Slow-Release Fertilizer

Strategic Market Assessment

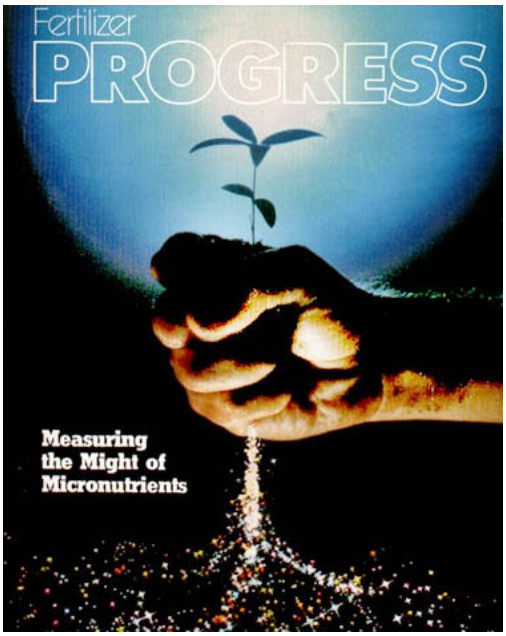

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Table of Contents

I. Executive Summary

a. Background

Dr. Jay W. Palmer, Ph.D. is the principal investigator (PI) on the slow-release fertilizer patent application filed June 19, 2003 by the University of South Florida, where he is an associate professor in the Chemistry Department. He has broad experience in the fields of physical and inorganic chemistry, as well as considerable experience in the industry. He has (or has applications for) over a dozen patents. Dr. Heidi Kay, a co-investigator for the slow-release fertilizer patent, has a Ph.D. in Physical Chemistry, and is now an visiting professor in the department of Global Health at USF.

b. Opportunity

The proposed patent takes advantages of shortfalls in the existing technologies for mining, refining and distributing fertilizers of large corporations already established in the market. The market opportunity is that this new product will utilize the existing waste products from old mining operations to create a new product that has a better composition with the micro-nutrients that are needed in many areas of the world.

c. Product

The slow-release fertilizer contains a mixture of monocalcium phosphate, dicalsium phosphate, gypsum and magnesium sulfate; dolomitic phosphatic clay slime comprising micro and trace essential elements; urea and potassium chloride.

d. Market

The leading markets for agricultural chemicals are predicted to be Asia and South America, which have rapidly expanding economies and agricultural sectors. The demand for fertilizers in

South American countries grows by 3% every year. The specific market segments for the product are regions with dry, arid lands with silica-sand soils like Florida and Africa, and lands with heavy rainfall like the Caribbean and Malaysia. Slow-release fertilizers represent a good potential for market expansion. The annual growth rate for this segment is between 3.5 and 4%.

e. Situational Analysis

The main strengths of the slow-release fertilizer is that it consumes waste products, it reduces nitrate runoff, it includes more trace elements (calcium, magnesium, boron, etc.), and it increases productivity and quality of food. Its weaknesses are that the use clay slurry waste creates a bad public perception, the price can be high, and no crop studies or health studies have been done to prove its benefits.

Some of the product's opportunities are that since the Gulf Coast Research Center advises Florida farmers, they could inform them of the benefits of the slow-release fertilizer, and since this product has a high value to farmers, it can be marketable at a higher price. Its threats are that there are many established companies in the market, genetically modified organisms reduce the demand for fertilizer, the price of natural gas is high, and some governments restrict the importation of urea (belief that it's a form of explosive).

f. Conclusions and Recommendations

Submit the $30,000 Florida Institute of Phosphate Research (FIPR) Grant and begin full scale crop studies at Gulf Coast Research Center. Complete final Patent Claims for filing international patents in China, Indonesia, India, Vietnam, Cambodia, Pakistan, Thailand, Malaysia, Africa, South America and USA where this product will sell the most. Begin patent License negotiations with involved industries.

II.Background

Dr. Jay W. Palmer, Ph.D. is the principal investigator (PI) on the slow-release fertilizer patent application filed on June 19, 2003 by the University of South Florida, where he is an associate professor in the Chemistry Department. He is also a member of the H. Lee Moffitt Cancer Center & Research Institute. He's recent research interests are in the synthesis of new Platinum (IV) NO/NO2 compounds that contain ligands with anti-tumor activity such as those with selenium and arsenic.[1]

Dr. Palmer has broad experience in the fields of physical and inorganic chemistry, as well as considerable experience in the industry. He has (or has applications for) over a dozen patents, including one for purification of gypsum and another for reducing radioactivity in phosphogypsum.[2] He also has several scientific publications, such as "*An Approach on Improving the Health of Human Populations Florida*" and "*Global Warming*," published in the Florida Scientist in 2000 and 1998, respectively. The "*Extraction of Cadmium from Industrial Phosphoric Acid with Chelating Agents*" was published in the J. Environmental Science Health in 1992. In addition, he has over 50 different articles in chemistry, archeology, and other fields.[3]

Dr. Heidi Kay, a co-investigator for the slow-release fertilizer patent, has a Ph.D. in Physical Chemistry from the University of South Florida, and is now an visiting professor in the department of Global Health at USF. She previously worked in the departments of Environmental and Occupational Health, and Chemistry. She is also working with Dr. Palmer on their most recent patent – the Platinum (IV) NO/NO2 compounds.[4]

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[1] Dr. Jay W. Palmer, CV
[2] Institute for Environmental Studies, "*Background Information*," Chemistry Department, College of Arts and Science, University of South Florida, Last updated September 20, 2004
http://nosferatu.cas.usf.edu/chemistry/info_research_resources/ies/background.html
[3] Dr. Jay W. Palmer, CV
[4] Dr. Heidi Kay, CV

Dr. Kay's specialization is in water chemistry, cancer drugs, education, kinetics, and photochemistry. She currently has eight patent disclosures, two patent application completed, five academic awards, and about eight scientific publications. Her publications are mainly on cancer research and photochemistry. [5]

According to the patent application filed with the U.S. Patent & Trademark Office, the slow-release fertilizer contains a mixture of monocalcium phosphate, dicalsium phosphate, gypsum and magnesium sulfate; dolomitic phosphatic clay slime comprising micro and trace essential elements; urea and potassium chloride. Slow-release fertilizers manufactured with these formulations can be used on mineral stressed soils to increase the quality and productions of food crops on them.

[5] Heidi Kay, Ph.D., Health Sciences Center, College of Public Health, Department of Global Health, University of South Florida, Last updated January 4, 2005, http://hsc.usf.edu/publichealth/gh/hkay/index.html

III.Opportunity

The competitive landscape and market opportunities currently available provide a clear position for the success of this patent. The competitive landscape includes a broad array of large corporations with comprehensive technologies for mining, refining and distributing fertilizers. The new patent takes advantages of shortfalls in these existing technologies. The primary ore mined in Florida is at a composition and quality that is fast disappearing. The new technology utilizes a grade and composition which is currently bypassed by the existing mining industry. Therefore this patent will provide a product that utilizes the ore remaining from previous mining operations. Old completed Florida phosphate mines can be reopened to extract the remaining ore at this lower grade to sell as a new higher quality product by utilizing this patent.

The market opportunity created with this patent creates a unique position where previous discarded ores are combined with the existing clay slurries and gypsum which were discarded in the current mining operations. This new product will utilize these existing waste products from old mining operations to create a new product that has a better composition with the micro-nutrients that are needed in many areas of the world.

IV.Product

As mentioned before, the slow-release fertilizer contains a mixture of monocalcium phosphate, dicalsium phosphate, gypsum and magnesium sulfate; dolomitic phosphatic clay slime comprising micro and trace essential elements; urea and potassium chloride.

The patent application explains the process to prepare the slow-release fertilizer, which is as follows: a) preparing a mixture of phosphate ore with sulfuric acid and water to form monocalcium phosphate, gypsum, magnesium sulfate, and residual phosphate ore; b) adding to the first mixture micro and trace essential elements and dolomitic phosphatic clay slime to yield a second mixture; c) heating the second mixture to yield a third mixture comprising dicalcium phosphate and residual phosphoric acid; d) adding phosphate to the third mixture to neutralize the residual phosphoric acid to yield a fourth mixture; e) adding urea and potassium chloride to form a fertilizer mixture; and f) drying the fertilizer mixture.[6]

[6] Palmer, Jay W., "Slow-release (GSSP fertilizer," U.S. Patent & Trademark Office, December 6, 2002, Application Number 20030115920

V.Market and Segments

a. Market Size

The overall fertilizer market represented $74.4 billion in 1994.[7] The United States currently represents 31% but its share slowly declines. The emerging regions are Asia (38% of the market) and South America (11%). The nitrogenous fertilizers make up the biggest part of the market with a share of 60%.[8]

b. Market Growth

According to the Food and Agriculture Organization of the United Nations (FAO), estimates on fertilizer usage over the next five years are substantially lower than estimates made in the late 1990s. Lowered estimates in large part have to do with more efficient apportioning of fertilizers due to computer projections and because of more efficient use of available fertilizers, according to an FAO study. In addition, the health benefits of non-chemical, organically grown products have led to a reduction in fertilizer usage. Fertilizer use, which was about 135 million metric tons (mmt) in 2002, is expected to be no more than 150 mmt in 2010 according to the study's authors.[9]

Since the 1990s, fertilizer manufacturers have faced flat or declining demand in many of the world's key markets, although increased demand from developing countries, particularly in Asia, was expected to bolster the market for fertilizers. Some industrialized countries have been seeking ways to minimize dependence on commercial fertilizers. A small but influential trend toward organic agriculture has raised consumers' awareness of the chemicals used to product food.

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[7] See projections spreadsheet in Appendix
[8] Fertilizer Use by Crop, 5th Edition, FAO, IFA, IFDC, & PPI, December 2001.
[9] Fertilizer Industry data, www.galenet.com

Developing East Asian countries, such as China, Indonesia, India, Vietnam, Cambodia, Pakistan, Thailand, and Malaysia, have remained major growth markets for fertilizers. The annual growth rate for those markets is in the 4 to 5% range. Because agriculture in these areas is a major economic sector, crop quality is crucial and fertilizers take an important part in their development prospects.[10]

The use of fertilizers, particularly in China and India, are increasing at a faster rate than the world average due to government subsidies for fertilizer purchases. These two nations are perceived as very important to the international fertilizer market. Governments in the Middle East, China, and India subsidize fertilizer use, which partly explains the steady increase in demand in these regions. These policies are likely to remain. Likewise, some governments in Africa distribute fertilizers and seeds to small rural farmers in attempts to fight hunger.

Shipments of fertilizers to Europe continue to slow, particularly since 2002. From that year on, countries such as Spain, Portugal, Greece, and Italy began fighting against the adverse effects of chemical residues on lands already ruined by unwise farming practices that cause desertification. In Europe, the FAO expects overall use of fertilizers to remain flat with slight increases. Latin America is forecasted to be a strong export region in the next 5 years.[11]

In the United States, the amount of acreage exempted from crop production had a significant impact on the demand for fertilizer. Since 1998, there has been a decline in nitrogen fertilizer facilities, which is mainly due to the natural gas crisis. Jobs are being exported to China, Russia, the Middle East, and the Caribbean. There has also been a significant decline in operating rates for the U.S. ammonia industry.[12]

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[10] Fertilizer Industry data, www.galenet.com
[11] Fertilizer Industry data, www.galenet.com
[12] The Fertilizer Institute and the Agricultural Retailers Association, " Agricultural Retailers Association and the Fertilizer Institute Testify on the Impact of Natural Gas Prices," March 17, 2005

Overall, the leading markets for agricultural chemicals through 2010 are predicted to be Asia and South America, which have rapidly expanding economies and agricultural sectors. The demand for fertilizers in South American countries grows by 3% every year.[13]

c. Market Segmentation

1. Product Segmentation

The market can be divided into several different segments according to the type of product. The low-cost fertilizers that account for the major part of the world consumption are fertilizers based on primary nutrients: nitrogenous fertilizer, phosphate fertilizer and potash fertilizer.

Another segment comprises mixed fertilizers which have all three primary nutrients in their granules. The final product is made by a process involving chemical reaction between the raw materials and intermediates used.

The compound fertilizers are made out of two or three of the primary nutrients.

Slow-release fertilizers make up the last segment. They are a more efficient source of nutrients but their higher cost limits their potential use.

2. Geographic segmentation

Another type of segmentation that can be used is based on geographic areas and their respective type of soils. The specific market segments for the product are regions with dry, arid lands with silica-sand soils like Florida and Africa, and lands with heavy rainfall like the Caribbean and Malaysia. Also, lands with moderately acidic soils, like the southeastern

[13] www.ifpri.org/2020/briefs/

United States and young igneous soils containing larger fragments of unreactive feldspars and quartz, found in Zimbabwe and Zambia. The secondary market segments are all other types of soils.[14]

d. Market Expansion

The market with the greatest potential for expansion is plant nutrient sulphur. As the composition of fertilizer materials changes, crop production intensifies, and sulphur dioxide emissions decrease. As a consequence, sulphur deficiencies are spreading worldwide, severely limiting agricultural production in affected areas. In Western Europe and North America, fertilizer companies are capitalizing on the growing sulphur fertilizer demand and farmers are profiting from its application. Programs to develop plant nutrient sulphur in Asia, especially China and India, have expanded to develop this vast long-term potential.[15]

Slow-release fertilizers represent a good potential as well. The annual growth rate for this segment is between 3.5 and 4%. A lot of research is conducted in order to improve the release process, which is currently temperature-dependent. The research focuses on sulfur coated ureas and polymer coated nitrogen. The aim is to come up with a fertilizer that would release its nutrients more slowly and in a uniform fashion.[16]

[14] Palmer, Jay W., "Slow-release (GSSP fertilizer," U.S. Patent & Trademark Office, December 6, 2002, Application Number 20030115920
[15] www.sulphurinstitute.org
[16] Controlled-released fertilizer Report, IFA, 2001.

