry2Ac3	AAQ52385	Baum et al	2003		
Cry2Ac4	DQ361267	Huang et al	2006	Bt WB9	
Cry2Ac5	DQ341379	Zhang et al	2005		

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry2Ac6	DQ359137	Xia et al	2006	Bt wuhanensis	
Cry2Ac7	AM292031	Saleem & Shakoori	2006	Bt SBSBT-1	No NCBI link yet
Cry2Ac8	AM421903	Saleem & Shakoori	2007	Bt CMBL-BT1	No NCBI link yet
Cry2Ac9	AM421904	Saleem & Shakoori	2007	Bt CMBL-BT2	No NCBI link yet
Cry2Ac10	BI 877475	Bai et al	2007	Bt	No NCBI link yet
Cry2Ac11	AM689531	Saleem & Shakoori	2007	Bt HD29	No NCBI link yet
Cry2Ac12	AM689532	Saleem & Shakoori	2007	Bt CMBL-BT3	No NCBI link yet
Cry2Ad1	AF200816	Choi et al	1999	Bt BR30	
Cry2Ad2	DQ358053	Huang et al	2006	Bt WB10	
Cry2Ad3	AM268418	Saleem et al	2006		No NCBI link yet
Cry2Ad4	AM490199	Saleem et al	2007	Bt CMBL-BT2	No NCBI link yet
Cry2Ad5	AM765844	Saleem et al	2007	Bt HD29	No NCBI link yet
Cry2Ae1	AAQ52362	Baum et al	2003		
Cry2Af1	EF439818	Akhurst et al	2007		No NCBI link yet
Cry3Aa1	M22472	Herrnstadt et al	1987	Bt san diego	
Cry3Aa2	J02978	Sekar et al	1987	Bt tenebrionis	
Cry3Aa3	Y00420	Hofte et al	1987		
Cry3Aa4	M30503	McPherson et al	1988	Bt tenebrionis	
Cry3Aa5	M37207	Donovan et al	1988	Bt morrisoni EG2158	
Cry3Aa6	U10985	Adams et al	1994	Bt tenebrionis	
Cry3Aa7	AJ237900	Zhang et al	1999	Bt 22	
Cry3Aa8	AAS79487	Gao and Cai	2004	Bt YM-03	
Cry3Aa9	AAW05659	Bulla and Candas	2004	Bt UTD-001	
Cry3Aa10	AAU29411	Chen et al	2004	Bt 886	
Cry3Aa11	AY882576	Kurt et al	2005	Bt tenebrionis Mm2	
Cry3Ba1	X17123	Sick et al	1990	Bt tolworthi 43F	
Cry3Ba2	A07234	Peferoen et al	1990	Bt PGSI208	
Cry3Bb1	M89794	Donovan et al	1992	Bt EG4961	
Cry3Bb2	U31633	Donovan et al	1995	Bt EG5144	
Cry3Bb3	I15475	Peferoen et al	1995		
Cry3Ca1	X59797	Lambert et al	1992	Bt kurstaki BtI109P	
Cry4Aa1	Y00423	Ward & Ellar	1987	Bt israelensis	
Cry4Aa2	D00248	Sen et al	1988	Bt israelensis HD522	
Cry4Aa3	AL731825	Berry et al	2002	Bt israelensis	
Cry4A-like	DQ078744	Mahalakshmi et al	2005	Bt LDC-9	insufficient sequence
Cry4Ba1	X07423	Chungjatpornchai et al	1988	Bt israelensis 4Q2-72	
Cry4Ba2	X07082	Tungpradubkul et al	1988	Bt israelensis	
Cry4Ba3	M20242	Yamamoto et al	1988	Bt israelensis	
Cry4Ba4	D00247	Sen et al	1988	Bt israelensis HD522	
Cry4Ba5	AL731825	Berry et al	2002	Bt israelensis	

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry4Ba-like		Mahalakshmi et al	2005	Bt LDC-9	insufficient sequence
Cry5Aa1	L07025	Narva et al	1994	Bt darmstadiensis PS17	
Cry5Ab1	L07026	Narva et al	1991	Bt darmstadiensis PS17	
Cry5Ac1	I34543	Payne et al	1997		
Cry5Ad	EF219060	Lenane et al	2007		
Cry5Ba1	U19725	Foncerrada &Narva	1997	Bt PS86Q3	
Cry6Aa1	L07022	Narva et al	1993	Bt PS52A1	
Cry6Aa2	AF499736	Bai et al	2001	Bt YBT1518	
Cry6Aa3	DQ835612	Jia et al	2006	Bt 96418	
Cry6Ba1	L07024	Narva et al	1991	Bt PS69D1	
Cry7Aa1	M64478	Lambert et al	1992	Bt galleriae PGSI245	
Cry7Ab1	U04367	Payne & Fu	1994	Bt dakota HD511	
Cry7Ab2	U04368	Payne & Fu	1994	Bt kumamotoensis 867	
Cry7Ab3	BI 1015188	Song et al	2007	Bt WZ-9	
Cry7Ba1	ABB70817	Zhang et al	2006	Bt huazhongensis	
Cry7Ca1	EF486523	Gao et al	2007	Bt	
Cry8Aa1	U04364	Narva & Fu	1992	Bt kumamotoensis	
Cry8Ab1	EU044830	Cheng et al	2007	Bt B-JJX	
Cry8Ba1	U04365	Narva & Fu	1993	Bt kumamotoensis	
Cry8Bb1	AX543924	Abad et al	2002		
Cry8Bc1	AX543926	Abad et al	2002		
Cry8Ca1	U04366	Ogiwara et al.	1995	Bt japonensis Buibui	
Cry8Ca2	AAR98783	Song et al	2004	Bt HBF-1	
Cry8Da1	AB089299	Yamamoto & Asano	2002	Bt galleriae	
Cry8Da2	BD133574	Asano et al	2002	Bt	
Cry8Da3	BD133575	Asano et al	2002	Bt	
Cry8Db1	AB303980	Yamaguchi et al	2007		
Cry8Ea1	AY329081	Fuping et al	2003	Bt 185	
Cry8Ea2	EU047597	Liu et al	2007	Bt B-DLL	
Cry8Fa1	AY551093	Fuping et al	2004	Bt 185	also AAW81032
Cry8Ga1	AY590188	Fuping et al	2004	Bt HBF-18	
Cry8Ha1	EF465532	Fuping et al	2006	Bt 185	
Cry9Aa1	X58120	Smulevitch et al	1991	Bt galleriae	
Cry9Aa2	X58534	Gleave et al	1992	Bt DSIR517	
Cry9Aa like	AAQ52376	Baum et al	2003		incomplete sequence
Cry9Ba1	X75019	Shevelev et al	1993	Bt galleriae	
Cry9Bb1	AY758316	Silva-Werneck et al	2004	Bt japonensis	
Cry9Ca1	Z37527	Lambert et al	1996	Bt tolworthi	
Cry9Ca2	AAQ52375	Baum et al	2003		

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry9Da1	D85560	Asano et al	1997	Bt japonensis N141	
Cry9Da2	AF042733	Wasano & Ohba	1998	Bt japonensis	
Cry9Db1	AY971349	Flannagan et al	2005	Bt kurstaki DP1019	
Cry9Ea1	AB011496	Midoh & Oyama	1998	Bt aizawai SSK-10	
Cry9Ea2	AF358863	Li et al	2001	Bt B-Hm-16	
Cry9Ea3	EF157307	Lin et al	2006		
Cry9Eb1	AX189653	Arnaut et al	2001		
Cry9Ec1	AF093107	Wasano & Ohba	2003	Bt galleriae	
Cry9Ed1	AY973867	Flannagan et al	2005	Bt kurstaki DP1019	
Cry9 like	AF093107	Wasano et al	1998	Bt galleriae	insufficient sequence
Cry10Aa1	M12662	Thorne et al	1986	Bt israelensis	
Cry10Aa2	E00614	Aran & Toomasu	1996	Bt israelensis ONR-60A	
Cry10Aa3	AL731825	Berry et al	2002	Bt israelensis	
Cry10A like	DQ167578	Mahalakshmi et al	2006	Bt LDC-9	incomplete sequence
Cry11Aa1	M31737	Donovan et al	1988	Bt israelensis	
Cry11Aa2	M22860	Adams et al	1989	Bt israelensis	
Cry11Aa3	AL731825	Berry et al	2002	Bt israelensis	
Cry11Aa-like	DQ166531	Mahalakshmi et al	2007	Bt LDC-9	
Cry11Ba1	X86902	Delecluse et al	1995	Bt jegathesan 367	
Cry11Bb1	AF017416	Orduz et al	1998	Bt medellin	
Cry12Aa1	L07027	Narva et al	1991	Bt PS33F2	
Cry13Aa1	L07023	Narva et al	1992	Bt PS63B	
Cry14Aa1	U13955	Narva et al	1994	Bt sotto PS80JJ1	
Cry15Aa1	M76442	Brown & Whiteley	1992	Bt thompsoni	
Cry16Aa1	X94146	Barloy et al	1996	Cb malaysia CH18	
Cry17Aa1	X99478	Barloy et al	1998	Cb malaysia CH18	
Cry18Aa1	X99049	Zhang et al	1997	Paenibacillus popilliae	
Cry18Ba1	AF169250	Patel et al	1999	Paenibacillus popilliae	
Cry18Ca1	AF169251	Patel et al	1999	Paenibacillus popilliae	
Cry19Aa1	Y07603	Rosso & Delecluse	1996	Bt jegathesan 367	
Cry19Ba1	D88381	Hwang et al	1998	Bt higo	
Cry20Aa1	U82518	Lee & Gill	1997	Bt fukuokaensis	
Cry21Aa1	I32932	Payne et al	1996		
Cry21Aa2	I66477	Feitelson	1997		
Cry21Ba1	AB088406	Sato & Asano	2002	Bt roskildiensis	
Cry22Aa1	I34547	Payne et al	1997		
Cry22Aa2	AX472772	Isaac et al	2002	Bt	
Cry22Ab1	AAK50456	Baum et al	2000	Bt EG4140	
Cry22Ab2	AX472764	Isaac et al	2002	Bt	