VI.Situational Analysis

a. SWOT Analysis

Strengths

- Consumes waste products
- Reduces nitrate runoff
- Cost less than commercial fertilizers
- Includes more trace elements – 16 nutrients (calcium, magnesium, boron, etc.)
- Use of sand soils and areas of heavy rainfall
- Increased productivity and quality of food – tastier vegetables and fruits
- Increased growth rate
- Losses water and becomes solid (good texture)
- Numbers of applications will decrease

Weaknesses

- Use of clay slurry waste that creates a bad public perception
- Urea drying process can release nitrogen toxins
- Price can be high; regular fertilizers are cheaper, however, the slow-release fertilizer can reduce costs in the long run by decreasing the number of applications
- Clay slurry has been used before but didn't work; end-product was wet (perception that the product might not work)
- No crop studies have been done; no proven benefits yet
- No health studies have been done

Opportunities

- The Gulf Coast Research Center advises Florida farmers, they could inform them of the benefits of the slow-release fertilizer; however, they need to do crop studies first, in order to get their support
- This product has a high value to farmers; marketable at a higher price
- Food production must increase more than 2% annually to maintain current diets; fertilizers as a reliable tool to provide sufficient yields to feed the world

Threats

- The biotechnology industry strives to develop crops that are hardy and resistant with and without the aid of fertilizers and pesticides
- Genetically modified organisms reduce the demand for fertilizer
- Price of natural gas is high
- Established companies in the market (brand names, more market exposure, better technology, access to funds)
- Seasonality
- Licensing for materials
- Some governments (e.g. Nigeria) restrict the importation of urea - belief that it’s a form of explosive

b. Issue Analysis

- Have the benefits of the fertilizer been proven (increased productivity, tastier vegetables and fruits, improved food quality, reduction of nitrate runoff)?
- Is it possible to get grant support to proceed with the crop and health studies?
- Is it possible to change the public perception about radiation in clay slurries?
- Is there a way to change the urea drying process to reduce nitrogen toxins?
- Is there a real market opportunity with Florida farmers for this product?
- Is the increase in the total world population and the demand for more food production a great market opportunity for the slow-release fertilizer?
- Are genetically modified foods a great threat to the fertilizer industry?
- Is the fertilizer able to withstand competitive pressures in the market?
- Is the seasonality of the agricultural market a hinder to the fertilizer sales?
- Are restrictions on the importation of urea a major threat that prevents the penetration of very important markets?

VII.Competitive Analysis

a. Competitors

Competitor Name	Product Composition	Total Sales ($) millions	Strengths	Weaknesses
Cargill	Nitrate, sulphur, urea granular fertilizers	2004 - $62,907	- Big player (US largest private corporation) - Established brand names and market exposure	- No access to capital market funding
Agrium, Inc.	Ammonium nitrate, urea granular fertilizer, phosphate, Nitrogen, fertilizers, potash	2003 - $2,499 2004 –$2,838 2004 – $556 (Fertilizer)	- Agrium can continue to serve its customers during peak periods because of a huge storage facility - One of the main players in North America for manufacturing and distribution of fertilizers	- Only sells to growers and does not conduct operations in the wholesale market
CF Industries, Inc.	Ammonium nitrate, phosphate, granular urea, fertilizer,potash	2003 - $1,287	- Interregional cooperatives: easy access to market	- Concentrated geographic sales (North America)
Terra Industries, Inc.	Ammonium nitrate, urea granular fertilizer	2004 – $1,509	- Expertise in nitrogen fertilizers	-Concentrated geographical sales (US and UK)
Asahi Kasei Co.	Ammonia, nitric acid, caustic soda, high-compound fertilizers	2004 - $11,866	-Leader in chemical production -Diversified product portfolio -Strong financial position	-Concentrated geographical sales (Asia) -Long research and development (R&D) time
DeBruce Grain, Inc.	Ammonium nitrate, phosphate, potash, urea granular fertilizer	2004 - 2,018.00	- Growing revenues - Strong service capabilities	- Lack of scale
Scotts Miracle-Gro Co.	Fertilizers	2003 - $2,037	-Strong position of brands -Research & Development focus -Strong association with retailers - Exclusive marketing agreement with Monsanto	-Dependence on few customers -Rising Operating expenses -Asbestos related law suits
Lesco Inc	Fertilizers	2003- $523 2003- $204 (Fertilizer)		
JR Simplot Company	Phosphate and nitrogen fertilizer, Organic fertilizer, Controlled release fertilizer, Specialty fertilizer	2004- $3,100	-Low cost miner of phosphate -Low cost manufacturer of nitrogen and phosphate fertilizers -Assists farmers with financing, harvesting & marketing -Produces controlled release and organic fertilizers	-Slow revenue growth -pollution due to Selenium emission -negative publicity
BASF	Fertilizers	2004- $51,200 2004- $4,574	World's largest chemical company Strong presence in Europe and Asia/Pacific & Africa	
PotashCorp	Potash, nitrogen, phosphate		World's leading producer of potash	
Sociedad Quimica y Minera de Chile (SQM)	Specialty fertilizers	2003- $691 2003- $346 (Fertilizer)	World's largest producer of iodine	

b. Overview of Competitive Analysis

The fertilizer industry is fragmented and has many competitors. Major competitors are established companies with average annual revenue of over $1,200 million dollars. Direct competitors would be manufacturers of other slow release fertilizers, and indirect competitors would be manufacturers of regular fertilizers. An overview of major companies in the U.S. and in the international arena provides insight into the industry as a whole.

c. U.S. MARKET:

Cargill is the largest U.S. private corporation and has operations in 67 countries worldwide. Sales amounted to $62,907 million in 2004. The company's operations are diversified including animal feed and crop fertilizer production. Cargill is the leading grain producer in the U.S., and has an established brand name and significant market exposure. However, the company has no access to capital market funding. In 2004, the company combined its crop-nutrition segment with phosphate fertilizer maker IMC Global to form a new publicly traded company called Mosaic, creating the world's largest maker of phosphate and potash crop nutrients. Cargill owns about 66% of the company.

Koch Industries Inc. is the second largest privately held company in the U.S., after Cargill. The company has operations globally including Europe, Asia, South Africa, and South and Central America. Sales for the company were estimated at $40,000 million in 2003. Koch Industries has diversified operations in over 20 business segments including chemicals, fertilizers, asphalt, energy, and minerals.

Agrium Inc. is a top producer and marketer of fertilizers in North America and had sales of $2,838 million in 2004. In addition, Agrium produces and markets phosphate and potash, as well as micronutrients used primarily in fertilizers. The company has 11 plants in Canada, the U.S. and Argentina that produce mainly nitrogen products. The plants have the capacity to produce more than 7 million tons of nitrogen annually. Agrium supplies wholesalers and operates over 200 fertilizer retail outlets in 22 states in the U.S., and almost 40 retail farm centers in South America. In 2005, Agrium expanded its operations in Argentina, Bolivia, and Chile by acquiring retail business of United Agri Products (UAP). Fertilizer sales of $556 million accounted for 10% of its total sales in 2004, while nitrogen and phosphate accounted for 45% and 10% of sales respectively.

Terra Industries Inc. is a publicly held company and had sales of $1,507 million in 2004. The company's sales, however, are in concentrated geographic areas within the U.S. and UK, with 70% of sales in the U.S. and 16% in the UK. Nitrogen product sales of $1,320 million accounted for 88% of total sales in 2004. The company ranks among the leading producers of nitrogen in North America, and produces ammonia and urea, necessary ingredients for fertilizer production. Terra Industries sells its products to dealers, retailers, cooperatives, and chemical companies. Terra Industries bought Mississippi Chemical, a fertilizer maker in 2004, which is now a wholly owned subsidiary.

JR Simplot Co. is a privately held company and had sales of $3,000 and $3,100 million in sales in 2002 and 2003 respectively. The company has operations in the U.S., Australia, Canada, China and Mexico. The company operates in five business segments including the Agricultural Business group, which mines phosphates for fertilizer and feed, as well as silica.

The company produces controlled release fertilizers and organic fertilizers. The company is a low cost miner of phosphate and low cost manufacturer of nitrogen and phosphate fertilizers giving it a competitive edge within the market. The Agricultural Business unit also assists farmers with services including financing, harvesting and marketing. On the downside, it faces negative publicity because of the pollution caused by Selenium emissions.

Scott Miracle-Gro Co. operates with manufacturing, sales, and service facilities in the U.S., Australia, Belgium, France, Germany, the UK and the Netherlands. Total sales for 2004 were $2,038 million, with North America accounting for 72% and International markets accounting for 21%. Scott's is the world's largest marketer of branded consumer lawn and garden fertilizers, and enjoys brand leadership across all of its products. The Scotts Miracle-Gro Co., has 98 patents in the U.S. and 434 worldwide and invests in extensive research & development to improve its products. The company depends on a few main customers within its main consumer segment in the U.S. for sales, such as, Home Depot (36%), Walmart (18%), and Lowes (13%). Loss of any of these customers can result in poor sales for the company.

CF Industries, Inc. is an interregional agricultural cooperative that manufacturers and markets fertilizers including nitrogen products, phosphates and potash in 48 U.S. states and two Canadian provinces. The company sales in 2003 were $1,287.3 million. CF industries operate nitrogen and phosphate plants, a phosphate mine, and a network of distribution terminals and storage facilities through which it offers its products worldwide.

Lesco, Inc., is a publicly held company and its principal manufacturing and distribution facilities are based in 8 U.S. states including Florida. The company sales in 2003 totaled $523.5 million, with its fertilizer and combination products segment accounting for $204.5 million, 39% of sales. In 2004, sales were $561 million. The company is divided into four sections including the product supply which manufactures fertilizer. Lesco sells its products through nearly 250 service centers, a fleet of approximately 70 tractor-trailer-based stores, and through sales representatives. In addition, Lesco supplies nurseries, garden centers and other independent marketers.

d. INTERNATIONAL MARKETS:

Bash Aktiengesellschaft is the world's largest chemical company and has more than 100 manufacturing facilities. The company engages in business globally with five business segments including the Agricultural Products and Nutrition segment which produces fertilizers. Sales for the company equaled $51,200 in 2004, with $671 million contributed by the Agricultural Products & Nutrition segment. More than half of the company's sales come from Europe (56%-2004), but the company continues to expand overseas, particularly in Asia. The company opened two new sites in Asia including one in Malaysia. North America accounted for 22% of sales in 2004, while Asia/Pacific & Africa accounted for 17%.

Potash Corporation of Saskatchewan is the world's leading producer of potash, and also produces nitrogen and phosphate. The company has an annual production capacity of 12.5 million tons of potash representing 25% of the world's capacity. The company has about 20 plants in North America, Brazil, Chile and Trinidad. PotashCorp has continued to invest in fertilizer businesses worldwide.

Sociedad Quimica y Minera de Chile S.A. (SQM) produces specialty fertilizers, primarily in Latin America, North America, and Europe. Total sales for the company in 2003 were $691.8 million, with the specialty fertilizers accounting for $346.1 million. PotashCorp owns approx. 28% of SQM. The company experienced increased sales in 2004 (which is expected to continue) because of a growing demand globally for potash, phosphates and nitrogen as well as higher prices for raw materials. Brazil and China are SQM's largest consumers by volume.

In Asia, **Asahi Kasei Co**. is a leader in chemical production and had annual revenues of $11,866 million in 2004. The company has a diversified product portfolio and a strong financial position; however it has concentrated geographic sales in Asia.

e. Summary of Competitive Analysis

The PIs believe that nobody out there has a product that compares to their fertilizer. Since one of the competitive advantages of this new technology is the fact it cuts down on waste production by consuming of the waste products (e.g. gypsum and clay slurry), all the research concerning fertilizer that would use and/or transform part waste products can be considered as a major competition. Likewise, some scientists have been working with urea as a major component of a new generation of fertilizers but have yet to come up with a dry product.

The PIs are pursuing an international patent on this technology, which prevents other companies from replicating it. However, it will be hard to protect the patent outside the U.S. since the PIs are planning to market overseas. It all depends on the country and the enforceability of the patents by their government. Some of its direct competitors would be manufacturers of other slow-release fertilizers and indirect competitors would be manufacturers of regular fertilizers. Those other slow-release fertilizers are being tested and produced but none of them includes all major nutrients present in the human body.

VIII.External Market Influences

a. Economic/Market Environment

Economy/International: The rising price of raw materials, namely, natural gas, phosphate and potash in the U.S. makes it more expensive for U.S. fertilizer producers to compete globally. The steady increase in the price of natural gas has adversely affected nitrogen fertilizer production and U.S. nitrogen plants are closing at extremely quick rate. In addition, prices of potash and phosphate have been the highest in many years and have added to the increase in production cost. Major fertilizer companies are selling at a price lower than cost in order to compete in global markets.

In the international arena, the demand for fertilizer is growing at a faster rate in developing countries; however consumers tend to demand lower priced products. Countries like India and China have increased output to meet increasing global demand.

Technology: The big industry players are intensifying research towards the impact of fertilizer on sustainable crop production. Slow release fertilizers and mixed fertilizers have received the most support for this type of research. On the other hand, the increased use of genetically modified organisms (GMO'S) for agriculture production has limited the use of fertilizer, especially in the U.S.

Demographics: With more than 6.45 billion people on earth, and an estimated 6.8 billion by 2010, experts estimate that food production must increase more than 2% annually to maintain current diets. Commercial fertilizers appear as the only reliable tool to provide

sufficient yields to feed the world. The fastest rate of population growth is in developing countries.

Governmental: Governments of India, China, and the Middle East all employ public policies that subsidize fertilizer. The demand is increasing the most in these regions, and these measures have an important impact on the overall global market. Additionally, government regulations can have a direct impact on the industry. The fertilizer industry is governed by a range of manufacturing regulations within the European Union. Regulations cover the health and safety of employees and the general public, conditions for the safe storage and transportation of manufactured fertilizer material and intermediates, limits on emissions to the atmosphere and water (fresh and marine), limits on noise levels, and the treatment and disposal of waste products resulting from the production of fertilizer.

Social: Consumer trends are changing toward a healthier diet in western countries, which has resulted in an increase in demand for organic food. This can have a negative impact on demand for fertilizer. The public perception of the slow release fertilizer can be negative because of the radiation caused by the clay slurry. However, this effect can be significantly reduced because of the minimal amount of radiation in the actual application of fertilizer. Public awareness programs can help diffuse this negative public perception.

Seasonal[10]: Agricultural markets are both seasonal and volatile. Demand is a function of such factors as grain prices, government farm programs, acreage and mix of crops planted, weather patterns, and farming practices. The consumer business is seasonal, with most North American sales made between February and June, as products are used for growing and

[10] Standard & Poor's, "Quantitative Stock Report", Page 3, March 26, 2005

maintaining lawns and gardens. Periods of wet weather tend to slow sales. The seasonality can be reduced by exploring other global markets, and in particular countries in Central America where agricultural production is less seasonal.

Political: Some governments, such as in Nigeria, restrict the importation of urea, a key element to the production of fertilizers, due to the belief that urea is a form of explosives.

Environmental: Nutrients present in fertilizer have an impact on the environment and public health, for example, nitrate runoffs in drinking water, ammonia in air quality, and nitrous releases of greenhouse gas that consequently depletes the ozone layer. The slow release fertilizer technology will provide greater public health benefits by reducing adverse environmental impacts.

b. Risks and Challenges

Trends and Continuing Challenges:

- Improving efficiency (including more essential nutrients)
- Reducing losses that impact the environment
- Increasing accountability of producers (pollution)
- Improving public perception
- Supporting science on the full impact of crop nutrients on economic, environmental and social sustainability

IX.Resources Required/Available

The resources needed by the principal investigators are related to research. Indeed, further research is still needed in order to finalize their product and make it ready to be marketed.

a. Personnel

The principal investigators currently have several volunteer undergraduate honors students working in the lab. These students have been very productive and efficient in their work within the labs, helping the principal investigators with their experimentations and improvements for the fertilizer. Dr. Kay has also supported students doing independent undergraduate research. Recently a student was honored by being selected to present during the Universities Undergraduate Research Symposium.

b. Facilities/Equipment

The current facilities consist of a small chemistry lab in the College of Public Health at the University of South Florida. Most of the testing is being done at this facility. Dr. Kay has obtained access to a new AA Spectrometer (an instrument that looks for the presence of selected metals) within the Kopp Engineering building on the USF Tampa campus. Testing of a pilot study crop of tomatoes has begun at these facilities. This current testing will provide adequate data to obtain the Florida Institute of Phosphate Research (FIPR) grant to fund extensive testing within the Gulf Coast Research & Education Center in Balm, Florida. This new center is the 19th such center devoted to advancing agriculture, horticulture and landscaping practices through the University of Florida's Institute of Food and Agricultural Sciences.

There is also a facility in Georgia that is helping them produce the fertilizer for pilot testing in Nigeria. This facility would be available for further testing, production, or commercialization.

c. Funding

3. Investment

a) Friends and Family/Angels

Over 125 separate Rotary Clubs of Hillsborough, Pinellas and Polk County contributed over $250,000 support for three years of a pilot study in Nigeria, Africa. The International Rotary Foundation visited the site where 500 farmers are involved. The results looked so good that the International Foundation has decided to continue support for a fourth year. They expect to expand in the future. The Rotary Club of Nigeria is involved and other groups in the region and interested in participating.

b) Venture Capital

Venture activities are not necessary. The PI has access to suitable funding and facilities. The current project development is sufficient to bring the additional funding needed to complete the pilot studies and publications necessary to begin license negotiations.

4. Grants

The $30,000 FIPR grant is sufficient to fund the product development and laboratory work for extensive testing. The PI is investigating obtaining another AA Spectrometer and additional lab resources within the new University Research Park for this more extensive

testing. The Balm Research Center has the staff, facilities and equipment to plant an acre or two of tomatoes and strawberries for testing the proposed fertilizer. Within a year of planting, the data will be compiled to document the improved production rates derived from this new product. These statistics are necessary before any firms will pursue patent licensing.

d. Intellectual Property (IP)

1. Patents

U.S. Patents Awarded

	PAT. NO.	Title	Date	Assignee
1	5,849,790	(Mono) ethylenediaminenitroplatinum (IV) complexes with ligands of oxides of nitrogen as possible anti-tumor agents	15-Dec-98	**University of South Florida**
2	4,915,936	Dental hygiene composition for reducing periodontal disease	10-Apr-90	United States Gypsum Company
3	4,849,193	Process of preparing hydroxylapatite	18-Jul-89	United States Gypsum Company
4	4,457,781	Method for solidifying waste slime suspensions	3-Jul-84	United States Gypsum Company
5	4,452,770	Phosphoanhydrite process	5-Jun-84	United States Gypsum Company
6	4,424,196	Phosphohemihydrate process for purification of gypsum	3-Jan-84	United States Gypsum Company
7	4,421,731	Process for purifying phosphogypsum	20-Dec-83	United States Gypsum Company
8	4,402,922	Process for rapid conversion of fluoroanhydrite to gypsum	6-Sep-83	United States Gypsum Company
9	4,388,292	Process for reducing radioactive contamination in phosphogypsum	14-Jun-83	United States Gypsum Company
10	4,251,416	Carpet backing adhesive	17-Feb-81	United States Gypsum Company

International Patent Applications Pending

	PAT. NO.	Title	Date	Assignee
1	(WO 03/050059)	SLOW-RELEASE FERTILIZER	19-Jun-03	**University of South Florida**
2	(WO 2005/016946)	PLATINUM COMPLEXES AND METHODS OF USE	24-Feb-05	**University of South Florida**
3	(WO 2005/023824)	METHODS FOR INHIBITING TUMOR CELL PROLIFERATION	17-Mar-05	**University of South Florida**

X.Projected Sales

Historical and Projected Sales							
Historical				Projected			
				Year 1	Year 2	Year 3	Year 4
	2002	2003	2004	2006	2007	2008	2009
Overall Industry	$72,683.98	$73,581.45	$74,417.95	$75,968.70	$76,715.71	$77,460.73	$78,177.09
Specific Market	$23,236.61	$23,271.43	$23,316.39	$23,410.92	$23,488.54	$23,601.01	$23,723.91
% of Overall	32%	32%	31%	31%	31%	30%	30%
Product							
Best Case				34.00	53.30	81.69	116.40
Worst Case				6.80	17.77	25.99	38.80
Most Likely				23.80	42.64	74.26	89.24
% of Overall				0.03%	0.06%	0.10%	0.11%
% of Specific				0.10%	0.18%	0.31%	0.38%

*Sales figures are estimated in millions.

The published fertilizer use for the world and the U.S. is available for years 1960-2001. This data was used to create a regression analysis to estimate the next 10 years of data.[11]

According to the 1997 IFA Report on controlled-release fertilizers, the market for slow-release fertilizers was estimated at 0.7% of the total fertilizer market for the U.S., and 4.1% for the world market. The projected growth of this segment was expected to be 4.5% for the next 10 years. Our projections are based on these estimations.

[11] The Fertilizer Institute, http://www.tfi.org/Statistics/USfertuse2.asp

XI.Options

The primary goal for the PIs would be to manufacture and distribute the slow-release fertilizer on the widest scale possible. To this end, we recommend that the PIs negotiate non-exclusive licenses with a few multinational companies (MNC's). Those transnational organizations do indeed have a broad distribution network and strong partnerships with local stakeholders worldwide. MNC's have strong bargaining power and may not accept to buy the license rights unless they are exclusive. A secondary option would be that the PIs then consider an exclusive licensing agreement with one big player in the industry. Cargill would be a good candidate for an exclusive license.

If an agreement cannot be reached with any multinational companies, the PIs should consider out licensing their invention to a few regional players. Many companies do have operations in specific parts of the world (Asahi in Asia, CF Industries in North America etc…). If a few of those corporations are interested in using the technology, non-exclusive agreements could be obtained. The fertilizer could then be distributed efficiently in various parts of the world since those companies have solid ties in the regions where they operate.

Joint Venture or Non-Exclusive

A possibility that is being currently assessed involves setting up a joint venture with a partner company that already produces fertilizer. A phosphate mining company has donated ore and helped considerably with the initial testing by providing material for the production of samples for testing. The principal investigator currently intends to provide this corporation with the initial opportunity to license the patent. This opportunity is in alignment with the options given in the technology and market assessments discussed above.

XII.Conclusions and Recommendations

Current market opportunities provide a clear position for the success of Dr. Jay Palmer's patent for the slow-release fertilizer. The patent takes advantages of shortfalls in the existing technologies for mining, refining and distributing fertilizers of large corporations already established in the market. One of the competitive advantages of this new technology is the fact it cuts down on waste production by consuming of the waste products (e.g. gypsum and clay slurries).

The non-exclusive licensing of the invention to multinational companies remains the most efficient alternative right now. It could provide the PIs with the necessary resources to distribute the fertilizer where it is needed. However, we recommend that they perform further research and development to prove the claimed benefits of the product and qualify for more grants. Health studies should also be conducted to prove the benefits the fertilizer provides to humans.

XIII.Implementation Program

Action	Outcome	Timeline
1) Finalize issue of the patent	- Protect the invention	As soon as possible
2) Obtain a second AA Spectrometer	- Determine product benefits - Experimental evidence	May 2005 - Aug. 2005
3) Apply for grant funding at FIPR	- Undertake further R & D	As soon as benefits are proven and published
4) Continue collaboration with the Rotary Club	- Pilot testing in Africa	Continue – already in process
5) Production of fertilizer	- Pilot testing in U.S. and internationally	Within the next few months
6) Negotiate contracts with MNCs (non-exclusive)	- License out patent	As soon as benefits are proven and published (July 2005 - Dec. 2005)
7) If a non-exclusive does not work out, negotiate an exclusive contract	- License out an exclusive contract	Nov. 2005 - Mar. 2006
8) If an exclusive does not work out, negotiate a non-exclusive contract with regional players	- License out a non-exclusive contract with regional players	Feb. 2006 - June 2006
9) If a non-exclusive does not work, negotiate a joint venture	- Joint venture with phosphate mining company to help commercialize the product	May 2006 - Aug. 2006

XIV.Glossary

Clay Slurry: a suspension of insoluble particles (as plaster of paris or lime or clay) usually in water

Dolomite: A white or light-colored mineral, essentially $CaMg(CO_3)_2$, used in fertilizer, as a furnace refractory, and as a construction and ceramic material

Feldspar: Any of a group of abundant rock-forming minerals occurring principally in igneous, plutonic, and some metamorphic rocks, and consisting of silicates of aluminum with potassium, sodium, calcium, and, rarely, barium

Gypsum: a common white or colorless mineral (hydrated calcium sulphate) used to make cements and plasters (especially plaster of Paris)

Igneous: Formed by solidification from a molten state

Ligand: An ion, a molecule, or a molecular group that binds to another chemical entity to form a larger complex

Ore: A mineral or an aggregate of minerals from which a valuable constituent, especially a metal, can be profitably mined or extracted

Urea: A water-soluble compound, $CO(NH_2)_2$, that is the major nitrogenous end product of protein metabolism and is the chief nitrogenous component of the urine in mammals and other organisms

XV.Bibliography

- "Fertilizer Use by Crop," IFA, IFDC, IPI, PPI, FAO Report, 5th Edition, 2002

- "Industry as a Partner for Sustainable Development," IFA & UNEP, December 2001

- "Agri Fertilizer Handbook," Hydro, December 2003

- "Fertilizer Statistics," Food and Agriculture Organization, 2002

- The Fertilizer Institute and the Agricultural Retailers Association, " Agricultural Retailers Association and the Fertilizer Institute Testify on the Impact of Natural Gas Prices," March 17, 2005

- Palmer, Jay W., "Slow-release (GSSP fertilizer," U.S. Patent & Trademark Office, December 6, 2002, Application Number 20030115920

- Standard & Poor's, "Quantitative Stock Report", Page 3, March 26, 2005

- The Fertilizer Institute, http://www.tfi.org/Statistics/USfertuse2.asp

- http://www.cfindustries.com

- www.cargill.com

- www.agrium.com

- www.datamonitor.com http://dbic.datamonitor.com/search/?search=249EE9E7-D53E-49D1-97AE5B5FE9783678&keywords=cargill

- www.fertilizer.org

- www.efma.org

- www.agrifor.com

- http://www.tfi.org/

XVI.Appendix

Strategic Market Assessments for New Technologies

Technology Assessment Tool

Investigators' Information Report Form

1. Principal Investigators (PI's):

Presenter and Key Contact: **Jay W. Palmer**
Dept.: Chemistry
Phone: (813) 633-0604
E-mail: jaywpalmer@webtv.net

Name: **Heidi Kay**
Dept.: College of Public Health
Phone: (813) 974-6408
E-mail: hkay@hsc.usf.edu

2. Lay summary of PI's key research and technological inventions:

Dr. Palmer has extensive experience with the fertilizer industry and the specific compounds and chemicals fundamental for plant growth and human nutrition. His research and innovation is involved with adjusting the fertilizer composition to include more of the clay, gypsum, and urea residues typically removed by the current state of the art. Including these compounds creates a slow-release formulation where additional trace minerals are added to make the fertilizer bring more of these vital nutrients to man through the food supply.