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry22Ba1	AX472770	Isaac et al	2002	Bt	
Cry23Aa1	AAF76375	Donovan et al	2000	Bt	Binary with Cry37Aa1
Cry24Aa1	U88188	Kawalek and Gill	1998	Bt jegathesan	
Cry24Ba1	BAD32657	Ohgushi et al	2004	Bt sotto	
Cry24Ca1	AM158318	Beron et al	2005		
Cry25Aa1	U88189	Kawalek and Gill	1998	Bt jegathesan	
Cry26Aa1	AF122897	Wojciechowska et al	1999	Bt finitimus B-1166	
Cry27Aa1	AB023293	Saitoh	1999	Bt higo	
Cry28Aa1	AF132928	Wojciechowska et al	1999	Bt finitimus B-1161	
Cry28Aa2	AF285775	Moore and Debro	2000	Bt finitimus	
Cry29Aa1	AJ251977	Delecluse et al	2000		
Cry30Aa1	AJ251978	Delecluse et al	2000		
Cry30Ba1	BAD00052	Ikeya et al	2003	Bt entomocidus	
Cry30Ca1	BAD67157	Ohgushi et al	2004	Bt sotto	
Cry30Da1	EF095955	Shu et al	2006	Bt Y41	
Cry31Aa1	AB031065	Mizuki et al	2000	Bt 84-HS-1-11	
Cry31Aa2	AY081052	Jung and Cote	2000	Bt	
Cry31Aa3	AB250922	Uemori et al	2006	Bt B0195	
Cry31Aa4	AB274826	Yasutake et al	2006	Bt 79-25	
Cry31Aa5	AB274827	Yasutake et al	2006	Bt 92-10	
Cry31Ab1	AB250923	Uemori et al	2006	Bt B0195	
Cry31Ab2	AB274825	Yasutake et al	2006	Bt 31-5	
Cry31Ac1	AB276125	Yasutake et al	2006	Bt 87-29	
Cry32Aa1	AY008143	Balasubramanian et al	2001	Bt yunnanensis	
Cry32Ba1	BAB78601	Takebe et al	2001	Bt	
Cry32Ca1	BAB78602	Takebe et al	2001	Bt	
Cry32Da1	BAB78603	Takebe et al	2001	Bt	
Cry33Aa1	AAL26871	Kim et al	2001	Bt dakota	
Cry34Aa1	AAG50341	Ellis et al	2001	Bt PS80JJ1	Binary with Cry35Aa1
Cry34Aa2	AAK64560	Rupar et al	2001	Bt EG5899	Binary with Cry35Aa2
Cry34Aa3	AY536899	Schnepf et al	2004	Bt PS69Q	Binary with Cry35Aa3
Cry34Aa4	AY536897	Schnepf et al	2004	Bt PS185GG	Binary with Cry35Aa4
Cry34Ab1	AAG41671	Moellenbeck et al	2001	Bt PS149B1	Binary with Cry35Ab1
Cry34Ac1	AAG50118	Ellis et al	2001	Bt PS167H2	Binary with Cry35Ac1
Cry34Ac2	AAK64562	Rupar et al	2001	Bt EG9444	Binary with Cry35Ab2
Cry34Ac3	AY536896	Schnepf et al	2004	Bt KR1369	Binary with Cry35Ab3
Cry34Ba1	AAK64565	Rupar et al	2001	Bt EG4851	Binary with Cry35Ba1
Cry34Ba2	AY536900	Schnepf et al	2004	Bt PS201L3	Binary with Cry35Ba2
Cry34Ba3	AY536898	Schnepf et al	2004	Bt PS201HH2	Binary with Cry35Ba3
Cry35Aa1	AAG50342	Ellis et al	2001	Bt PS80JJ1	Binary with Cry34Aa1

Name	Acc No.	Authors	Year	Source Strain	Comment
Cry35Aa2	AAK64561	Rupar et al	2001	Bt EG5899	Binary with Cry34Aa2
Cry35Aa3	AY536895	Schnepf et al	2004	Bt PS69Q	Binary with Cry34Aa3
Cry35Aa4	AY536892	Schnepf et al	2004	Bt PS185GG	Binary with Cry34Aa4
Cry35Ab1	AAG41672	Moellenbeck et al	2001	Bt PS149B1	Binary with Cry34Ab1
Cry35Ab2	AAK64563	Rupar et al	2001	Bt EG9444	Binary with Cry34Ac2
Cry35Ab3	AY536891	Schnepf et al	2004	Bt KR1369	Binary with Cry34Ab3
Cry35Ac1	AAG50117	Ellis et al	2001	Bt PS167H2	Binary with Cry34Ac1
Cry35Ba1	AAK64566	Rupar et al	2001	Bt EG4851	Binary with Cry34Ba1
Cry35Ba2	AY536894	Schnepf et al	2004	Bt PS201L3	Binary with Cry34Ba2
Cry35Ba3	AY536893	Schnepf et al	2004	Bt PS201HH2	Binary with Cry34Ba3
Cry36Aa1	AAK64558	Rupar et al	2001	Bt	
Cry37Aa1	AAF76376	Donovan et al	2000	Bt	Binary with Cry23Aa
Cry38Aa1	AAK64559	Rupar et al	2000	Bt	
Cry39Aa1	BAB72016	Ito et al	2001	Bt aizawai	
Cry40Aa1	BAB72018	Ito et al	2001	Bt aizawai	
Cry40Ba1	BAC77648	Ito et al	2003	Bun1-14	
Cry41Aa1	AB116649	Yamashita et al	2003	Bt A1462	
Cry41Ab1	AB116651	Yamashita et al	2003	Bt A1462	
Cry42Aa1	AB116652	Yamashita et al	2003	Bt A1462	
Cry43Aa1	AB115422	Yokoyama and Tanaka	2003	P. lentimorbus semadara	
Cry43Aa2	AB176668	Nozawa	2004	P. popilliae popilliae	
Cry43Ba1	AB115422	Yokoyama and Tanaka	2003	P. lentimorbus semadara	
Cry43-like	AB115422	Yokoyama and Tanaka	2003	P. lentimorbus semadara	
Cry44Aa	BAD08532	Ikeya et al	2004	Bt entomocidus INA288	
Cry45Aa	BAD22577	Okumura and Saitoh	2004	Bt 89-T-34-22	
Cry46Aa	BAC79010	Ito et al	2004	Bt dakota	
Cry46Ab	BAD35170	Yamagiwa et al	2004	Bt	
Cry47Aa	AY950229	Kongsuwan et al	2005	Bt CAA890	
Cry48Aa	AJ841948	Berry et al	2005	B sphaericus	No link binary with 49Aa
Cry48Aa2	AM237205	Berry et al	2006	B sphaericus	No link binary with 49Aa2
Cry48Aa3	AM237206	Berry et al	2006	B sphaericus	No link binary with 49Aa3
Cry48Ab	AM237207	Berry et al	2006	B sphaericus	No link binary with 49Ab1
Cry48Ab2	AM237208	Berry et al	2006	B sphaericus	No link binary with 49Aa4
Cry49Aa	AJ841948	Berry et al	2005	B sphaericus	No link binary with 48Aa
Cry49Aa2	AM237201	Berry et al	2006	B sphaericus	No link binary with

Name	Acc No.	Authors	Year	Source Strain	Comment
					48Aa2
Cry49Aa3	AM237203	Berry et al	2006	B sphaericus	No link binary with 48Aa3
Cry49Aa4	AM237204	Berry et al	2006	B sphaericus	No link binary with 48Ab2
Cry49Ab1	AM237202	Berry et al	2006	B sphaericus	No link binary with 48Ab1
Cry50Aa	AB253419	Ohgushi et al	2006	Bt sotto	
Cry51Aa	DQ836184	Meng et al	2006	Bt F14-1	
Cry52Aa	EF613489	Song et al	2007	Bt Y41	
Cry53Aa	EF633476	Song et al	2007	Bt Y41	
Cyt1Aa1	X03182	Waalwijk et al	1985	Bt israelensis	
Cyt1Aa2	X04338	Ward & Ellar	1986	Bt israelensis	
Cyt1Aa3	Y00135	Earp & Ellar	1987	Bt morrisoni PG14	
Cyt1Aa4	M35968	Galjart et al	1987	Bt morrisoni PG14	
Cyt1Aa5	AL731825	Berry et al	2002	Bt israelensis	
Cyt1Aa6	ABC17640	Zhang et al	2005	Bt LLP29	
Cyt1Aa-like	ABB01172	Mahalakshmi	2007	Bt LDC-9	
Cyt1Ab1	X98793	Thiery et al	1997	Bt medellin	
Cyt1Ba1	U37196	Payne et al	1995	Bt neoleoensis	
Cyt1Ca1	AL731825	Berry et al	2002	Bt israelensis	unusual hybrid
Cyt2Aa1	Z14147	Koni & Ellar	1993	Bt kyushuensis	
Cyt2Aa2	AF472606	Promdonkoy & Panyim	2001	Bt darmstadiensis73E10	
Cyt2Ba1	U52043	Guerchicoff et al	1997	Bt israelensis 4Q2	
Cyt2Ba2	AF020789	Guerchicoff et al	1997	Bt israelensis PG14	
Cyt2Ba3	AF022884	Guerchicoff et al	1997	Bt fuokukaensis	
Cyt2Ba4	AF022885	Guerchicoff et al	1997	Bt morrisoni HD12	
Cyt2Ba5	AF022886	Guerchicoff et al	1997	Bt morrisoni HD518	
Cyt2Ba6	AF034926	Guerchicoff et al	1997	Bt tenebrionis	
Cyt2Ba7	AF215645	Yu & Pang	2000	Bt T301	
Cyt2Ba8	AF215646	Yu & Pang	2000	Bt T36	
Cyt2Ba9	AL731825	Berry et al	2002	Bt israelensis	
Cyt2Ba-like	ABE99695	Mahalakshmi et al	2007	Bt LDC-9	
Cyt2Bb1	U82519	Cheong & Gill	1997	Bt jegathesan	
Cyt2Bc1	CAC80987	Delecluse et al	1999	Bt medellin	
Cyt2B-like	DQ341380	Zhang et al	2005		
Cyt2Ca1	AAK50455	Baum et al	2001	Bt	

B List of *Bacillus thuringiensis* Holotype Toxins[45]

	Name	Old Name	NCBI	Swiss Prot
1	Cry1Aa	CryIA(a)	AAA22353	P02965
2	Cry1Ab	CryIA(b)	AAA22330	P06578
3	Cry1Ac	CryIA(c)	AAA22331	P05068
4	Cry1Ad	CryIA(d)	AAA22340	Q03744
5	Cry1Ae	CryIA(e)	AAA22410	Q03748
6	Cry1Af		AAB82749	P96315
7	Cry1Ag		AAD46137	Q9S515
8	Cry1Ah		AF281866	
9	Cry1Ai		AY174873	
10	Cry1Ba	CryIB	CAA29898	P05517
11	Cry1Bb	ET5	AAA22344	Q45739
12	Cry1Bc	PEG5	CAA86568	Q45774
13	Cry1Bd	CryE1	AAD10292	Q9ZAZ5
14	Cry1Be		AAC32850	O85805
15	Cry1Bf		CAC50778	
16	Cry1Bg		AY176063	
17	Cry1Ca	CryIC	CAA30396	P05518
18	Cry1Cb	CryIC(b)	M97880	P56953
19	Cry1Da	CryID	CAA38099	P19415
20	Cry1Db	PrtB	CAA80234	Q45747
21	Cry1Dc		EF059913	
22	Cry1Ea	CryIE	CAA37933	Q57458
23	Cry1Eb	CryIE(b)	AAA22346	Q03745
24	Cry1Fa	CryIF	AAA22348	Q03746
25	Cry1Fb	PrtD	CAA80235	O66377
26	Cry1Ga	PrtA	CAA80233	Q45746
27	Cry1Gb	CryH2	AAD10291	Q9ZAZ6
28	Cry1Gc		AAQ52381	
29	Cry1Ha	PrtC	CAA80236	Q45748
30	Cry1Hb		AAA79694	Q45718
31	Cry1Ia	CryV	CAA44633	Q45752
32	Cry1Ib	CryV	AAA82114	Q45709
33	Cry1Ic		AAC62933	O87404
34	Cry1Id		AAD44366	Q9XDL1
35	Cry1Ie		AAG43526	