3. PI's assessment of potential uses of technology as currently developed:

Potential uses currently being explored are in areas of North Africa, as well as Florida, where soil quality is so low, and in Malaysia and the Caribbean where there are heavy levels of rainfall. The fertilizer must be tested and used in a controlled setting to define specific benefits with measurable results and comparisons with industry standards. The field study needs to be done before any grant can be accorded. This will allow the PI to publish within the fertilizer industry and to eventually find potential commercial partners.

4. Recent <u>relevant</u> PI's published scientific papers (please attach reprints):

<u>Titles of articles and authors</u>

1) An Approach on Improving the Health of Human Populations, Florida Scientist, 2000; 63(3):167-176. **Jay W. Palmer.**

2) Florida and Global Warming, Florida Scientist, 1998; 61(2): 96-105. **Jay W. Palmer.**

3) Extraction of Cadmium from Industrial Phosphoric Acid with Chelating Agents, J. Environ. Sci. Health, 1992 A27(6):1405-1413. **J.W. Palmer**, D. F. Martin, C.D. Norris.

5. PI's patent applications and issued patents (please attach copies):

Titles of patents, dates of issuance or application, patent numbers and inventors

1	5,849,790	(Mono) ethylenediaminenitroplatinum (IV) complexes with ligands of oxides of nitrogen as possible anti-tumor agents	**15-Dec-98**	Palmer, Jay W.; Stanko, Joseph A.; Sebti, Said M.; Burdge, Julia R
2	4,915,936	Dental hygiene composition for reducing periodontal disease	**10-Apr-90**	Patterson, Lloyd D.; Palmer, Jay W.
3	4,849,193	Process of preparing hydroxylapatite	**18-Jul-89**	Palmer, Jay W.; Rosenstiel, Terry L.
4	4,457,781	Method for solidifying waste slime suspensions	**3-Jul-84**	Palmer, Jay W.; Gaynor, John C.
5	4,452,770	Phosphoanhydrite process	**5-Jun-84**	Palmer, Jay W.; Gaynor, John C.
6	4,424,196	Phosphohemihydrate process for purification of gypsum	**3-Jan-84**	Palmer, Jay W.; Gaynor, John C.
7	4,421,731	Process for purifying phosphogypsum	**20-Dec-83**	Palmer, Jay W.; Gaynor, John C.
8	4,402,922	Process for rapid conversion of fluoroanhydrite to gypsum	**6-Sep-83**	Palmer, Jay W.; Gaynor, John C.
9	4,388,292	Process for reducing radioactive contamination in phosphogypsum	**14-Jun-83**	Palmer, Jay W.; Gaynor, John C.
10	4,251,416	Carpet backing adhesive	**17-Feb-81**	Palmer, Jay W.
WO	03/050059	Slow-release fertilizer	**19-Jun-03**	Palmer, Jay W.
WO	05/016946	Platinum Complexes and Methods of Use	**19-Jun-03**	Kay, Heidi; Palmer, Jay, W.;
WO	05/026392	Methods for inhibiting Tumor Cell Proliferation	**17 Mar-2005**	TURKSON, James; JOVE, Richard; PALMER, Jay, W.; KAY, Heidi; HUA, Yu

6. Potential Competitive Issued Patents (please attach copies)

Titles of patents, dates of issuance or application, patent numbers and inventors

	PAT. NO.	Title
IN/"Langer; Robert S" AND AN/Massachusetts AND Fertilizer		
1	4,921,757	System for delayed and pulsed release of biologically active substances
2	4,898,734	Polymer composite for controlled release or membrane formation
IN/"Bolind; Michael L"		
1	4,283,423	Free-flowing granular urea nutrient supplements
AN/"Gypsum" AND SPEC/semi-permeable		
1	4,015,972	Fortified gypsum granule
ABST/Bioerodible AND SPEC/fertilizer		
1	4,898,734	Polymer composite for controlled release or membrane formation
2	4,629,621	Erodible matrix for sustained release bioactive composition
ABST/semi-permeable AND SPEC/fertilizer		
1	6,656,882	Controlled release products and processes for the preparation thereof
2	4,921,757	System for delayed and pulsed release of biologically active substances
3	4,891,223	Controlled release delivery coating formulation for bioactive substances
IN/Tijsma		
1	6,656,882	Controlled release products and processes for the preparation thereof
2	6,139,597	Controlled release fertilizer compositions and processes for the preparation thereof

7. Names and locations of key leading <u>competitive</u> investigators in the relevant field of study (university- and/or industry-based):

Name: Robert S. Langer
Affiliation: Massachusetts Institute of Tech.
Phone: (617) 253-3123

Affiliation: Twente University of Technology
Phone: N/A

Name: Michael L. Bolind
Affiliation: United States Gypsum Company
Phone: (800) 874-4968

Name: OMS Investments, Inc.
Affiliation: The Scotts Company
Phone: N/A

Name: Edze Jan Tijsma

8. View of research <u>competition</u> in the relevant field (how do PI's rank themselves, in their own view). Additional comments may be attached.

The PIs believe that nobody out there has a product that compares to their fertilizer. Since one of the competitive advantages of this new technology is the fact it cuts down on waste production by consuming part of the waste products (e.g.: gypsum), all the research concerning fertilizer that would use and/or transform waste products can be considered as a major competition. Likewise, some scientists have been working with urea as a major component of a new generation of fertilizers but have yet to come up with a dry product.

9. View of technological <u>competition</u> in the relevant field (what do the PI's see as potential competition, in their own view). Additional comments may be attached.

The PIs have a patent on this technology, which prevents other companies in the U.S. from replicating it. However, it will be hard to protect the patent outside the U.S. since the PIs are planning to market overseas. The PIs don't see any competition because they believe that nobody out there is able to produce a fertilizer in the form of a granule that dries out and that's applied as regular fertilizer. Some of its direct competitors (in our view) would be manufacturers of other slow release fertilizers and indirect competitors would be manufacturers of regular fertilizers. Those other slow-release fertilizer are being tested and produced but none of them includes all major nutrients present in the human body.

10. Names and locations of <u>collaborating</u> investigators in the relevant field of study working within <u>university settings</u>:

Name: **Jonathan Hart**
Dept.: Undergraduate Honors Student
University: University of South Florida

Name: **Glenn Harris**
Dept.: Undergraduate Honors Student
University: University of South Florida

Name: **Alok Pandya**
University: University of South Florida
Dept.: Undergraduate Honors Student

11. Names and locations of collaborating investigators in the relevant field of study working within industrial settings:

NONE

12. Current status of PIs' research and developing technologies (status of commercialization activities and contracted studies):

A fertilizer production based in Georgia has been used to produce the fertilizer at a large scale. This production has been sent to Nigeria where the fertilizer proved its efficiency. This field experimentation had to be stopped due to international regulations being tightened after Sept 11, 2001. No measurable results could be gathered yet. The PI now needs to be granted some funds in order to conduct a field study and publish its findings. At the current stage, it is not possible to make any commercial agreement.

13. List SBIRs and STTRs awarded to PI's. Please attach copies.

No SBIRs nor STTRs have been awarded yet.

14. Current status of commercial products developed using this or related research and technologies:

No commercial products have been developed using this research and technology.

15. Current status of PI's research and clinical studies support (by whom, amount funded, how long, what areas of research)? Additional research support may be attached.

1) $250,000 grant awarded by Rotary International to begin pilot testing in Nigeria for 3 years.

16. How much research support do the PIs need for the next three years, for what purposes?

PIs need research support from the University to get an instrument that looks for the presence of selected metals contained in tomatoes grown with the fertilizer (AA Spectrometer- recently obtained). After they get this instrument, they will be able to get grants and support from FIPR (at least $30,000 needed). This grant would allow the PI to develop a substantial field test. The new fertilizers are to be adapted to different types of soils. In the next three years, they want to perform crop studies to determine yield and productivity. They also need to analyze the fruits and vegetables in order to determine their nutritional value, as well as their taste. Eventually, they will conduct a health study, so they can evaluate the benefits to humans as a result of the use of the slow release fertilizer, and to introduce it as a dietary supplement.

17. Team's assessment of potential uses of technology as currently developed (list—as broadly defined as possible):

- Change in the mining process to produce fertilizers to make it more profitable (cut downs on labor costs because of a simplification of the process; use of waste products)
- More extensive use of sand soils to grow agricultural products (possibility of using dolomitic ores)
- More nutritious and tastier vegetables and fruits
- Reduce nitrate runoff

18. Current development stage of technology (see below for stage definitions):

PI's Assessment __3__ **Team's Assessment** __3__

Technology Development Stage:

1. **CONCEPT**
   PRE-DISCLOSURE
   DISCLOSURE

2. **"LAB CURIOUSITY"**
   DISCLOSURE

3. **LAB PRODUCT—REPRODUCIBLE ("PROOF OF PRINCIPLE")**
   PROVISIONAL PATENT

4. **BENCH/PILOT PROTOTYPE—REDUCTION TO PRACTICE**
   PATENT

5. **SCALABLE PROTOTYPE**
   PROCESS PATENTS

6. **MANUFACTURING PROCESSES COMPLETE**
   PROCESS PATENTS

7. **PRODUCTION**

TECHNOLOGY OPPORTUNITY ASSESSMENT

DECISION MATRIX

TECHNOLOGY INDEX SCORE

	Very Weak	Strong	
	0	10	Score
*PI Scientific Publications	< 5	≥15	10
*PI # of Patent Disclosures	< 1	> 5	10
*PI # of Patents Issued	< 1	> 5	10
Age of Patent Disclosures (Tech. Specific)	≥ 5 years	≤ 1 year	7.5
Patent Competition (U.S. Patents)	≥ 50	< 5	7
*PI Grant Support (Annual Total)	≤ $100K	≥ $5M	0
*PI SBIR/STTR Grants (0-10)			0
Overall Team Competitive Assessment (0-10)			8
Raw Score (= Sum)			52.5
Technology Index Score (= Raw Score x 1.25)			**66**

Factors to be Considered in Team Competitive Assessment:

PI's Energy and/or Enthusiasm
PI's Breadth and Depth of Knowledge of Subject/Technology
PI's Background/Credentials/Focus/"Track Record"
PI's "Feel" for Competitive "Space"—Science/Technology/Industry/Competition
PI's Interest in Developing Technology
—Personally
—as Part of a Team
PI's Interest in Developing Business
PI's Business Experience
PI's "Business Savvy"

*PI = Principal Investigator

Strategic Market Assessments for New Technologies

Strategic Market Assessment Tool

Business Opportunity Analysis Outline

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1. Name of researcher(s), their department(s) and description of potential product(s) to be derived from/markets to be entered with the technology.

Name of PI: Dr. Jay W. Palmer and Dr.Heidi Kay

College: University of South Florida

Department: Chemistry and Public Health, respectively

Potential Products/Markets (list—broadly defined as possible):

The potential market for this new technology is the generic fertilizer market. It is part of the broader agricultural chemical industry. The fertilizer industry comprises phosphatic fertilizers, nitrogenous fertilizers, potassium fertilizers, and mixed fertilizers. The new technology, a mixed fertilizer, can have an impact on this overall market and potentially take market shares away from any segment.

2. Overall Market

- **Describe the overall market for the past, present and the next five years.**
  - **Size, growth, geography, demographics, etc.**

According to the Food and Agriculture Organization of the United Nations (FAO), estimates on fertilizer usage over the next five years are substantially lower than estimates made in the late 1990s. Lowered estimates in large part have to do with more efficient apportioning of fertilizers due to computer projections and because of more efficient use of available fertilizers, according to an FAO study. In addition, the health benefits of non-chemical, organically grown products have led to a reduction in fertilizer usage. Fertilizer use, which was about 135 million metric tons (mmt) in 2002, is expected to be no more than 150 mmt in 2010 according to the study's authors.

- **On both national and international levels discuss sales, profits, trends driving the market and growth rates.**

Since the 1990s, fertilizer manufacturers have faced flat or declining demand in many of the world's key markets, although increased demand from developing countries, particularly in Asia, was expected to bolster the market for fertilizers. Some industrialized countries have been seeking ways to minimize dependence on commercial fertilizers. A small but influential trend

toward organic agriculture has raised consumers' awareness of the chemicals used to produce food.

Developing East Asian countries, such as China, Indonesia, India, Vietnam, Cambodia, Pakistan, Thailand, and Malaysia, have remained major growth markets for fertilizers. Because agriculture in these areas is a major economic sector, crop quality is crucial and fertilizers take an important part in their development prospects.

The use of fertilizers, particularly in China and India, are increasing at a faster rate than the world average due to government subsidies for fertilizer purchases. These two nations are perceived as very important to the international fertilizer market. Governments in the Middle East, China, and India subsidize fertilizer use, which partly explains the steady increase in demand in these regions. These policies are likely to remain. Likewise, some governments in Africa distribute fertilizers and seeds to small rural farmers in attempts to fight hunger.

Shipments of fertilizers to Europe continue to slow, particularly since 2002. From that year on, countries such as Spain, Portugal, Greece, and Italy began fighting against the adverse effects of chemical residues on lands already ruined by unwise farming practices that cause desertification. In Europe, the FAO expects overall use of fertilizers to remain flat with slight increases. Latin America is forecasted to be a strong export region in the next 5 years.

In the United States, the amount of acreage exempted from crop production had a significant impact on the demand for fertilizer. Since 1998, there has been a decline in nitrogen fertilizer facilities, which is mainly due to the natural gas crisis. Jobs are being exported to China, Russia, the Middle East, and the Caribbean. There has also been a significant decline in operating rates for the U.S. ammonia industry.[12]

Overall, the leading markets for agricultural chemicals through 2010 are predicted to be Asia and South America, which have rapidly expanding economies and agricultural sectors.

3. Specific Market Segment(s)

- **Use the analysis above to describe the specific market segments for the product(s) both past, present, and projected.**

The specific market segments for the product are regions with dry, arid lands with silica-sand soils like Florida and Africa, and lands with heavy rainfall like the Caribbean and Malaysia. Also, lands with moderately acidic soils, like the southeastern United States and young igneous soils containing larger fragments of unreactive feldspars and quartz, found in Zimbabwe and Zambia. The secondary market segments are all other types of soils.[13]

- **Provide a brief overview of the competitive factors affecting the market.**

The market faces competitive pressures from a variety of companies, primarily from established companies with greater financial, marketing, and technical resources. These competitors may be better able to withstand pressure on price or other margin pressures. Some

[12] The Fertilizer Institute and the Agricultural Retailers Association, " Agricultural Retailers Association and the Fertilizer Institute Testify on the Impact of Natural Gas Prices," March 17, 2005

[13] Palmer, Jay W., "Slow-release (GSSP fertilizer," U.S. Patent & Trademark Office, December 6, 2002, Application Number 20030115920

factors may affect the market, like economic recession and aggressive pricing policies of its competitors. The major manufacturers of fertilizer, in general, that actively market to the retail sector are Bayer-Pursell which manufactures Vigoro, a slow release chemical fertilizer, the Scotts company which manufactures Miracle Gro, and the Shultz company. However, the slow release fertilizer of Dr. Palmer and Dr. Kay provides a dry granular product that reduces nitrate runoff, unlike any other product on the market.

The biotechnology industry strives to develop crops that are hardy and resistant with and without the aid of fertilizers and pesticides. Consequently, genetically modified organisms represent a threat to the fertilizer market because it reduces the demand for fertilizer.

Another competitive factor is that the price of natural gas is high in the United States, compared to global markets. This is important because the production of fertilizer needs natural gas. The major players within the U.S. are selling below market prices to compete with imports to the U.S.

- **Complete the following table with regard to competition.**

Competitor Name	Product Composition	Total Sales ($) millions	Strengths	Weaknesses
Cargill	Nitrate, sulphur, urea granular fertilizers	2004 - $62,907	- Big player (US largest private corporation) - Established brand names and market exposure	- No access to capital market funding
Agrium, Inc.	Ammonium nitrate, urea granular fertilizer	2003 – $2,499	- Agrium can continue to serve its customers during peak periods because of a huge storage facility - One of the main players in North America for manufacturing and distribution of fertilizers	- Only sells to growers and does not conduct operations in the wholesale market
CF Industries, Inc.	Ammonium nitrate, phosphate, urea granular fertilizer	2003 – $1,287	- Interregional cooperatives: easy access to market	- Concentrated geographic sales (North America)
Terra Industries, Inc.	Ammonium nitrate, urea granular fertilizer	2004 - $1,509	- Expertise in nitrogen fertilizers	-Concentrated geographical sales (US and UK)
Asahi Kasei Co.	Ammonia, nitric acid, caustic soda, high-compound fertilizers	2004 - $11,866	-Leader in chemical production -Diversified product portfolio -Strong financial position	-Concentrated geographical sales (Asia) -Long research and development (R&D) time
DeBruce Grain, Inc.	Ammonium nitrate, phosphate, potash, urea granular fertilizer	2004 - $2,018	- Growing revenues - Strong service capabilities	- Lack of scale

4. Market Influences

- **Describe the factors that have a major impact on past and projected sales for the industry.**

  Economy/ International: The countries where the need for fertilizer is the greatest are developing countries that tend to look for low cost products.

  Technology: The big industry players are intensifying research towards fertilizer enabling sustainable crop production. Slow release fertilizers and mixed fertilizers receive the most support.
  Demographics: With more than 6.45 billion people on earth, and an estimated 6.8 billion by 2010, experts estimate that food production must increase more than 2% annually to maintain current diets. Commercial fertilizers appear as the only reliable tool to provide sufficient yields to feed the world.

  Governmental: Governments in India, China, and the Middle East subsidy fertilizer. Those regions are the ones where the demand is increasing the most, and these measures have an important impact on the overall market. The European Union is governed by a wide number of manufacturing regulations. Regulations pertaining to the fertilizer industry cover the health and safety of employees and the general public, conditions for the safe storage and transportation of manufactured fertilizer material and intermediates, limits on emissions to the atmosphere and water (fresh and marine), limits on noise levels, and the treatment and disposal of waste products resulting from the production of fertilizer or fertilizer intermediates.

  Social: The public perception of fertilizer can be negative because of the radiation caused by the clay slurry. There are consumer trends that push for a healthier diet in western countries and the demand for organic food is growing.

  Seasonal[14]: Agricultural markets are both seasonal and volatile. Demand is a function of such factors are grain prices, government farm programs, acreage and mix of crops planted, weather patterns, and farming practices. The consumer business is seasonal, with most North American sales made between February and June, as products are used for growing and maintaining lawns and gardens. Periods of wet weather tend to slow sales.

  Political: Some governments, such as in Nigeria, restrict the importation of urea, a key element to the production of fertilizers, due to the belief that urea is a form of explosives.

  Environmental: Nutrients present in fertilizer have an impact on the environment and public health:
  - nitrate in drinking water
  - ammonia in air quality
  - nitrous releases greenhouse gas and consequently is an ozone depletory

[14] Standard & Poor's, "Quantitative Stock Report", Page 3, March 26, 2005

Trends and Continuing Challenges:

- Improving efficiency
- Reducing losses that impact the environment
- Increasing accountability
- Improving public perception
- Supporting science on the full impact of crop nutrients on economic, environmental and social sustainability

- **Describe key market indicators that may have a significant impact on sales, and what the impact(s) would be, and how these impacts could be promoted if positive and/or mitigated if negative.**

Year-to-year changes in demand reflect the level of planted acreage and fertilizer application rates. There was an increase in planted acreage and fertilizer application rates in 2004 in the United States, and this is expected to remain steady in 2005.[15]

Prices for both phosphate and potash had the highest levels in many years, which affect the cost of production and ultimately sales prices.[16]

It is believed that the developing countries of Asia and Latin America hold greater long-term growth potential that is mainly due to rising populations, income levels, and demand for better living standards. The developing countries are expected to account for 72% of world crop production in 2030 compared to an overall world crop production of 57%.[17]

5. Historical and projected sales

- **Complete the following table with regard to industry and product sales**

Historical and Projected Sales							
Historical				**Projected**			
				Year 1	**Year 2**	**Year 3**	**Year 4**
	2002	**2003**	**2004**	**2006**	**2007**	**2008**	**2009**
Overall Industry	72,683.98	73,581.45	74,417.95	75,968.70	76,715.71	77,460.73	78,177.09
Specific Market	23,236.61	23,271.43	23,316.39	23,410.92	23,488.54	23,601.01	23,723.91
% of Overall	32%	32%	31%	31%	31%	30%	30%
Product							
Best Case				34.00	53.30	81.69	116.40
Worst Case				6.80	17.77	25.99	38.80
Most Likely				23.80	42.64	74.26	89.24
% of Overall				0.03%	0.06%	0.10%	0.11%
% of Specific				0.10%	0.18%	0.31%	0.38%

[15] Standard & Poor's, "Quantitative Stock Report", Page 3, March 26, 2005
[16] Standard & Poor's, "Quantitative Stock Report", Page 3, March 26, 2005
[17] Standard & Poor's, "Quantitative Stock Report", Page 3, March 26, 2005

- **Describe your methodology and sources for developing the above analysis.**

The published fertilizer use for the world and the U.S. is available for years 1960-2001. This data was used to create a regression analysis to estimate the next 10 years of data.[18]

According to the 1997 IFA Report on controlled-release fertilizers, the market for slow-release fertilizers was estimated at 0.7% of the total fertilizer market for the U.S., and 4.1% for the world market. The projected growth of this segment was expected to be 4.5% for the next 10 years. Our projections are based on these estimations.

[18] The Fertilizer Institute, http://www.tfi.org/Statistics/USfertuse2.asp

MARKET OPPORTUNITY ASSESSMENT

DECISION MATRIX

MARKET INDEX SCORE

	Very Weak	Strong	U.S.	World
	0	10	Score	Score
Number of Competitors	< 5	>10	10	10
Market Size (Sales)	$100M	$1B	10	10
Market Growth Rate	≤15%	50%	0	2
Market Structure (VW-Consolidated/Hi-Competitive) (S-Fragmented/Lo-Competitive) (VW-Regulatory/Difficult Entry) (S-No Regulatory/Easy Entry)			0	0
Market Share Attainable	< 5%	> 40%	0	0
Market Capacity (VW-Currently met by participants) (S-Currently unmet)			6	8
Comparables (VW-Largest competitor > 50% Mkt Sh) (S-Largest competitor < 20% Mkt Sh)			10	10
Marketing Budget (Budget required vs. "Adequate Resources" obtainable; internal, equity, debt, license, partner, etc.)			7	5
Opportunities (Build, License, Partner, etc.) "Split" Technology Additional Mkt Segments			5	7
Overall Team Competitive Assessment (0-10)			5	7
Raw Score (= Sum)			53	59
Market Index Score (= Raw Score x 1.0)			53	59

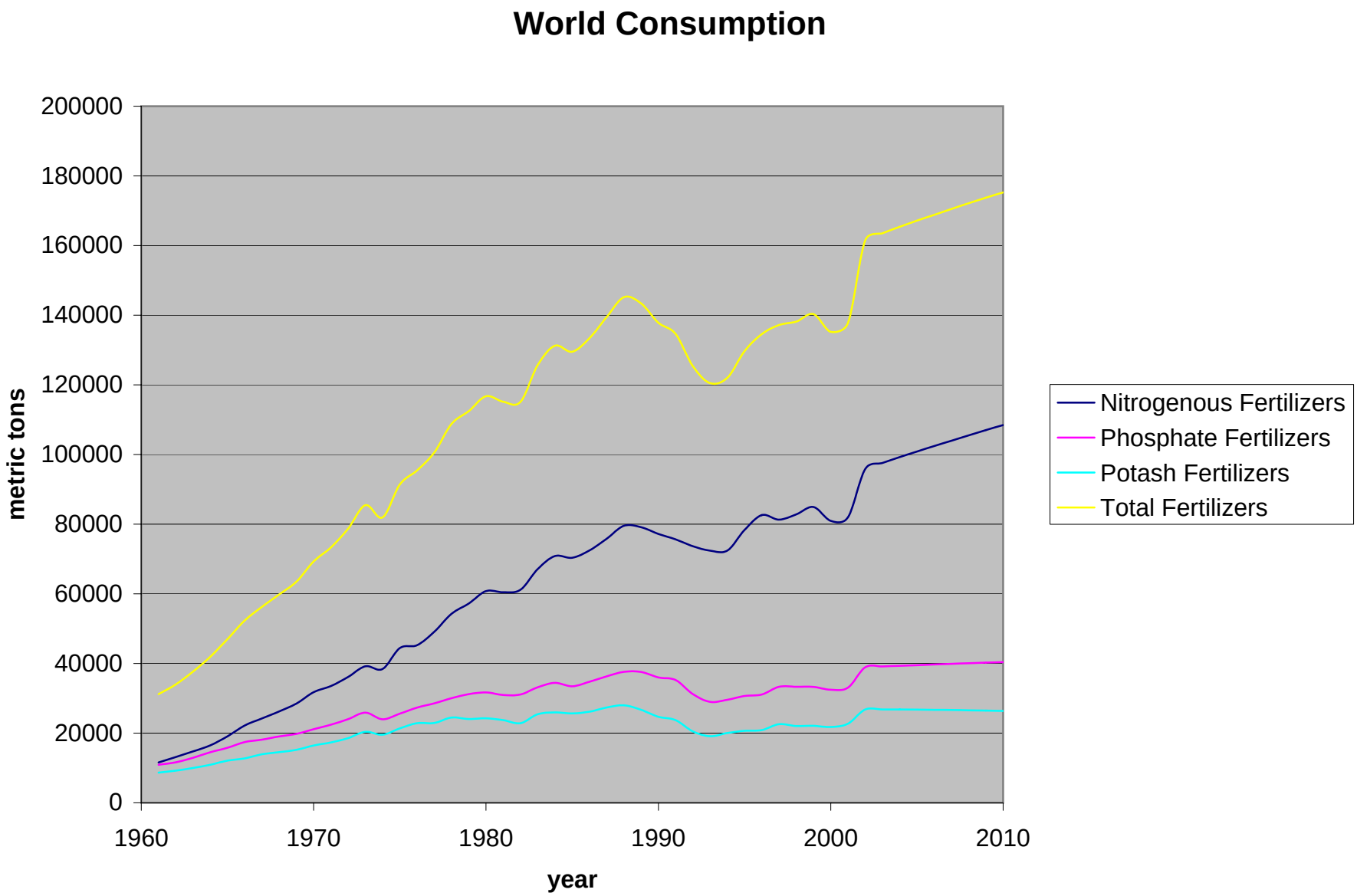
Factors to be considered in Team Competitive Assessment:

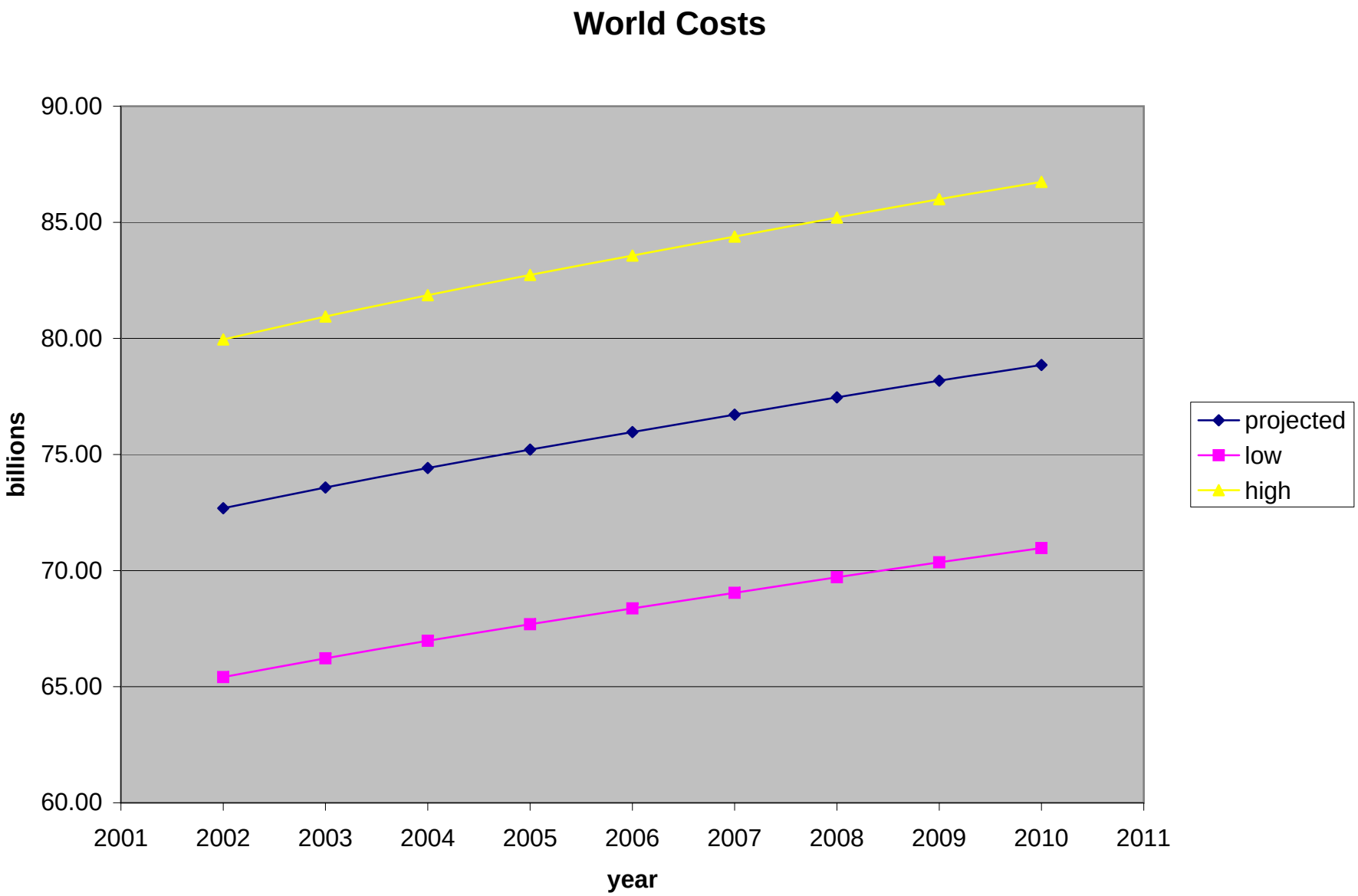
Is technology potentially "life/world-changing"?
Application potential of technology within market(s)
Likelihood of significant market interest in technology (e.g., ease of use, cost, etc.)
Likelihood of competitive "paradigm shift" (+ or -)
Ability to generate repetitive sales/cash flows (e.g., "razor blade model")
Likelihood of significant market resistance to technology/products
Process required to enter market (e.g., regulatory approval, etc.)
Other….

MARKET OPPORTUNITY ASSESSMENT

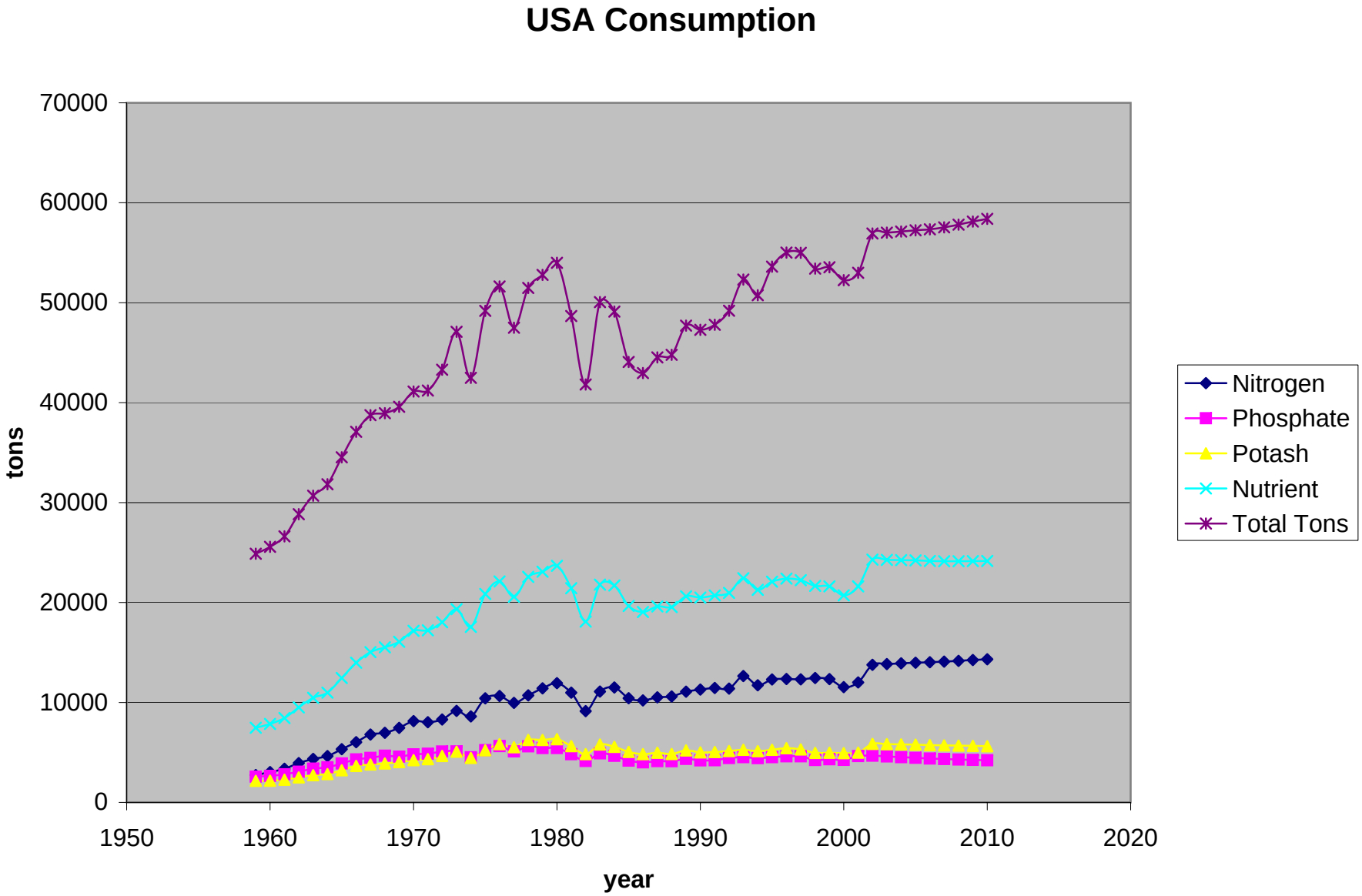
	MARKET INDEX SCORE	**ACTION**
VERY WEAK	**< 50**	**ABANDON**
WEAK	**50 – 69**	**OUT-LICENSE QUICKLY**
MODERATE	**70 – 84**	**BUILD VALUE OUT-LICENSE JOINT VENTURE**
STRONG	**85 – 100**	**VALUE ADDED ⟶ LICENSE JOINT VENTURE NEW VENTURE FORMATION**

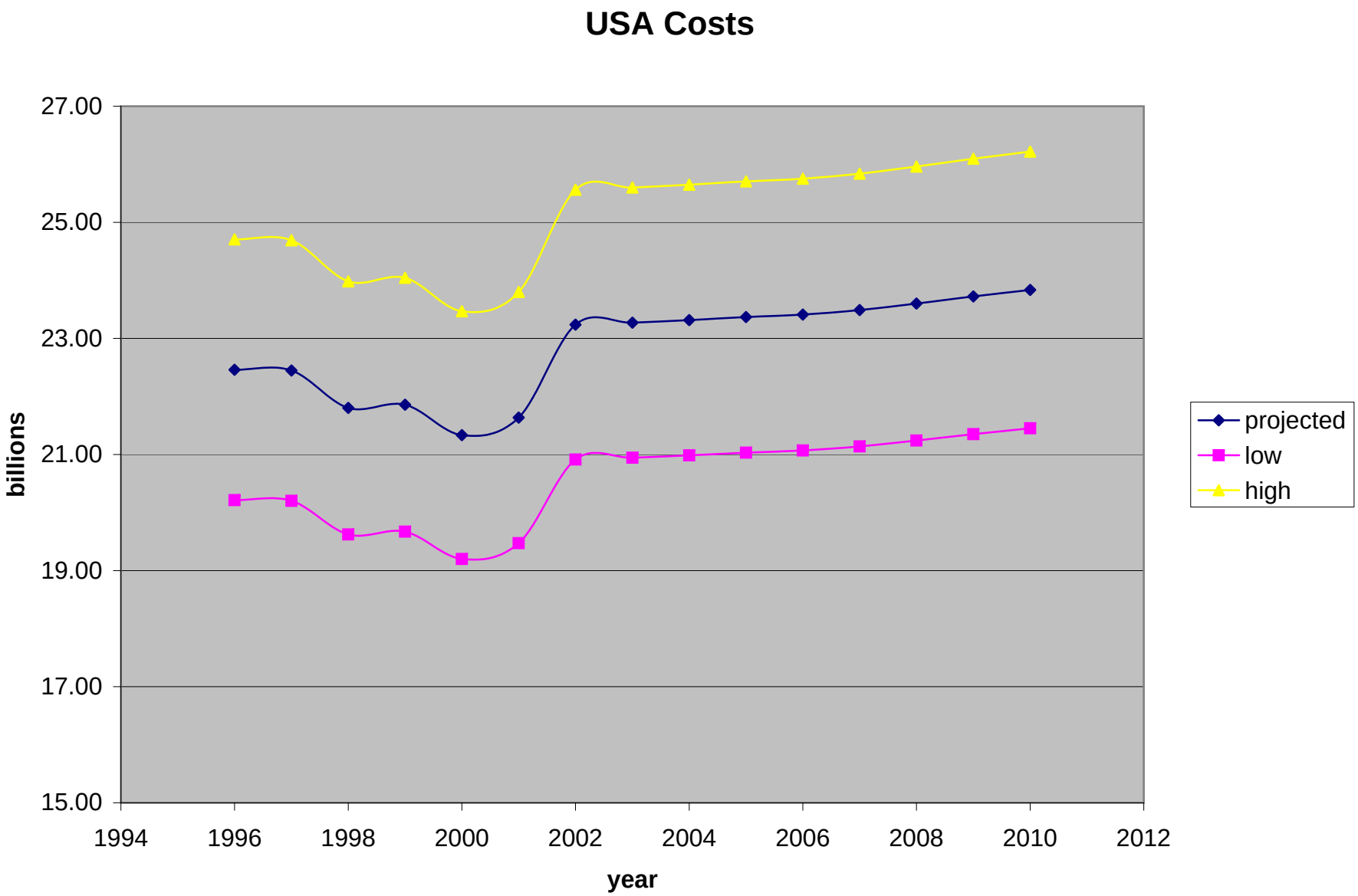
PROJECTED COST CALCULATIONS


World Consumption
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
metric tons
1960
1970
1980
1990
2000
2010
year
Nitrogenous Fertilizers
Phosphate Fertilizers
Potash Fertilizers
Total Fertilizers