[45] Crickmore, N., Zeigler, D.R., Schnepf, E., Van Rie, J., Lereclus, D., Baum, J, Bravo, A. and Dean, D.H. "*Bacillus thuringiensis* toxin nomenclature" (2007) http://www.lifesci.sussex.ac.uk/Home/Neil_Crickmore/Bt/

	Name	Old Name	NCBI	Swiss Prot
36	Cry1If		AAQ52382	
37	Cry1Ja	ET4	AAA22341	Q45738
38	Cry1Jb	ET1	AAA98959	Q45716
39	Cry1Jc		AAC31092	
40	Cry1Jd		CAC50779	
41	Cry1Ka		AAB00376	Q45715
42	Cry1La		AAS60191	
43	Cry2Aa	CryIIA	M31738	P21253
44	Cry2Ab	CryIIB	M23724	P21254
45	Cry2Ac	CryIIC	X57252	Q45743
46	Cry2Ad		AF200816	Q9RMG3
47	Cry2Ae		AAQ52362	
48	Cry2Af		EF439818	
49	Cry3Aa	CryIIIA	M22472	P07130
50	Cry3Ba	CryIIIB	X17123	P17969
51	Cry3Bb	CryIIIBb	M89794	Q06117
52	Cry3Ca	CryIIID	X59797	Q45744
53	Cry4Aa	CryIVA	Y00423	P16480
54	Cry4Ba	CryIVB	X07423	P05519
55	Cry5Aa	CryVA(a)	L07025	Q45760
56	Cry5Ab	CryVA(b)	L07026	Q45753
57	Cry5Ac		I34543	P56955
58	Cry5Ad		EF219060	
59	Cry5Ba		U19725	Q45712
60	Cry6Aa	CryVIA	L07022	Q45757
61	Cry6Ba	CryVIB	L07024	Q45758
62	Cry7Aa	CryIIIC	M64478	Q03749
63	Cry7Ab	CryIIICb	U04367	Q45707
64	Cry7Ba1		ABB70817	
65	Cry7Ca1		EF486523	
66	Cry8Aa	CryIIIE	U04364	Q45704
67	Cry8Ab		EU044830	
68	Cry8Ba	CryIIIG	U04365	Q45705
69	Cry8Bb		CAD57542	
70	Cry8Bc		CAD57543	
71	Cry8Ca	CryIIIF	U04366	Q45706
72	Cry8Da		BAC07226	
73	Cry8Db		AB303980	
74	Cry8Ea		AY329081	
75	Cry8Fa		AY551093	

	Name	Old Name	NCBI	Swiss Prot
76	Cry8Ga		AY590188	
77	Cry8Ha		EF465532	
78	Cry9Aa	CryIG	X58120	Q99031
79	Cry9Ba	CryIX	X75019	
80	Cry9Bb		AAV28716	
81	Cry9Ca	CryIH	Z37527	Q45733
82	Cry9Da		D85560	O06014
83	Cry9Db		AY971349	
84	Cry9Ea		AB011496	Q9ZNL9
85	Cry9Eb		AX189653	
86	Cry9Ec		AAC63366	
87	Cry9Ed		AY973867	
88	Cry10Aa	CryIVC	M12662	P09662
89	Cry11Aa	CryIVD	M31737	P21256
90	Cry11Ba	Jeg80	X86902	Q45730
91	Cry11Bb		AF017416	Q9ZIU5
92	Cry12Aa	CryVB	L07027	Q45754
93	Cry13Aa	CryVC	L07023	Q45755
94	Cry14Aa	CryVD	U13955	Q45710
95	Cry15Aa	34kDa	M76442	Q45729
96	Cry16Aa	cbm71	X94146	Q45882
97	Cry17Aa	cbm72	X99478	O05102
98	Cry18Aa	CryBP1	X99049	Q45358
99	Cry18Ba		AF169250	P57091
100	Cry18Ca		AF169251	P57092
101	Cry19Aa	Jeg65	Y07603	O32307
102	Cry19Ba		D88381	O86170
103	Cry20Aa		U82518	O32321
104	Cry21Aa		I32932	P56956
105	Cry21Ba		BAC06484	
106	Cry22Aa		I34547	P56957
107	Cry22Ab		AAK50456	
108	Cry22Ba		CAD43578	
109	Cry23Aa		AF038048	
110	Cry24Aa	Jeg72	U88188	O87905
111	Cry24Ba		BAD32657	
112	Cry24Ca1		AM158318	
113	Cry25Aa	Jeg74	U88189	O87906
114	Cry26Aa		AF122897	Q9X597
115	Cry27Aa		AB023293	Q9S597

	Name	Old Name	NCBI	Swiss Prot
116	Cry28Aa		AF132928	Q9X682
117	Cry29Aa		AJ251977	
118	Cry30Aa		AJ251978	
119	Cry30Ba		BAD00052	
120	Cry30Ca		BAD67517	
121	Cry30Da		EF095955	
122	Cry31Aa		AB031065	
123	Cry31Ab		BAE79809	
124	Cry31Ac		BAF34368	
125	Cry32Aa		AY008143	
126	Cry32Ba	CryE6L	BAB78601	
127	Cry32Ca	CryE6Q	BAB78602	
128	Cry32Da	CryE6S	BAB78603	
129	Cry33Aa		AAL26871	
130	Cry34Aa		AAG50341	
131	Cry34Ab		AAG41671	
132	Cry34Ac		AAG50118	
133	Cry34Ba		AAK64565	
134	Cry35Aa		AAG50342	
135	Cry35Ab		AAG41672	
136	Cry35Ac		AAG50117	
137	Cry35Ba		AAK64566	
138	Cry36Aa		AAK64558	
139	Cry37Aa		AAF76376	
140	Cry38Aa		AAK64559	
141	Cry39Aa		BAB72016	
142	Cry40Aa		BAB72018	
143	Cry40Ba		BAC77648	
144	Cry41Aa		AB116649	
145	Cry41Ab		AB116651	
146	Cry42Aa		AB116652	
147	Cry43Aa		AB115422	
148	Cry43Ba		AB115422	
149	Cry44Aa		BAD08532	
150	Cry45Aa		BAD22577	
151	Cry46Aa		BAC79010	
152	Cry46Ab		BAD35170	
153	Cry47Aa		AY950229	
154	Cry48Aa	p135	CAJ18351	
155	Cry48Ab		AM237207	

	Name	Old Name	NCBI	Swiss Prot
156	Cry49Aa	p49	CAH56541	
157	Cry49Ab		AM237202	
158	Cry50Aa		BAE86999	
159	Cry51Aa		DQ836184	
160	Cry52Aa		EF613489	
161	Cry53Aa		EF633476	
162	Cyt1Aa	CytA	X03182	P05069
163	Cyt1Ab	CytM	X98793	P94594
164	Cyt1Ba		U37196	Q45790
165	Cyt1Ca		CAD30104	
166	Cyt2Aa	CytB	Z14147	Q04470
167	Cyt2Ba	"CytB"	U52043	Q45723
168	Cyt2Bb		U82519	O32322
169	Cyt2Bc	CytMed	CAC80987	
170	Cyt2Ca		AAK50455	

APPENDIX B: Description of Patent Databases Used

(Databases used in this report)

Database Name	General Information
USPTO	• Patents issued from 1790 through 1975 are searchable only by patent number, issue date, and current U.S. classifications. • US Patent Classification data in the Full-Text Database (*Current US Classification [CCL]*) is frequently updated to reflect the most current PTO Master Classification File (MCF), and will not necessarily match the classification data which appears on the patent full-page images (i.e., the printed patent) or on the Patent Classification pages. • The Issued Patents Full-Text Database is a database of patent full-text *as it was printed on the patent on the day of issue.* Changes to patent documents contained in Certificates of Correction and Re-examinations Certificates are not included in the searchable full-text of the patent databases, but are available as additional full-page images at the end of each patent's linked full-page images. • Neither assignment changes nor address changes recorded at the USPTO are reflected in the patent full-text or the patent full-page images. • These databases have limited resources, both bandwidth and computer systems. Therefore, to assure availability to the general public, searches are limited in terms of both the length of the query and the amount of computer time available for any single search. In particular, if the fully-expanded parsed query, which can be estimated by looking at a resulting hit-list link using your browser's Right-click-Properties capability, exceeds 256 characters in length, the query may be rejected by the parser, may time out before completion, or may produce invalid results even though it appears to have worked correctly. • The fact that an invention cannot be found by searching in the Patent Full-Text Database does not mean that the invention is patentable. The USPTO's text-searchable patent database begins with patents granted since 1976. A complete patentability search must consider all prior art, including earlier patents, foreign patents and non-patent literature.

www.uspto.gov

Database Name	General Information
GenomeQuest	• GenomeQuest is a web based sequence searching system designed for scientists and intellectual property (IP) bio-analysts. GenomeQuest allows investigators to quickly identify and investigate relevant records, create reports on select records of interest, and maintain continuous sequence surveillance. • Sources for GenomeQuest: 1. USPTO: Data fetched daily; complete coverage starting from 1980 onward. 2. EPO feeds/INPADOC: Data fetched weekly. Patent sequences from 1979 onward 3. WIPO & PCT: Data fetched weekly. Electronic and paper submissions. Patent sequences from 1980 onwards. 4. GenBank, DDJB, EMBL: Weekly updates patent divisions. Patent

	sequences from 1969 onwards. • GenomeQuest GQ-PAT repository has 137 million total sequences, among which 67 million are unique patent number-sequence pairs spanning 179, 083 patent documents. GenBank patent division contains 3.7 million sequences, about 5% of the sequences contained in GQ-PAT. • GenomeQuest GQ-PAT database is processed using GenomeQuest's proprietary pipeline which include manual curation to make all the sequences and annotations searchable and browseable. • GenomeQuest offers a single repository for search result analysis with powerful filtering, grouping, and sorting capabilities giving the ability to generate reports quickly and easily with only the relevant information. • GenomeQuest allows the searching of other databases within the application. **GenePAST** • GenePast identifies subject sequences within a given percent identity. This search is used to strictly look for the percent identity of one sequence against another. GenePAST is an approximate string-matching, global best-fit algorithm that optimizes the global percent identity between two sequences. It works by finding the minimum number of edits (insertions / deletions / substitutions) required to transform one sequence into the other, ultimately leading to the best fit of the smallest sequence into the longer one. There is no substitution matrix, no additional penalties for opening or extending gaps, and there is no statistical measure of the biological likeliness of the match occurring by chance. The alignment that GenePAST finds is guaranteed to be the largest alignment between two sequences that meets or exceeds a certain percent identity threshold. This is useful when filing patents that claim a sequence and a set of other sequences, that are 80% identical or more. Where BLAST will provide a shorter alignment of high homology, GenePAST will provide a longer alignment of perhaps lower identity (but exceeding the desired minimum threshold). Unlike the traditional approaches where the percent ID is only computed relative to an alignment, GenePAST allows to specify percentage identities on the sequence itself. **GeneBLAST** • A heuristic method of searching long sequences based on biological similarity and provides a shorter alignment of high homology. More limiting than GenePAST.