World Costs
90.00
85.00
80.00
75.00
70.00
65.00
60.00
billions
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
year
projected
low
high

In thousand metric tons of nutrient, years ending June 30*					
World	**Item**				
Consumption	**Nitrogenous Fertilizers**	**Phosphate Fertilizers**	**Potash Fertilizers**	**Total Fertilizers**	**total cost (billions) $450 / mt**
1961	11,588	10,931	8,664	31,182	14
1962	13,137	11,612	9,231	33,981	15
1963	14,760	12,929	9,999	37,688	17
1964	16,474	14,490	10,920	41,884	19
1965	19,097	15,799	12,106	47,003	21
1966	22,179	17,414	12,736	52,329	24
1967	24,210	18,140	13,928	56,277	25
1968	26,248	19,037	14,525	59,810	27
1969	28,471	19,801	15,210	63,482	29
1970	31,756	21,117	16,435	69,308	31
1971	33,536	22,435	17,340	73,310	33
1972	36,144	24,009	18,542	78,695	35
1973	39,204	25,870	20,401	85,475	38
1974	38,425	23,986	19,534	81,945	37
1975	44,420	25,609	21,370	91,399	41
1976	45,263	27,323	22,849	95,435	43
1977	49,120	28,549	22,938	100,607	45
1978	54,252	30,046	24,456	108,754	49
1979	57,223	31,196	24,054	112,472	51
1980	60,776	31,700	24,244	116,720	53
1981	60,452	30,946	23,749	115,147	52
1982	61,173	31,086	22,853	115,112	52
1983	67,117	33,177	25,410	125,704	57
1984	70,836	34,442	25,959	131,237	59
1985	70,354	33,463	25,673	129,490	58
1986	72,481	34,769	26,167	133,417	60
1987	75,811	36,291	27,374	139,476	63
1988	79,543	37,612	28,005	145,159	65
1989	79,115	37,568	26,685	143,368	65
1990	77,175	35,970	24,684	137,829	62
1991	75,633	35,241	23,732	134,606	61
1992	73,657	31,190	20,492	125,339	56
1993	72,388	28,962	19,131	120,480	54
1994	72,430	29,566	20,051	122,046	55
1995	78,357	30,663	20,661	129,681	58
1996	82,590	31,104	20,885	134,579	61
1997	81,317	33,293	22,577	137,188	62
1998	82,814	33,312	22,041	138,167	62
1999	84,917	33,288	22,096	140,302	63
2000	80,949	32,472	21,778	135,198	61
2001	81,970	33,050	22,711	137,730	62
2002	95,831	38,909	26,780	161,520	73
2003	97,566	39,147	26,802	163,514	74
2004	99,243	39,340	26,790	165,373	74
2005	100,860	39,521	26,753	167,134	75
2006	102,416	39,705	26,699	168,819	76
2007	103,952	39,883	26,644	170,479	77
2008	105,495	40,077	26,564	172,135	77
2009	106,996	40,245	26,487	173,727	78
2010	108,453	40,396	26,387	175,235	79
Source: Food and Agriculture Association (FAO)					


USA Consumption
70000
60000
50000
40000
30000
20000
10000
0
tons
1950
1960
1970
1980
1990
2000
2010
2020
year
Nitrogen
Phosphate
Potash
Nutrient
Total Tons


USA Costs
27.00
25.00
23.00
21.00
19.00
17.00
15.00
billions
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
year
projected
low
high

U.S. Fertilizer Use

In thousand short tons, years ending June 30

Year	Nitrogen	Phosphate	Potash	Nutrient	Total Tons
1959	2,738.00	2,572.40	2,153.30	7,463.70	24,877
1960	3,030.80	2,645.10	2,168.50	7,844.40	25,567
1961	3,370.00	2,807.00	2,270.50	8,447.50	26,615
1962	3,929.10	3,072.90	2,503.40	9,505.40	28,844
1963	4,352.80	3,377.80	2,729.70	10,460.30	30,681
1964	4,638.50	3,512.20	2,834.50	10,985.20	31,836
1965	5,326.30	3,897.10	3,221.20	12,444.60	34,532
1966	6,027.10	4,304.70	3,641.80	13,973.60	37,081
1967	6,787.60	4,453.30	3,792.60	15,033.50	38,743
1968	6,957.60	4,665.60	3,891.60	15,514.80	38,949
1969	7,459.00	4,573.80	4,035.50	16,068.30	39,589
1970	8,133.60	4,803.40	4,231.40	17,168.40	41,118
1971	8,022.30	4,863.70	4,326.80	17,212.80	41,206
1972	8,295.10	5,085.20	4,648.70	18,029.00	43,288
1973	9,157.20	5,098.60	5,082.60	19,338.40	47,094
1974	8,600.80	4,506.80	4,453.20	17,560.90	42,484
1975	10,411.60	5,227.60	5,209.70	20,848.80	49,189
1976	10,647.40	5,629.70	5,833.80	22,110.90	51,624
1977	9,954.60	5,096.10	5,526.10	20,586.90	47,497
1978	10,714.70	5,605.80	6,244.50	22,565.10	51,480
1979	11,406.70	5,431.50	6,245.10	23,083.30	52,787
1980	11,923.80	5,434.40	6,319.50	23,677.70	53,988
1981	10,983.90	4,813.90	5,630.90	21,427.90	48,669
1982	9,127.00	4,137.50	4,831.00	18,095.50	41,813
1983	11,092.20	4,901.10	5,796.80	21,790.10	50,056
1984	11,492.60	4,657.60	5,553	21,702.60	49,109
1985	10,424.40	4,177.90	5,052.60	19,654.90	44,071
1986	10,209.50	4,008.30	4,836.50	19,054.30	42,964
1987	10,511.60	4,128.50	4,972.70	19,612.80	44,527
1988	10,592.60	4,116.90	4,838.00	19,547.50	44,787
1989	11,076.00	4,344.70	5,202.80	20,623.50	47,705
1990	11,286.90	4,200.60	5,001.20	20,488.70	47,290
1991	11,446.40	4,217.90	5,041.70	20,706.00	47,794
1992	11,392.50	4,435.60	5,140.70	20,968.90	49,197
1993	12,642.80	4,521.10	5,268.10	22,432.00	52,319
1994	11,718.50	4,424.80	5,128.40	21,271.70	50,744
1995	12,303.40	4,527.30	5,257.50	22,088.20	53,604
1996	12,352.10	4611.8	5,424.50	22,388.40	55,017
1997	12,312.60	4,615.30	5,300.70	22,228.60	54,985
1998	12,451.90	4,245.20	4,953.50	21,659.50	53,410
1999	12,333.80	4,313.80	4,971.60	21,619.20	53,542
2000	11,534.70	4,257.20	4,926.10	20,718.00	52,259
2001	12,009.30	4,630.00	4,981.60	21,620.90	52,999
2002	13,768.27	4,667.32	5,854.56	24,291.01	56,920
2003	13,841.62	4,597.67	5,830.83	24,270.98	57,005
2004	13,913.39	4,528.35	5,803.89	24,246.52	57,115
2005	13,978.12	4,462.69	5,774.01	24,215.72	57,240
2006	14,029.17	4,393.46	5,735.46	24,159.00	57,347
2007	14,087.09	4,334.18	5,702.68	24,124.87	57,537
2008	14,155.58	4,288.67	5,679.56	24,124.74	57,813
2009	14,241.14	4,246.42	5,654.55	24,143.03	58,114
2010	14,317.01	4,211.77	5,625.38	24,155.09	58,387

PATENT RESEACH

Palmer, Jay W.

USA Patents Awarded

	PAT. NO.	Title	Date	Assignee	Abstract
1	5,849,790	(Mono) ethylenediaminenitro platinum (IV) complexes with ligands of oxides of nitrogen as possible anti-tumor agents	**15-Dec-98**	The University of South Florida (Tampa, FL)	The present invention discloses (mono)ethylenediaminenitroplatinum (IV) complexes of with ligands of oxides of nitrogen, and their synthesis, which, in vivo, may be reduced to produce "cisplatin" type platinum(II) antitumor complex and nitric oxide, which also reportedly has anti-tumor activity.
2	4,915,936	Dental hygiene composition for reducing periodontal disease	**10-Apr-90**	United States Gypsum Company (Chicago, IL)	Gingivitis and related periodontal problems of the gingival tissues may be treated with a dental hygiene composition comprising an effective amount of a calcium sulfate compound such as calcium sulfate hemihydrate. Preferred compositions comprise mouthwashes and oral rinses containing about 5-90% by weight of calcium sulfate hemihydrate, a liquid carrier such as water, a humectant and an alcohol.
3	4,849,193	Process of preparing hydroxylapatite	**18-Jul-89**	United States Gypsum Company (Chicago, IL)	This invention relates to the manufacture of hydroxylapatite in a through-solution process wherein monobasic calcium phosphate is reacted with a calcium hydroxide solution. In a preferred embodiment, an acidic premix is formed by reacting phosphoric acid and calcium hydroxide with high shear agitation in a first stage, and thereafter reacting the acidic premix with a saturated solution of calcium hydroxide also under high shear agitation in a second stage. The second stage reaction is carried out in an alkaline solution by carefully metering the acid premix into the calcium hydroxide solution whereby the pH of the solution is maintained above 11 until the reaction is near completion. It is particularly preferred to use a stoichiometric portion of calcium hydroxide in carrying out the reactions. After the hydroxylapatite precipitate is recovered, it may be sintered at a temperature between about 700.degree. C. and 1100.degree. C. for about 5 to 30 minutes to form a crystalline hydroxylapatite.
4	4,457,781	Method for solidifying waste slime suspensions	**3-Jul-84**	United States Gypsum Company (Chicago, IL)	Solidification of colloidal argillaceous matter in essentially non-settling, aqueous slime media into a solid stable matrix is accomplished by mixing such slime with a hydratable calcium sulfate and hydrating to form an interlocking strength bearing matrix. The method is particularly useful for coalescing phosphatic clay slimes with hydratable calcium sulfate prepared from the co-produced waste phosphogypsum.
5	4,452,770	Phosphoanhydrite process	**5-Jun-84**	United States Gypsum Company (Chicago, IL)	A wet process for producing phosphoric acid and phosphoanhydrite by acidulation of phosphate rock with a phosphoric acid/sulfuric acid mixture containing a very high recycle content of small sized anhydrite seed crystals. A strong phosphoric acid is obtained having a concentration of at least about 35% P.sub.2 O.sub.5. Further, the phosphoanhydrite may be readily converted to an industrially usable gypsum product.