www.genomequestlive.com

Database name	General Information
Questel-Orbit	FamPat is the family design database of PlusPat and represents a significant breakthrough in patent family databases offering greater searching options as well as the added display convenience of family records, making FamPat easier to use than PlusPat. • 50+ million documents from over 75 worldwide patenting authorities, with major country coverage dating from the early 20th century • 17+ million abstracts summarizing inventions (12+ million in English), 9+ million patent drawings • Key content: - object of invention - advantages, drawbacks of previous inventions - independent claims

	• Updated European and U.S. classifications, and new Reformed IPC • Citations for DE, EP, FR, GB, JP, PCT, US and more available soon • Legal Status **Full Text Coverage** • PCT, US, EP, France, German, United Kingdom **Dynamic Toolbar for Each Result** • No duplicate records • Drawings in mosaic view • Order PDF copies of patents • View family and family number details including corresponding full text • Color-coded legal status information • Visualize citation relationships **ANALYZE, VISUALIZE SEARCH REPORTS** • Visualize and analyze citation relationships • Comprehensive family report • Legal status reports with coverage back to the 1970s • Family citation reports

www.qpat.com

Database name	General Information
ESP@CENET	The worldwide database enables one to search for information about published patent applications from over 80 different countries and regions. It is based on the PCT minimum documentation , which is defined by WIPO as the minimum requirement for patent collections used to search for prior-art documents for the purpose of assessing novelty and inventiveness. The EPO has expanded the coverage of its internal database far beyond the PCT minimum documentation to include data from other countries and other time periods. Moreover, additional information, such as ECLA symbols and references to cited documents, is added to other fields by examiners in the course of their work. Abstracts of non-examined Japanese patent applications filed by Japanese applicants since October 1976 and all patent applications filed since 1998 which do not have a Japanese priority are available in the worldwide database since January 2005. Due to the translation process from Japanese into English, these abstracts are not available until six months after publication. In March 2007, *esp@cenet®* held data on 60 million patents from 81 countries. A total of 30.5 million of these patents have a title, while 29.5 million have an ECLA class and 19.5 million an abstract in English. Number of terms used in each search string is limited The following table gives an overview of the availability of the PCT minimum documentation in the worldwide database:

Country	Facsimiles from	Abstracts from	European Classification
CH	1888, from CH1 onwards	1970	1888
DE	1877, from DE1 onwards	1970	1877, from DE1 onwards
EP	1978, from EP1 onwards	1978	1978
FR	1900	1970	1902
GB	1859	1893	1859
US	1836, from US1 onwards	1970	1836, from US1 onwards
WO	1978	1978	1978

www.espacenet.com

Database name	General Information
Dialog	DialogClassic Web is designed for information professionals who want to use the sophisticated search capabilities offered by Dialog Command Language with the added versatility of a Web-based environment. All DialogClassic Web features are browser-based, eliminating the need to install software. **Features** • Take shortcuts with a new graphical interface with menu icons for common tasks Create and edit a search strategy before running it with the new Type-ahead buffer Use new mark-and-copy features and EDITOR window to easily cut and paste portions of your search results into a single document Save search results and MARKED TEXT in new formats, including Word, HTML, Text and Adobe Acrobat® PDF • Enter command statements up to 2,000 characters long • View Bluesheets and other reference materials in the new Databases pane • Navigate easily back to a specific place your search session by using the new Session navigation pane • Click previous commands and click new "Send to buffer" icon to save time re-entering commands • Link to fulltext journal articles and other documents using Dialog eLinks, including document images for D&B® Company Reports, NTIS Technical Reports, and Investext® Broker/Analyst Reports • Set up and edit Alerts with a fill-in-the-blanks form • Try new form-based interfaces to certain commands: EDIT ADDR, EDIT PROFILE, SAVE ALERT, XSLT • Save search results temporarily on the Dialog service and retrieve later via a direct hyperlink • Load saved search strategies from a file on your computer • Display in-line images in .PNG format (patents, trademarks and chemical

	structures) Output data in XML, HTML, RTF (Rich Text Format) and TEXT using new commands for generating data in formats easy to integrate into other applications Create attractive reports from your search results using the advanced formatting features available via the Editor Tab

www.dialogclassic.com

Database name	General Information
Derwent World Patent Index	• Most comprehensive database of international patent information • Approximately 19,000 patent documents from over 40 patent-issuing authorities are reviewed and value enhanced by experts • Documents are read in their native language. Titles and abstracts are then rewritten in English to create a DWPI record • Included in the record is the drawing from the patent that is most representative of its claims and special indexing to help search for key patent information. • Can be accessed via Dialog or Delphion

www.dialogclassic.com or **www.delphion.com**

Database name	General Information
Westlaw	• Westlaw, which is owned by the Thompson Company, and can be accessed at is a premium access database that is useful for patent law practitioners. It provides access to the Derwent World Patent Index as well as relevant sources, including cases and statutes, patents and patent treatises, and post-issuance information, such as KeyCite for patents. • The value added services from Westlaw can be accessed off the "Patent Practitioner" tab of the user's account after login. This tab includes links to facilitate research in patent literature, cases, statutes, and regulations, court records and litigation tracking. It also provides information on recent developments, litigation practice guides, prosecution practice guides, and forms. • Includes a link to Delphion that includes access to the full text of US, European, and PCT patents and patent applications, and the patent abstracts from Japan • Includes the ability to search full-text patents and a link to display the full original patent, including drawings in PDF • The Westlaw database contains full-text information of patents before 1972, whereas other services just have bibliographic information • Links to Derwent databases, including the World Patent Index • Citing references provide relevant previous patent literarture • Flexible pricing plans (i.e., large company or single attorney) • A link to "KeyCites" that covers all patents granted by the USPTO beginning with 1976 utility, design, and plant patents 1. This link also includes access to reissued patents, defensive publications, and statutory invention registrations 2. Can click on the flag on the document or result list or click "Full History" or "Citing References" links on the "Links" tab to retrieve KeyCite information for the patent Disadvantages: • Using certain truncations and connectors is difficult when using the Westlaw database • Hybrid searches often generate a large number of irrelevant results • Citing references are U.S. only

	• Data manipulation is less user-friendly in Westlaw than Dialog or Questel/Orbit • No patent landscaping tools are available

www.westlaw.com

Database name: WIPO	Availability based on International Filing Date Due to changes in the PCT Regulations and to the availability of documents in electronic form, the information available is different depending on the date of filing of the international application	Notes This service provides access to published PCT international applications and to the latest bibliographic data and documents contained in the files of PCT international applications.
Document /Data Type		
Published bibliographic data	1978 to present	
Published PCT international applications in image format.	1978 to present	
Latest bibliographic data available to the International Bureau (including changes since publication).	July 1998 to present	
Text of description and claims for applications published in English, French, German or Spanish.	1978 to present	
Priority documents	January 2001 to present	
Declarations (PCT Rule 4.17)	March 2001 to present	
International Preliminary Examination Report (IPER) - English Translation of the IPER	January 2002 to December 2003	Documents are only available after 30 months from the first priority date and if at least one elected Office has requested the International Bureau to make these documents available on its behalf under PCT Rule 94.1(c).
- Written Opinion of the International Search Authority (WO-ISA) - International Preliminary Report on Patentability: Chapter I (IPRP Chapter I) - English Translation of the WO-ISA and English Translation of the IPRP Chapter I	January 2004 to present	Documents are only available after 30 months from the first priority date.
- International Preliminary Report on Patentability: Chapter II (IPRP Chapter II) - English Translation of the IPRP Chapter II	January 2004 to present	Documents are only available after 30 months from the first priority date and if at least one elected Office has requested the International Bureau to make these documents available on its behalf under PCT Rule 94.1(c).
Form PCT/IB/304 – Notification -Concerning Submission or Transmittal of Priority Document	January 2006 to present	

Form PCT/IB/306 – Notification of the Recording of a Change		
PCT National Phase Data	Depending on Office	

www.wipo.int

Database name	General Information
LexisNexis	• Is a premium and user-friendly website that offers point and click access to prior art (or "patent searching") information: both patent and non-patent literature. Patent prior art information includes primary legal materials, analytical legal materials, indices to foreign patents, European patents (and classifications), and treatises. Furthermore, Lexis gives the patent researcher access to INPADOC patent families. Non-patent prior art information includes industry and news sources. • User-friendly website design with point and click retrieval of patent and non-patent prior art literature • FOCUS feature that allows the patent informatics specialist to restrict his search parameters for specific terms…the results are a subset of the original search results, but they are more relevant to your research needs • Alert feature: can elect to have Lexis alert you for events including post-issuance court decisions affecting patent status • Database is international in scope • Shepard's, like KeyCite in Westlaw, provides post-issuance patent information, including status changes, litigation notices, re-exam requests, and patent expirations • 24 hour reference staff is available • A history trail of searches is available Disadvantages of Database: • Shepard's does not provide updated information on patents, it only reports court decisions • No mapping and analysis tools on Lexis-Nexis • Premium database: will add to the client's bill. (Client bill can be mitigated through use of history trail and knowledge of efficient search techniques, including effective use of Boolean operators, truncations, and FOCUS)

www.lexisnexis.com

Database name	General Information
Micropatent Aureka	• With Aureka, you can search the full text of thousands of granted • patents and published applications from the US, DE, EP, FR, GB, JP (abstracts • only), and PCT authorities. You can also search non-patent or corporate data you • may have stored on your Aureka domain. Aureka's unique searching features include: • User-friendly interface • Customized display of search results • Viewing of patent images with rotation, zoom, and print capabilities • Importing of sharable corporate documents, such as white papers, news articles, and third-party data • Sub-searching of your collection to define the size and scope of sub-themes • Power browsing through your list to make selections Aureka's suite of visualization tools provides much-needed organization and advanced analysis for all your critical IP information.

1. **Vivismo: Effective Clustering**

Aureka's Vivisimo is a combination organization and analysis tool that analyzes text and sorts documents into groups or clusters based on common terms and phrases. With Vivisimo, you can:

- View concepts within your document set categorized into meaningful, hierarchically-sorted folders
- Find information faster
- Drill down within a list to see subtopics related to a particular technology
- Uncover results that otherwise might remain buried

2. **Themescape: Patent Mapping**

With the click of a button, ThemeScape gives you a big-picture view of the technology landscape, transforming a complex set of documents into a visually-appealing landscape according to the prominent themes and concepts in the records. With Themescape, you can:

- Parse documents and analyze statistically
- what key terms or topics those records have in common
- Visually portray themes on a contour map, identifying predominant concepts and their relationship to one another
- Identify where your patents stand in relation to those of your competitors, pinpointing areas of opportunity and risk

3. **Citation Analysis:**

Advanced Patent Analysis

Citation Analysis with hyperbolic citation trees visually depicts all referencing and referenced patents to a source document in an interactive diagram that illustrates the history and expansion of a technology.

With citation analysis, you can:

- Determine the citations in the patents of interest and assess technology trends
- in a technical area
- Find the roots of a technology and see its developmental directions
- See where competitors are threatening your technologies and where you have sufficiently insulated your IP from outside influence

4. **Aureka's Directory Tree electronically:**

- Stores IP project information in your own online repository, so you can easily and securely collaborate with Team members.
- Authorized users may annotate patents, lists, folders, clusters, citation trees, and maps. Other project members can then review and respond, efficiently communicating with one another.
- With Aureka's reporting features, you can create detailed company profiles, gather and decipher competitive and technical intelligence, compare portfolio analyses for mergers and acquisitions, and determine marketplace importance.
- There are five report categories from which to choose: assignees, inventors, patent classes, citations, and a general category.
- You can review the top categories using Aureka's Basic reports, or get reports on the full data set using standard reports.
- There is also an export option that enables users to analyze data in Microsoft Excel using user defined pivot tables and graphs or with the Aureka Add-in macro set.

www.micropat.com

Database name	General Information
Delphion	Delphion gives patent collections & searching options inside the world's important patent databases. Sources: • United States Patents — Applications (US) • United States Patents — Granted (US) • Derwent World Patents Index (DWPI) • European Patents — Applications (EP-A) • European Patents — Granted (EP-B) • German Patents — Applications • German Patents — Granted • INPADOC Family and Legal Status • Patent Abstracts of Japan (JP) • Switzerland (CH) • WIPO PCT Publications (WO) Delphion analytical tools give different insights into data: • Citation Link creates graphical maps of forward and backward references • Snapshot allows quick online analysis of your results using bar charts • PatentLab-II supports offline analysis of results with 3D graphs and charts • Clustering performs keyword-based linguistic analysis • Corporate Tree facilitates targeted Assignee name searching The productivity tools help make the most of research efforts: • Data Extract exports key bibliographic fields in common formats • Work Files save, organize, annotate and share personalized lists of patents • Saved Searches saves queries for frequently-used searches • Alerts automatically notifies you of updates • PDF Express bulk downloads of up to 500 PDFs • Patent viewing options include the Delphion Integrated View, both high-resolution and low-resolution image options, and a variety of download and delivery options.

www.delphion.com

Database name	General Information
INDECOPI	• INDECOPI is Peru's National Institute for the Defense of Competition and the Protection of Intellectual Property. • INDECOPI provides a free online service giving the public access to Peru's patent database for searching. • Presently, the Peruvian Patent Office provides only electronic abstracts to a limited number of patents so thorough patent searching requires the assistance of a Peruvian Patent Attorney. • Can search for issued patents using title names only. • Can search for patent applications using application numbers only.

www.indecopi.gob

Database name	General Information
OAPI	• The African Intellectual Property Organization is a central registration system for the French speaking African Status. The member states are: Benin, Burkina, Faso, Cameroon, Central African Republic, Chad, Republic of Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Senegal, Togo. • OAPI partners include: World Intellectual Property Organization (WIPO), European Patent Office (EPO), Austrian Patent Office, German Patent Office, African Regional Intellectual Property Organization (ARIPO), National Institute of Industrial Property (INPI), African Regional Center of Technology (CRAT), United Nations Organization for Education in Sciences (UNESCO), USPTO, African Economic Commission (CEA), • OAPI patents are accessible through ESP@CENET portal, INPADOC (Delphion).

www.oapi.wipo.net

Database name	General Information
ARIPO	• The African Regional Industrial Property Organization (ARIPO) is a central filing system comprised of 16 member African states: Botswana, The Gambia, Ghana, Kenya, Lesotho, Malawi, Mozambique, Namibia, Sierra Leone, Somalia, Somalia, Sudan, Swaziland, Uganda, United Republic of Tanzania, Zambia, and Zimbabwe • OAPI maintains a strong partnership with the United Nations Economic Commission for Africa (ECA), WIPO and the Organization of African Unity (OAU). • The Organization also cooperated with the Austrian Patent Office, German Patent Office, and Korean Industrial Property Office (KIPO) • ARIPO has concluded agreements of cooperation with the following industrial property offices to ensure technical cooperation and mutual exchange of documentation and information: UK Patent Office, Swedish Patent and Registration Office, Institute of National Industrial Property of Brazil (INPI) • ARIPO patents are accessible through INPADOC (Delphion)

www.aripo.wipo.net

APPENDIX C: Definitions of the U.S. Classification & International Classifications

U.S. and International Classification/sub-classification Definitions

- A Patent Classification is a code which provides a method for categorizing the invention. Classifications are typically expressed as "482/1". The first number, 482, represents the class of invention. The number following the slash is the subclass of invention within the class. There are about 450 Classes of invention and about 150,000 subclasses of invention in the USPC. A USPC Class is one of over 450 major subdivisions of patented technology currently in the U.S. Patent Classification System (USPC). Each class has a designated class number, and includes a descriptive title, class schedule, and definitions. Class 482 EXERCISE DEVICES is an example of a USPC Class.

- A subclass is a smaller refined subset of a class. A subclass has a number, a title, an indent level indicated by zero or more dots, a definition, a hierarchical relationship to other subclasses in a class, relationships to other subclasses in other classes, and a set of patents in it. A subclass is the smallest searchable grouping of patents in the U.S. Patent Classification system.

- An International Patent Classification (IPC) is a classification drawn from The International Patent Classification System, administered by the World Intellectual Property Organization (WIPO). The IPC divides technology into eight sections with approximately 69,000 subdivisions. Each subdivision has a symbol consisting of Arabic numerals and letters of the Latin alphabet

- European Classification (ECLA): This is the classification scheme applied by the European Patent Office to its internal collection of search documentation and is based on the IPC, but is often more detailed. ECLA classification codes can be used to carry out subject searches on the Espacenet® database. This is done by either inserting an ECLA classification in the EC classification field, if known, or by clicking on the highlighted ECLA field when a bibliographic record of a patent specification known to be of interest is found. This provides a "back door" way of exploring the classification with the ECLA code for that record highlighted in yellow. The advantages of using ECLA are that when the schedules are revised, which happens quite frequently, the Espacenet® database is revised so that only the latest codes need to be searched to cover back in time. The codes are also applied consistently by one group of examiners and are usually better than the IPC for the American patents. The data also goes back much further than the IPC: to 1877 for Germany, 1909 for Britain, 1911 for France and 1920 for the USA, for example. However the data is often only applied several months after the publication of the specifications, so it is not suitable for current awareness searching. There are also seem to be some gaps in its coverage for the older non-German patents. The text of the classification schedules is available on the web but appropriate classes are best found on Espacenet® by clicking on the EC hypertext link to see a definition of what sounds like a likely patent; then browsing to see if nearby definitions are more useful; clicking the box next to the class; and then clicking on "Copy" to insert that class into Espacenet®. Keywords can of course be added as well to indicate a particular aspect of that class.

U.S. Classifications

Available at: www.uspto.gov/web/patents/classification/

1. **Class 435:** Molecular biology and microbiology
2. **Class 800:** Multi-cellular living organisms and unmodified parts thereof and related processes
3. **Class 514**: Drug, Bio-affecting and body treating compositions (Integral part of Class of 424)
4. **Class 536**: Organic Compounds
5. **Class 424**: Drug, Bio affecting and body treating compositions
6. **Class 530**: Natural resins or derivatives; Peptides or proteins: lignins or reaction products, thereof
7. **Class 426**: Food or edible material; Processes, compositions, and products

Class/Sub-classifications

1. **435/252.3:** Subject matter wherein the genotype of the microorganism is a product of recombination or transformation with a vector or foreign or exogenous gene, or the result of bacterial cell fusion, etc.
2. **435/252.31:** Subject matter wherein the altered microorganism is a species of Bacillus
3. **800/302:** Subject matter wherein the higher plant, seedling, plant seed, or plant part is insect resistant and has been made via a transgenic method or a mutation step.
4. **435/418:** Subject matter wherein the plant cell or cell line has a property which allows it to survive pest or herbicide attacks or a property which makes it lethal to living organisms which prey on or come in contact with it.
5. **514/2:** Subject matter which contains a protein or its reaction product, e.g., peptides, peptones, fibrinogen, etc., wherein the protein molecule is not degraded to the constituent amino-acids
6. **536/23.71:** Compounds which are DNA fragments which encode *Bacillus thuringiensis* insect toxins.
7. **424/ 93.461:** Subject matter involving a Bacillus micro-organism from the species thuringiensis.
8. **435/69.1:** Processes which involve the use of recombinant DNA techniques in a process of synthesis of a protein or polypeptide.
9. **530/825:** Cross-reference art collection for peptides or proteins which are separated from bacteria
10. **435/71.1:** Processes wherein a protein or peptide synthesized is produced by a culture of a microorganism
11. **435/410:** Subject matter which includes plant cells or cell lines, per se which may be transgenic, mutant, or products of other processes for obtaining plant cells; compositions containing plant cells; processes of in vitro propagating, maintaining or preserving plant cells or cell lines; processes of isolating or separating plant cells; processes of regenerating plant cells into tissues, plant parts, or plants, per se, wherein no genotypic change occurs; and medium for propagation, maintenance, preservation, etc. of plant cells or cell lines.
12. **800/265:** Method wherein the stable or transient change results in a resistance to or tolerance of a pathogenic or pest organism in the plant.

13. 426/637: Subject matter involving material derived from an edible tuber, i.e., white potato, sweet potato and yam.
14. 435/832: Bacillus
15. 800/295: Subject matter which is a plant, seedling, plant seed, or plant part.
16. 800/317.2: Subject matter wherein the Solanaceae is a potato.
17. 800/279: Method wherein the polynucleotide molecule confers resistance to or tolerance of pests or pathogenic organisms in the plant or plant part.
18. 800/288: Method wherein the polynucleotide encodes a polypeptide not originating from a plant.
19. 800/292: Method wherein the polynucleotide is inserted into the plant cell by means of electroporation.
20. 800/293: Method wherein the polynucleotide molecule is present upon or within a particle which is introduced or inserted into the plant or plant part by said particle penetrating the plant cell membranes in a ballistic fashion, i.e., due to a relatively high velocity.
21. 800/294: Method wherein the polynucleotide is introduced into the plant cell by infecting the cell with an Agrobacterium which contains the polynucleotide.
22. 800/300: Subject matter wherein the higher plant, seedling, plant seed, or plant part is herbicide resistant and has been made via a transgenic method or a mutation step.
23. 435/320.1: Subject matter directed to self-replicating nucleic acid molecules which may be employed to introduce a nucleic acid sequence or gene into a cell; such nucleic acid molecules are designated as vectors and may be in the form of a plasmid, hybrid plasmid, cosmid, viral vector, bacteriophage vector, etc.
24. 435/440: Processes for (1) producing a mutation in an animal cell, plant cell or microorganism, (2) fusing animal, plant, or microbial cells, (3) producing a stable and heritable change in the genotype of an animal cell, plant cell, or a microorganism by artificially inducing a structural change in a gene or by incorporation of genetic material from an outside source, or (4) producing a transient change in the genotype of an animal cell, plant cell, or microorganism by the incorporation of genetic material from an outside source.
25. 435/468: Processes of inserting polynucleotide molecules into or rearranging genetic material within a plant cell.
26. 435/469: Processes wherein the nucleic acid is introduced into the plant cell by means of an Agrobacterium.
27. 435/470: Processes wherein the nucleic acid molecule is introduced into the plant cell by electroporation, particle, fiber or microprojectile mediated insertion, or injection.
28. 530/350: Subject matter in which a polypeptide is composed of more than 100 amino acid residues or has a molecular weight of greater than 10,000.
29. 424/405: Subject matter in which the composition having a special physical form is claimed or disclosed as biocidal or repellent or attractant to animals or insects.
30. 424/780: Subject matter wherein the active ingredient is a material or an extract obtained from a micro-organism.
31. 435/252.5: Subject matter wherein the microorganism is a species of Bacillus
32. 435/822: The subject matter below are microorganism cross-reference art collections. The bacteria terminology below is based upon "Bergey"s Manual of Determinative Bacteriology," Eighth Edition, which is to be considered dispositive of the subject matter.

33. 536/23.1: Compounds which are fragments of nucleic acid having a specific sequence of deoxyribonucleotide units, or ribonucleotide units, linked by successive 3i-5i phosphodiester linkages, or modified derivatives thereof.
34. 536/23.4: Compounds which are DNA fragments which encode specific fusion proteins.
35. 435/410: Subject matter which includes plant cells or cell lines, per se which may be transgenic, mutant, or products of other processes for obtaining plant cells; compositions containing plant cells; processes of in vitro propagating, maintaining or preserving plant cells or cell lines; processes of isolating or separating plant cells; processes of regenerating plant cells into tissues, plant parts, or plants, per se, wherein no genotypic change occurs; and medium for propagation, maintenance, preservation, etc. of plant cells or cell lines.
36. 514/12: Subject matter wherein a peptide chain has 25 or more peptide units in an uninterrupted chain.
37. 424/93.2: Subject matter involving a micro-organism, cell or virus which (a) is a product of recombination, transformation, or transfection with a vector or a foreign or exogenous gene or (b) is a product of homologous recombination if it is directed rather than spontaneous or (c) is a product of fused or hybrid cell formation.
38. 424/93.3: Subject matter involving a mixture consisting of two or more different microbial, cellular, or viral genera.
39. 424/192.1: Subject matter involving a fusion protein or fusion polypeptide, which fusion protein or fusion polypeptide is taken to mean the expression product of a gene fusion.
40. 424/184.1: Subject matter involving an antigen, an epitope, or another immunospecific immunoeffector, such as an immunospecific vaccine, an immunospecific stimulator of cell-mediated immunity, an immunospecific tolerogen, or an immunospecific immunosuppressor.
41. 424/185.1: Subject matter wherein an amino acid sequence specifying an antigen, an epitope, or another immunospecific immunoeffector is disclosed in whole or in part, wherein the disclosed amino acid sequence may be part of a conjugate, a complex, or a fusion protein or fusion polypeptide.
42. 424/278.1: Subject matter involving a nonspecific immunoeffector, per se, or a nonspecific immunoeffector, a stabilizer, an emulsifier, a preservative, a carrier, or any other additive for a composition containing an immunoglobulin, an antiserum, an antibody, a conjugate or complex of an antibody or fragment thereof, an antigen, an epitope, or any other immunospecific immunoeffector.

International Classifications:
Available at: http://www.wipo.int/classifications/fulltext/new_ipc/ipcen.html

1. IPC(C12N): MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q).

2. **IPC (CO7H): SUGARS; DERIVATIVES THEREOF; NUCLEOSIDES; NUCLEOTIDES; NUCLEIC ACIDS** (derivatives of aldonic or saccharic acids C07C, C07D; aldonic acids, saccharic acids C07C 59/105, C07C 59/285; cyanohydrins C07C 255/16; glycals C07D; compounds of unknown constitution C07G; polysaccharides, derivatives thereof C08B; DNA or RNA conceming genetic engineering, vectors, e.g. plasmids, or their isolation, preparation or purification C12N 15/00; sugar industry C13).

3. *IPC (* **C07K-014/325**):
C07K: **PEPTIDES** (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
14/325: *Bacillus thuringiensis* crystal peptide (delta-endotoxin)

4. **IPC (C12N-015/82)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q) **015/82:** For plant cells
C12N-015/82C8B6E: European Classification for insect resistance

5. **IPC (A01N-063/00)**
A01N: **PRESERVATION OF BODIES OF HUMANS OR ANIMALS OR PLANTS OR PARTS THEREOF; BIOCIDES, e.g. AS DISINFECTANTS, AS PESTICIDES, AS HERBICIDES** (preparations for medical, dental, or toilet purposes A61K; methods or apparatus for disinfection or sterilisation in general, or for deodorisation of air A61L); **PEST REPELLANTS OR ATTRACTANTS** (decoys A01M 31/06; medicinal preparations A61K); **PLANT GROWTH REGULATORS** (compounds in general C01, C07, C08; fertilisers C05; soil conditioners or stabilisers C09K 17/00)
063/00: Biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates or substances produced by, or extracted from, micro-organisms or animal material (containing compounds of determined constitution A01N 27/00 to A01N 59/00)

6. **IPC (A01N-063/02)**
A01N: PRESERVATION OF BODIES OF HUMANS OR ANIMALS OR PLANTS OR PARTS THEREOF; BIOCIDES, e.g. AS DISINFECTANTS, AS PESTICIDES, AS HERBICIDES (preparations for medical, dental, or toilet purposes A61K; methods or apparatus for disinfection or sterilisation in general, or for deodorisation of air A61L); **PEST REPELLANTS OR ATTRACTANTS** (decoys A01M 31/06; medicinal preparations A61K); **PLANT GROWTH REGULATORS** (compounds in general C01, C07, C08; fertilisers C05; soil conditioners or stabilisers C09K 17/00)
063/02: Fermentates or substances produced by, or extracted from, micro-organisms or animal material.

7. **IPC (C12R-001/07B)**
C12R: INDEXING SCHEME ASSOCIATED WITH SUBCLASSES C12C TO C12Q OR C12S, RELATING TO MICRO-ORGANISMS
001/07: Bacillus
C12R-001/07B: European Classification for *Bacillus thuringiensis*.

8. **IPC (C07K-014/00)**
C07K: PEPTIDES (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
014/00: 00 Peptides having more than 20 amino acids; Gastrins; Somatostatins; Melanotropins; Derivatives thereof

9. **IPC (C07K-014/415)**
C07K: PEPTIDES (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
014/415: from plants.

10. **IPC (C07K-014/195)**
C07K: **PEPTIDES** (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
014/195: from bacteria

11. **IPC (C07K-014/32)**
C07K: **PEPTIDES** (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
014/32: from Bacillus (G).

12. **IPC (C07K-014/435)**
C07K: **PEPTIDES** (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
014/435: from animals; from humans

13. **IPC (C07K/435A)**
C07K: **PEPTIDES** (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type

C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
C07K-014/435A: European Classification : from invertebrates] [N9604]

14. **IPC (C07K-014/435A4)**
C07K: PEPTIDES (peptides in foodstuffs A23, e.g. obtaining protein compositions for foodstuffs A23J; preparations for medicinal purposes A61K; peptides containing ß-lactam rings C07D; cyclic dipeptides not having in their molecule any other peptide link than those which form their ring, e.g. piperazine-2,5-diones, C07D; ergot alkaloids of the cyclic peptide type C07D 519/02; macromolecular compounds having statistically distributed amino acid units in their molecules, i.e. when the preparation does not provide for a specific, but for a random sequence of the amino acid units, homopolyamides and block copolyamides derived from amino acids C08G 69/00; macromolecular products derived from proteins C08H 1/00; preparation of glue or gelatine C09H; single cell proteins, enzymes C12N; genetic engineering processes for obtaining peptides C12N 15/00; compositions for measuring or testing processes involving enzymes C12Q; investigation or analysis of biological material G01N 33/00)
014/435A4: **European Classification**: from insects [N9604]

15. **IPC (C12N-015/63)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/63: Introduction of foreign genetic material using vectors; Vectors; Use of hosts therefor; Regulation of expression

16. **IPC (C12N-015/79)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)

015/79: Vectors or expression systems specially adapted for eukaryotic host

17. **IPC (C12N-015/82)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/82: For plant cells
European Classification: e.g. plant artificial chromosomes (PACs) [C0211]

18. **IPC (C12N-015/82B)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
C12N-015/82B: **European Classification**: Methods for controlling, regulating or enhancing expression of transgenes in plant cells] [N9607] [C0211].

19. **IPC (C12N-015/79)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/79: Vectors or expression systems specially adapted for eukaryotic host

20. **IPC (C12N-015/82)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or

surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/82: for plant cells

21. **IPC (C12N-015/82C)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/82C: **European Classification**: Phenotypically and genetically modified plants via recombinant DNA technology] [N9607]

22. **IPC (C12N-015/82C8)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/82C8: **European Classification**: with agronomic (input) traits, e.g. crop yield [N9607] [C0211]

23. **IPC (C12N-015/82C8B)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/82C8B: **European Classification**: for stress resistance, e.g. heavy metal resistance] [N9607] [N0211]

24. **IPC (C12N-015/82C8B6)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/82CB6: European Classification: for biotic stress resistance, pathogen resistance, disease resistance] [N9607] [C0211];

25. **IPC (C12N-015/82C8B6B)**
C12N: MICRO-ORGANISMS OR ENZYMES; COMPOSITIONS THEREOF (biocides, pest repellants or attractants, or plant growth regulators containing micro-organisms, viruses, microbial fungi, enzymes, fermentates, or substances produced by, or extracted from, micro-organisms or animal material A01N 63/00; food compositions A21, A23; medicinal preparations A61K; chemical aspects of, or use of materials for, bandages, dressings, absorbent pads or surgical articles A61L; fertilisers C05); **PROPAGATING, PRESERVING, OR MAINTAINING MICRO-ORGANISMS** (preservation of living parts of humans or animals A01N 1/02); **MUTATION OR GENETIC ENGINEERING; CULTURE MEDIA** (microbiological testing media C12Q)
015/82 C8B6B: European Classification: for fungal resistance] [N0211]

APPENDIX D: Summer Genome Quest Past/BLAST Reports

See PIPRA DVD for Summer GenomeQuest located in the "GenomeQuest search report" folder.

APPENDIX E: Fall GenomeQuest PAST/BLAST Reports

See PIPRA DVD for Fall GenomeQuest located in the "GenomeQuest search report" folder.

APPENDIX F: Print articles cited

See PIPRA DVD.

APPENDIX G: Regional and National Patent Reports

Click to read the Peruvian Patent Search Report.

Click the hyperlink to view the two ARIPO Patents found through an ARIPO regional patent search: AP 430 and AP 498.

The Ugandan Search Report is below.

AFRICAN REGIONAL INTELLECTUAL PROPERTY ORGANIZATION (ARIPO)

11 Natal Road
P. O. Box 4228
794072/3
Harare
ZIMBABWE

Tel: 263 4 794065/6/8
Fax: 263 4

Email: mail@aripo.org
aripo@ecoweb.co.zw

Our Ref: AP498 and AP1613

December 4, 2007

Mr. John Magezi
Magezi, Ibale & Co. Advocates
1st Floor, Reco House
25 Nkrumah Road
P.O. Box 10969
KAMPALA

Uganda

Fax No: 00-256-41-4235539/4234252

Dear Mr. Magezi

RE: <u>Request for Uganda National Patent Search Concerning "*Bacillus thuringiensis*" and/or "Thuringiensis"</u>

I refer to your e-mail dated November 30, 2007 and wish to confirm that there are 2 patents concerning "*Bacillus thuringiensis*" and/or "Thuringiensis" and designating Uganda.

i) AP498 which is equivalent to AU 0674140B_2 or ZA 9403344A and entitled "Photoprotected *Bacillus thuringiensis* Toxin".

   This patent was granted on May 29, 1996 and expired on May 13, 1998. Therefore it is no longer valid and is in public domain.

ii) AP1613 equivalent EP1283676B_1 and entitled "A Bioinsecticide Formulation Consisting of *Bacillus thuringiensis* Var Insraelensis, and its Concerning Manufacture Proceedings", designating Uganda and has not been

   renewed since May 24, 2007. This means that it will be in public domain by February 27, 2008 if it is not renewed.

Should you need further information, please do not hesitate to contact me.

Yours faithfully

C.J. Kiige
DIRECTOR, TECHNICAL

/bm

Mr. John Magezi
Magezi, Ibale & Co. Advocates
1st Floor, Reco House
25 Nkrumah Road
P.O. Box 10969
KAMPALA

Uganda

APPENDIX H: E-mail Correspondence

See "Email Records" folder in PIPRA DVD.

APPENDIX I: WIPO Intellectual Property Country Profiles

Click the hyperlink to see the Peru, Uganda, and Kenya IP Country Profiles

APPENDIX J: Patent Family Definitons according to Derwent and INPADOC and the U.S. Manual of Patent Examining Procedure

Because patent protection is country specific, a company or an individual that wants to protect its invention in a particular country must apply for patent protection in that country — either by filing national patent applications, or by making the application via one of the multi-national routes (e.g. an EP or a PCT application). If protection is sought in more than one country, or through more than one patenting authority, this will result in what is known as a family of patents.

For information on patent families, please refer to the following references:

Derwent World Patent Index Produced by Thomson Scientific

Derwent gathers all of the patent documents relating to an invention into a single database record. In general, one record in Derwent WPI represents one invention and shows you all the patent documents that Derwent has collected relating to that invention.

http://support.dialog.com/searchaids/dialog/dwpi_fam.shtml

INPADOC Produced by the European Patent Office

http://gb.espacenet.com/gb/en/helpV3/patentfamily.html

http://gb.espacenet.com/espacenet/gb/en/help/161.htm

http://www.stn-international.de/training_center/patents/pat_term.pdf

MPEP 901.05 Foreign Patent Documents [R-3] - 900 Prior Art, Classification, and Search

901.05 Foreign Patent Documents [R-3]
All foreign patents, published applications, and any other published derivative material containing portions or summaries of the contents of published or unpublished patents (e.g., abstracts) which have been disseminated to the public are available to U.S. examiners. See MPEP § 901.06(a), paragraphs I.C. and IV.C. In general, a foreign patent, the contents of its application, or segments of its content should not be cited as a reference until its date of patenting or publication can be confirmed by an examiner's review of a copy of the document. Examiners should remember that in some countries, there is a delay between the date of the patent grant and the date of publication.
Information pertaining to those countries from which the most patent publications are received *>is< given in the following sections and in MPEP § 901.05(a). Additional information can be obtained from the Scientific and Technical Information Center.
See MPEP § 707.05(e) for data used in citing foreign references.

I. PLACEMENT OF FOREIGN PATENT EQUIVALENTS IN THE SEARCH FILES

There are approximately 25 countries in which the specifications of patents are published in printed form either before or after a patent is granted.

UNTIL OCTOBER 1, 1995, THE FOLLOWING PRACTICE WAS USED IN PLACING FOREIGN PATENT EQUIVALENTS IN THE SEARCH FILES:

When the same invention is disclosed by a common inventor(s) and patented in more than one country, these patents are called a family of patents. Whenever a family of patents or published patent disclosures existed, the Office selected from a prioritized list of countries a single family member for placement in the examiners' search file and selected the patent of the country with the earliest patent date. If the U.S. was one of the countries granting a patent in the "family" of patents, none of the foreign "equivalents" was placed in the U.S. search files. See paragraph III., below. However, foreign patents or published patent disclosures within a common family which issued prior to the final highest priority patent (e.g., U.S.) may have been placed in the U.S. paper search files and these copies were generally not removed when the higher priority patent was added to the U.S. search files at a later date.

Beginning in October 1995, paper copies of foreign patents were no longer classified into the U.S. Classification System by the U.S. Patent and Trademark Office. See MPEP § 901.05(c) for search of recently issued foreign patents.

APPENDIX K: Author *Curriculum Vitae*

Mr. Bumrae CHO

99 Clinton St. Unit E9
Concord, NH03301
U.S.A
Tel : (603)545-5927 / E-mail : bcho@piercelaw.edu

EDUCATION

Franklin Pierce Law Center, Concord, U.S.A.
J.D. & LLM, Intellectual Property Law, 2009

Yonsei University, The Graduate School of Law, Seoul, Korea
LL.M., Intellectual Property Law, 2003.
(Dissertation : "A Study of Self-Designation International Application", 2003)

Yonsei University, College of Engineering, Seoul, Korea
B.S., Food and Biotechnology, 1996.

EXPERIENCE

2007 July — **Genzyme Corporation**, Cambridge, MA.
Organizing INDA data and making reports.

2001-2006 — **NewKorea International Patent & Law Office**, Seoul, Korea
Law Assistant / Assistant Manager / Manager (Chemical Department) / Deputy General Manager / General Manager (Foreign Department) / General Manager (Chemical Department), Client Development. Manage utility patent, design patent, trademark, and copyright prosecution. Drafting applications. Manage litigation. Manage human resources. Offer legal opinions in areas of Intellectual Property.

2000-2001 — **L&K Patent Firm**, Seoul, Korea
Law Assistant, Managed foreign patent filings

1998-2000 — **Studying for Patent Bar in Korea**
Studied Molecular Biology, Patent Law, Civil Law, Trademark Law, Civil Procedure Law, Design Law and Advanced Natural Science in Hanbit Institute, Seoul, Korea
Studying Genetic Engineering by private lesson.

1996-1998 — **National Police Band**, Inchon, Korea
Clarinetist (Military Service)

College — **EUPHONIA Orchestra** in Yonsei University, Seoul, Korea

1992-1996 Clarinetist / Chairman. Play clarinet, Manage Concerts, Marketing, Charity concert

ACTIVITIES

Member of Intellectual Property Managing Strategy Forum
Foundation Member of Zeloso Wind Ensemble (Charity Band)

LANGUAGES

Korean - fluently
English - proficiently
Japanese - conversational

INTERESTS

Avid reader, Clarinetist,
Enjoy skiing, cooking, wine,
Playing and collecting musical instruments

JOHN SHEFFIELD KENYON

16 Thomdike St., Apt #1
CONCORD, NH 03301
(850) 228-7465
KJSKENYON@AOL.COM

LICENSES

Patent Bar Eligible, Patent Bar Candidate, USPTO ID #: 29823

EDUCATION

Franklin Pierce Law Center, Concord, NH
JD/LLM in Intellectual Property Candidate, 2009
Coursework: Patent Practice & Procedure I & II, Law and Biotechnology, Patent Law, International & Comparative Patent Law, Technology Licensing, IP Research Tools, Mining Patents
Activities: International Exchange Chat Partner Program

University of Miami School of Medicine, Miami, FL
MD Candidate, 81% average; 2003-05
Coursework included: Cardiology, Neurology, Gross Human Anatomy, Epidemiology, Biochemistry, Cell Biology, Medical Genetics, Immunology, Microbiology, Embryology, Histology, Pathology, Cellular Biophysics, and Pharmacology

Davidson College, Davidson, NC
BA in Political Science, Minor Chemistry, Premedical Track, May 2001; Class Rank: Top 10%

EXPERIENCE

The Law Firm of Schwegman, Lundberg, & Woessner, P.A. Concord, NH/Minneapolis, MN
Claim Processing Clerk, October 2007-Present
Member, Patent Tracking Team: Track prosecution history of patent claims and learn patent prosecution and procedure.

Public Intellectual Property Resources for Agriculture (PIPRA)
Assistant to Patent Search Specialists, May 2007-December 2007
Expertise in cross platform international patent searching with experience using USPTO, Dialog, Questel-Orbit QPAT, GenomeQuest, Delphion, Micropatent, Lexis, and Westlaw databases. Assist faculty-members of Franklin Pierce Law Center with international patent search project to make agricultural technologies more easily available for development and distribution of subsistence crops for humanitarian purposes in the developing world.

The Law Firm of Daniel W. Dobbins, P.A. Tallahassee, FL.
Law Clerk, January 16, 2006-July 31, 2006
Prepared and revised settlement (demand) brochures and estate planning documents.

Fred A. Martin & Associates, Inc. Governmental Affairs Consultants, Tallahassee, FL.
Assistant, December 2002-May 2003

Lobbied Florida state legislature on economic development issues on behalf of international and interstate corporate clients seeking to establish a business presence in Florida.

Jacksonville Center for Clinical Research (JCCR), Jacksonville, FL.
Clinical Trials Research Assistant, August 2001-June 2002
Assistant to Director of JCCR, a Clinical Research Organization; Recruited patients for 40 different clinical trials in over a dozen therapeutic areas. Performed initial patient screening, presentation of informed consent, and patient follow-up.

PROFESSIONAL ASSOCIATIONS

American Intellectual Property Law Association
American Bar Association
Licensing Executives Society, United States & Canada

ACADEMIC PEER-REVIEWED PUBLICATIONS

Needell, M, **Kenyon, J. "Ethical Evaluation of 'Retainer Fee' Medical Practice."** Spring 2005 ed. *The Journal of Clinical Ethics.* Vol. 16, Issue 1.

Wessner, David R., Maiorano, Peggy C., **Kenyon, J.**, Pillsbury, R., Campbell, A. Malcolm. **"Spot Overlay Ames Test of Potential Mutagens."** Association of Biology Laboratory Educators (ABLE) 22nd Annual Meeting.

Acknowledgement for research contribution in:
Herrington, D., et al. **"Effects of SERMs on Important Indicators of Cardiovascular Health: Lipoproteins, Hemostatic Factors, and Endothelial Function."** *Women's Health Issues.* Vol 11, No 2. March/April 2001.

INTERESTS

Golf; Tennis; Running

LANGUAGES

Working knowledge of Spanish

Natalia Sepulveda Pence, RN
10 Blanchard Street #B
Concord, NH 03301
(985) 290-6396 or (603)219-0268 npence@piercelaw.edu

CERTIFICATIONS

Registered to sit for the USPTO Bar Examination, January 2008
Registered Nurse- Louisiana

EDUCATION

Franklin Pierce Law Center, Concord, NH
Juris Doctor, LLM anticipated May 2009
Member, AIPLA/ GPA 3.12/4.0
Coursework taken: Fundamentals of IP, International and Comparative Patent Law, Patent Data Mining; (Patent Law, Patent Practice and Procedure I, Technology Licensing, IP Tools: to be completed by December 2007)

Virginia Wesleyan College, Virginia Beach, VA
Bachelors of Arts in Biology, December 2003
National Deans List, 2002 & 2003

EXPERIENCE

Claims Processing clerk –Presently employed
Schwegman, Lundberg & Woessner, P.A., Minneapolis, MN
Duties include studying office action for rejected patent claims, determine what arguments and references were applied to the case, add the arguments from the USPTO examiner and attorney to the proper claims and enter this information at each stage of the prosecution.

Research Assistant –Summer 2007 to December 2007
Franklin Pierce Law Center
Produced landscape patent analysis research and report for the African Sweet Potato Project of the Plant Sciences Department of PIPRA, Public Intellectual Property Resources for Agriculture and CIP, The International Potato Center, Peru. Performed cross-platform international patent searching using USPTO, Dialog, Questel-Orbit QPAT, GenomeQuest, Delphion, Micropatent, LexisNexis, and Westlaw databases.

Registered Nurse
Staff nurse on the ER/ Burn- trauma/ Neuroscience/ Cardiac and Vascular step-down unit Teams of level I and 2 trauma hospitals providing care for mid to high acuity pediatric and adult patients. Duties included performing a full range of routine and emergent care including progressive ventilatory care, pre and post operative cardiac and spinal cord monitoring, neuro-ventricular shunt monitoring; orthopedic traction care, burn-shock trauma wound care, cardiac-pulmonary resuscitation and emergency triage. Delivered dermatological treatments including cosmetic laser treatments and circulated as an OR nurse during cosmetic surgery procedures. Contributed to the research and reporting of dermatological FDA approval studies.

Children's Hospital, New Orleans, LA	2/05-6/06
Slidell Memorial Hospital, Slidell, LA	6/05-6/06
Sentara Norfolk General Hospital, Norfolk, VA	6/02-6/05
Vanderbilt University Medical Center, Nashville, TN	11/01-6/02
Gold Skin Care Center, Nashville, TN	7/96-10/98

Media Spokesperson/National Training Director
Vanishing Point, New York City, NY 10/98-10/01
Management Team member of a start-up company specializing in cosmetic laser procedures. Functioned as the organizational spokesperson on a nationwide scale including appearances on/in MSNBC, CNN "Business Unusual," Allure Magazine, GQ Magazine, and Dateline NBC. Key contributor to the company's amazing launch success achieving $1.5M in revenues during the first 8 months of operation. National Training Director for medical personnel in the delivery of cosmetic laser procedures. Developed training procedures and testing/certification protocols to ensure skill levels and success of operators.

LANGUAGES

Bilingual: Spanish and English

SKILLS AND INTERESTS

Tae Kwon Do, fitness training, and target shooting

KERRY ELIZABETH SWIFT

11 Woodland Drive • Underhill VT 05489 • 802-899-4546 • kswift@uvm.edu

EDUCATION

1994-1998 **TUFTS UNIVERSITY – SACKLER SCHOOL OF BIOMEDICAL SCIENCES** **BOSTON, MA**

Awarded MS in Molecular Microbiology ***June, 1999***

1990 - 1994 **UNIVERSITY OF NEW HAMPSHIRE** **DURHAM, NH**

Awarded BS magna cum laude in Biochemistry

- Pfizer Undergraduate Research Grant, Summer Fellowship (1993)
- Undergraduate Research Opportunities Fellowship (UROP) (1993-1994)
- Varsity Women's Crew Team (1990-94), Varsity Women's Swim Team (1992-94)

Work Experience

2004-Present **UNIVERSITY OF VERMONT OFFICE OF TECHNOLOGY TRANSFER** **BURLINGTON, VT**

Facilitates the practical application of UVM technologies by enabling the development of commercial products via continuing research, intellectual property, start-up companies and licensing.

Technology Licensing Officer

Manage and support the commercialization of intellectual property and technologies developed at UVM

Technology transfer activities

- Prior art searches, IP landscape analysis, marketing, patent strategy, construction and negotiation of license and option agreements, and management of joint ownership relationships for all types of intellectual property and technologies at UVM.
- Established an independent Office of Technology Transfer and administrative support processes.

Creation of an innovation culture at UVM

- Development and presentation of the technology transfer process to the university community.
- On campus resource for queries on intellectual property and the commercial development of technologies via industrial research support and licensing.
- Implementation of a gap fund for on-campus technology development and a yearly entrepreneur conference connecting the business and university communities.

Industrial research support

- Negotiate and execute sponsorship and service contracts for industry supported research and educational opportunities.
- Manage and negotiate all university material transfer agreements (MTAs).
- Development of contract templates and processes for MTAs and industrial contracts.

1998-2004 M.I.T. TECHNOLOGY LICENSING OFFICE **CAMBRIDGE, MA**

Responsible for the management and licensing of all intellectual property (IP) developed at M.I.T.

Associate Technology Licensing Officer / Licensing Associate

Managed the evaluation, marketing, and licensing of intellectual property and technologies in the biological, engineering, and medical device fields.

Constructed and negotiated deals:

- Set and negotiated license and option agreement terms including: initial and yearly fees, running royalties, milestone payments, sublicensing, patent reimbursement, and field of use.

Optimized value through licensing and IP strategy

- Coordinated prior art searches and established patent strategies with outside patent counsel and inventors.
- Determined commercially relevant fields of use for technologies. Sized potential markets and identified marketing strategies.

Supported the creation of "faculty start-ups"

- Matched entrepreneurs with scientists, technologies and sources of capital.

Administered ongoing license agreements and technology portfolios

- Executed and managed over 100 exclusive and non-exclusive agreements with large pharmaceutical, biotech, start-up, medical device, laser, chemical manufacturing, and educational companies.
- Managed the patent prosecution and maintenance of over 300 technologies, including large multi-patent/multi-license IP portfolios.
- Managed the licensing and distribution of MIT's portfolio of 100+ transgenic mice and additional biological research tools through research use and distribution agreements with both for-profit and non-profit entities.

1994-1998 TUFTS UNIVERSITY – SACKLER SCHOOL OF BIOMEDICAL SCIENCES **BOSTON, MA**

Research Scientist – Independently designed and executed molecular biology experiments in conjunction with the thesis work for my Masters degree

- Researched the role of citrate synthase, the rate-limiting enzyme of the Krebs Cycle, in the sporulation process of *Bacillus subtilis*.

PERSONAL

- Member of the Association of University Technology Managers. Co-chair of the Start-up Course 2004-05 and Basic Course for 2007.
- Sculling and sweep rowing - Head of the Charles and US National champion
- Appalachian Mountain Club (AMC) – Hiking and Backpacking Trip Leader
- Pottery, gardening, swimming, and skiing (both Alpine and X-country)

AUTHOR BIOGRAPHIES

BUMRAE CHO, a native of Korea, is pursuing his J.D., LL.M degree in Intellectual Property and is currently a second-year law student at Franklin Pierce Law Center in Concord, New Hampshire. Mr. Cho graduated from *Yonsei University* in Seoul, Korea in February 1996 wit[illegible] *Bachelor of Science* degree in Food and Biotechnology, and a LL.M degree in In[illegible] Property Law. He has worked in *NewKorea International Patent & Law Off[illegible]* [illegible] Korea for seven years as a patent engineer. During his work in the law firm, he has [illegible] ced diverse biotech patent litigations and freedom-to-operate searches for global [illegible] ceutical and biotech companies. He is interested in business development in biotech companies and law firms.

JOHN SHEFFIELD KENYON, a native of the U.S., is pursuing his J.D., LL.M degree in Intellectual Property and is currently a second-year law student at Franklin Pierce Law Center in Concord, New Hampshire. Mr. Kenyon graduated from *Davidson College* in Davidson, North Carolina in May 2001 with a *Bachelor of Arts* degree in Political Science and Chemistry. He is interested in utilizing his biotechnology background from medical school coursework completed at the University of Miami School of Medicine to pursue a career in Intellectual Property Management and Licensing.

NATALIA SEPULVEDA PENCE, RN, a native of Colombia, South America is pursuing her J.D., LL.M degree in Intellectual Property and is currently a second-year law student at Franklin Pierce Law Center in Concord, New Hampshire. Mrs. Pence graduated from Aquinas College in 1996 with an Associates of Science in Nursing and in 2003 with a Bachelors of Arts in Biology from Virginia Wesleyan College. She wishes to utilize her nursing and biology background to pursue a career in Intellectual Property Management and Licensing in the public health sector.

SUPERVISING PROFESSORS:
JON R. CAVICCHI, J.D., LL.M (Intellectual Property)
STANLEY KOWALSKI, Ph.D, J.D.

AUTHOR BIOGRAPHIES

BUMRAE CHO, a native of Korea, is pursuing his J.D., LL.M degree in Intellectual Property and is currently a second-year law student at Franklin Pierce Law Center in Concord, New Hampshire. Mr. Cho graduated from *Yonsei University* in Seoul, Korea in February 1996 with a *Bachelor of Science* degree in Food and Biotechnology, and a LL.M degree in Intellectual Property Law. He has worked in *NewKorea International Patent & Law Office* in Korea for seven years as a patent engineer. During his work in the law firm, he has experienced diverse biotech patent litigations and freedom-to-operate searches for global pharmaceutical and biotech companies. He is interested in business development in biotech companies and law firms.

JOHN SHEFFIELD KENYON, a native of the U.S., is pursuing his J.D., LL.M degree in Intellectual Property and is currently a second-year law student at Franklin Pierce Law Center in Concord, New Hampshire. Mr. Kenyon graduated from *Davidson College* in Davidson, North Carolina in May 2001 with a *Bachelor of Arts* degree in Political Science and Chemistry. He is interested in utilizing his biotechnology background from medical school coursework completed at the University of Miami School of Medicine to pursue a career in Intellectual Property Management and Licensing.

NATALIA SEPULVEDA PENCE, RN, a native of Colombia, South America is pursuing her J.D., LL.M degree in Intellectual Property and is currently a second-year law student at Franklin Pierce Law Center in Concord, New Hampshire. Mrs. Pence graduated from Aquinas College in 1996 with an Associates of Science in Nursing and in 2003 with a Bachelors of Arts in Biology from Virginia Wesleyan College. She wishes to utilize her nursing and biology background to pursue a career in Intellectual Property Management and Licensing in the public health sector.

SUPERVISING PROFESSORS:

JON R. CAVICCHI, J.D., LL.M (Intellectual Property)

STANLEY KOWALSKI, Ph.D, J.D.