Palmer, Jay W.					
USA Patents Awarded					
	PAT. NO.	**Title**	**Date**	**Assignee**	**Abstract**
6	4,424,196	Phosphohemihydrate process for purification of gypsum	**3-Jan-84**	United States Gypsum Company (Chicago, IL)	A wet process for producing phosphoric acid and phosphohemihydrate by acidulation of phosphate rock. A strong phosphoric acid is obtained with concomitant production of an improved calcium sulfate that is extremely low in radioactivity by operation in Region II for shorter time so as to produce small sized hemihydrate particles, then hydration of a substantial proportion but less than all of the hemihydrate to coarse gypsum substantially free of radioactivity in a dilute acidic aqueous slurry at a temperature and P.sub.2 O.sub.5 concentration selected so as to be within Region I of FIG. 1 and having a substantial weight proportion of coarser gypsum particles that are substantially free of radioactivity.
7	4,421,731	Process for purifying phosphogypsum	**20-Dec-83**	United States Gypsum Company (Chicago, IL)	A process for reducing radioactive contamination of phosphogypsum. Phosphogypsum containing radioactive material is calcined to form hemihydrate crystals carrying the radioactive contaminants, and a portion of the crystals is converted to substantially radiation-free gypsum crystals which are readily separated from the hemihydrate crystal relics containing substantially all of the radioactive contamination.
8	4,402,922	Process for rapid conversion of fluoroanhydrite to gypsum	**6-Sep-83**	United States Gypsum Company (Chicago, IL)	A process for making an industrially usable gypsum from fluoroanhydrite in which fluoroanhydrite is contacted with a fluid reaction medium slurry containing soluble sulfate ions and a substantial proportion of small gypsum seed crystals to rapidly hydrate a large proportion of the fluoroanhydrite to a coarser, substantially pure gypsum. The slurry is clarified to separate coarse purified gypsum reaction product, and the reaction medium is reconstituted and recycled containing gypsum crystals less than the desired reaction product size and constituting about 50-90% of the total solids of the reconstituted fluid reaction medium.
9	4,388,292	Process for reducing radioactive contamination in phosphogypsum	**14-Jun-83**	United States Gypsum Company (Chicago, IL)	A process of two crystallization stages for reducing radioactive contamination of phosphogypsum is disclosed. In the process anhydrite crystals are obtained through dehydration of the radiation containing phosphogypsum in strong sulfuric acid; a portion of the anhydrite crystals containing the radioactive contamination is converted to substantially radiation free gypsum by crystallizing out on a large solids concentration of radiation free gypsum seed crystals; and coarse radiation free gypsum crystals are separated from small anhydrite crystal relics containing substantially all of the radioactive contamination.
10	4,251,416	Carpet backing adhesive	**17-Feb-81**	United States Gypsum Company (Chicago, IL)	The coagulation of a styrene butadiene latex emulsion which normally occurs upon the introduction of gypsum as a filler in the preparation of an adhesive composition is prevented by the addition of ammonium sulfate or sodium sulfate or a mixture of the two to the emulsion prior to the addition of the gypsum.

International Patents Pending					
	PAT. NO.	**Title**	**Date**	Assignee	
1	(WO 03/050059)	SLOW-RELEASE FERTILIZER	19-Jun-03	UNIVERSITY OF SOUTH FLORIDA	
2	(WO 2005/016946)	PLATINUM COMPLEXES AND METHODS OF USE	24-Feb-05	UNIVERSITY OF SOUTH FLORIDA	
3	(WO 2005/023824)	METHODS FOR INHIBITING TUMOR CELL PROLIFERATION	17-Mar-05	UNIVERSITY OF SOUTH FLORIDA	
http://www.wipo.int/ipdl/en/		tampa AND Palmer			

abst/"slow-release fertilizers"			
1	6,500,222		Diureides and their use
2	6,353,134		Diureides and their use
3	4,978,786		Chemical process for the preparation of oxamide derivatives and compounds prepared thereby
abst/"slow-release"			
	PAT. NO.		Title
2	6,821,928		Method to reduce the rate of diffusion of slow-release materials through polymers and process for making drip irrigation devices with long-term control of root growth
6	6,776,816		Methods for accelerating production of magnesium ammonium phosphate while attaining higher yields thereof and a slow-release fertilizer produced therefrom
11	6,500,222		Diureides and their use
14	6,464,746		Homogeneous granules of slow-release fertilizer and method of making the same
18	6,358,296		Slow-release polyurethane encapsulated fertilizer using oleo polyols
19	6,353,134		Diureides and their use
20	6,326,015		Slow-release insect-repellent fabric composition and related methods
21	6,316,427		Treatment for diabetes
22	6,306,425		Injectable naltrexone microsphere compositions and their use in reducing consumption of heroin and alcohol
23	6,290,990		Slow-release matrix pellets and the production thereof
24	6,274,173		Oral pharmaceutical composition with delayed release of active ingredient for pantoprazole
25	6,261,997		Slow release formulations of pesticides
26	6,242,381		Influencing the activity of plant growth regulators
27	6,201,164		Hydrocolloid wound gel
28	6,192,128		Current-sensitive telephone-line disconnect system
29	6,132,768		Oral pharmaceutical composition with delayed release of active ingredient for reversible proton pump inhibitors
30	6,132,710		Preventing/treating neonatal NEC by administering lactobacillus salivarius and lactobacillus plantarum or a combination thereof
31	6,074,673		Slow-release, self-absorbing, drug delivery system
32	6,068,856		Oral pharmaceutical composition with delayed release of active ingredient for pantoprazole
33	6,066,332		Immediate-effect ibuprofen-containing medicament and its use
34	6,037,374		Composition and method for the control of parasitic mites in honey bees
35	6,022,827		Sod or other vegetation having a root support matrix with beneficial plant adjuvants thereon
36	6,015,570		Slow-release insect-repellent compositions and uses
37	5,945,124		Oral pharmaceutical composition with delayed release of active ingredient for pantoprazole
38	5,891,914		Bioactive topical siloxane compositions having enhanced performance and safety
39	5,807,575		Manufacture of cross-linked amylose useful as a excipient for control release of active compounds
40	5,749,935		Manganese fertilizer
41	5,686,065		Topical siloxane sunscreen compositions having enhanced performance and safety
42	5,663,145		Products for administering an initial high dose of Cetrorelix and producing a combination package for use when treating diseases
43	5,631,271		Methods and preparations for the treatment and prophylaxis of metabolic disturbances
44	5,631,011		Tissue treatment composition comprising fibrin or fibrinogen and biodegradable and biocompatible polymer
45	5,620,702		Adhesive bandages, wound dressings, sutures, drapes orthodontic rubber bands, toothbrushes, and the like
46	5,589,191		Slow-release sodium valproate tablets

47	5,560,768		Method for preparing an encapsulated slow-release particulate fertilizer
48	5,538,530		Method for safely disposing of propellant and explosive materials and for preparing fertilizer compositions
49	5,510,114		Slow release pharmaceutical composition containing a bile acid as an active ingredient
50	5,454,851		Slow release fertilizers
51	5,426,163		Redispersible powder composed of n-vinylpyrrolidone/vinyl acetate copolymer the preparation and use thereof
52	5,419,913		Adhesive bandages, wound dressings, sutures, drapes, orthodontic rubber bands, toothbrushes, and the like
53	5,409,905		Cure for commond cold
54	5,373,021		Use of disulfiram for Neuronal Protection
55	5,348,748		Pulsatile once-a-day delivery systems for minocycline
56	5,346,704		Polyfunctional agrochemical bicarbonate-containing compositions
57	5,338,551		Polyfunctional agrochemical bicarbonate-containing compositions
58	5,304,760		Ultra-high-tension circuit-breaker
59	5,262,173		Pulsatile once-a-day delivery systems for minocycline
60	5,211,959		Processes for producing slow-release powders
61	RE34,222		Pharmaceutical compositions comprising magnesium compounds
62	5,188,840		Slow-release pharmaceutical agent
63	5,145,604		Aqueous emulsion and aerosol delivery system using same
64	5,093,200		Multilayer sustained release granule
65	5,057,317		Slow-release pharmaceutical agent
66	5,041,431		Pharmaceutical composition and method for the treatment of colitis ulcerosa and Crohn's disease by oral administration
67	5,039,524		Vermin-repellent microcapsules with slow-release potentiality
68	5,019,434		Molded slow-release air freshener
69	5,017,378		Intraorgan injection of biologically active compounds contained in slow-release microcapsules or microspheres
70	5,013,727		Pharmaceutical composition and method for the treatment of colitis ulcerosa and Crohn's disease by oral administration
71	4,988,744		Perfume compositions produced by sol-gel methods
72	4,987,161		Aromatic composition and a method for the production of the same
73	4,980,392		Aromatic composition and a method for the production of the same
74	4,980,173		Pharmaceutical composition and method for the treatment of colitis ulcerosa and Crohn's disease by oral administration
75	4,978,786		Chemical process for the preparation of oxamide derivatives and compounds prepared thereby
76	4,966,772		DHP delayed release preparation
77	4,960,765		Pharmaceutical composition and method for the treatment of colitis ulcerosa and Crohn's disease by oral administration
78	4,936,897		Method for the manufacture of slow release fertilizers
79	4,906,488		Modification of permeant
80	4,904,478		Slow-release sodium fluoride tablet and method for treatment of osteoporosis
81	4,889,816		Process and apparatus for carrying out specific binding assays
82	4,880,851		Aromatic composition and method for the production of the same
83	4,880,794		Pharmaceutical composition and method for the treatment of colitis ulcerosa and crohn's disease by oral administration
84	4,880,455		Method for the manufacture of slow-release fertilizers
85	4,834,076		Device for treating the external human epithelium, process for its manufacture and process for using such a device
86	4,808,416		Preparation of a slow-release drug
87	4,800,085		Slow-release composite and process for producing the same
88	4,788,180		Pharmaceutical compositions
89	4,780,322		Method of producing slow-release pharmaceutical forms
90	4,749,574		Sustained-release transdermal delivery preparations

91	4,726,952		Slow-release sodium fluoride tablet, method of making, and method of treatment of osteoporosis
92	4,720,387		Sustained-release preparation of pinacidil
93	4,713,247		Long-acting formulation of cefaclor
94	4,652,443		Slow-release composite and process for producing the same
95	4,600,577		Pharmaceutical preparations of pinacidal
96	4,579,579		Method for preparing a slow-release fertilizer
97	4,571,435		Preparation of nitrogen fertilizers from oxalate esters prepared by the oxidative carbonylation of alcohols over noble metal catalysts utilizing regenerable 2,5-cyclohexadiene-1,4-dione oxidants
98	4,549,897		Protein degraded pre-vulcanized natural rubber coated slow release fertilizers
99	4,539,038		Device ensuring permanent nutrition of pot plants
100	4,536,207		Nematocidally active chitin-protein complex
101	4,496,553		Pharmaceutical composition and method for the treatment of colitis ulcerosa and Crohn's disease by oral administration
102	4,472,394		Method for increasing weight in domestic animals
103	4,406,883		Controlled release suppositories consisting essentially of a linear polymer particularly, polyvinyl pyrrolidones
104	4,328,024		Slow-release nitrogen fertilizer employing waste proteinaceous animal food and method of making and use
105	4,292,300		Controlled release suppositories
106	T100,903		Preparation of nitrogen fertilizers from oxalate esters prepared by the oxidative carbonylation of alcohols over noble metal catalysts utilizing regenerable 2,5-cyclohexadiene-1,4-dione oxidants
107	4,265,875		Controlled release suppositories
108	4,183,918		Detoxifying-medicinal emulsions
109	4,089,899		Fertilizer compound of the ureaform type and a method for the production thereof
110	4,087,356		Method for depolluting fresh and sea water from petroleum products
111	4,083,042		Continuous quantitative signal-display system using light-emitting elements
112	3,994,439		Slow-release air freshener polymer-blend composition
113	3,984,225		Soil conditioners and fertilizers from spent sulfite liquor
114	3,970,625		Production of urea-formaldehyde concentrates
115	3,954,964		Air reodorant compositions
116	3,944,662		Non-volatile slow-release pesticidal generators

IN/"Langer; Robert S" AND AN/Massachusetts AND Fertilizer		
	PAT. NO.	Title
1	6,007,845	Nanoparticles and microparticles of non-linear hydrophilic-hydrophobic multiblock copolymers
2	5,578,325	Nanoparticles and microparticles of non-linear hydrophilic-hydrophobic multiblock copolymers
3	5,543,158	Biodegradable injectable nanoparticles
4	5,500,161	Method for making hydrophobic polymeric microparticles
5	4,921,757	System for delayed and pulsed release of biologically active substances
6	4,898,734	Polymer composite for controlled release or membrane formation
IN/"Bolind; Michael L"		
1	6,217,946	Method for applying polymeric diphenylmethane diisocyanate to cellulose/gypsum based substrate
2	6,138,377	Apparatus and process for cooling and de-steaming calcined stucco
3	4,283,423	Free-flowing granular urea nutrient supplements
AN/"Gypsum" AND SPEC/semi-permeable		
2	4,283,423	Free-flowing granular urea nutrient supplements
3	4,076,862	Method of treating earthen areas
4	4,015,972	Fortified gypsum granule
5	4,012,491	Phosphate process
ABST/Bioerodible AND SPEC/fertilizer		
	PAT. NO.	Title
1	6,565,867	Animal repellent compositions and methods of use thereof
2	4,898,734	Polymer composite for controlled release or membrane formation
6	4,629,621	Erodible matrix for sustained release bioactive composition
ABST/semi-permeable AND SPEC/fertilizer		
1	6,656,882	Controlled release products and processes for the preparation thereof
2	6,391,205	Osmotic desalinization process
3	4,921,757	System for delayed and pulsed release of biologically active substances
4	4,891,223	Controlled release delivery coating formulation for bioactive substances
5	4,235,561	Subterranean irrigation means and system
6	4,052,190	Sustained-release plant food
7	4,041,712	Method for reducing water loss through soil by seepage
IN/Tijsma		
1	6,787,234	Triggered start products and processes for the production and use thereof
2	6,656,882	Controlled release products and processes for the preparation thereof
3	6,312,493	Water soluble fertilizer compositions
4	6,139,597	Controlled release fertilizer compositions and processes for the preparation thereof
5	5,993,505	Controlled release fertilizer compositions and processes for the preparation thereof
6	3,986,092	Stabilization system for a platform suspended in a gimbal frame
6	5,658,967	Providing a surface with carboxyl groups and surface and product thus provided

AN/"OMS Investments"		
1	6,787,234	Triggered start products and processes for the production and use thereof
2	6,711,850	Plant growth media and processes for production thereof and compositions for use therein
3	6,656,882	Controlled release products and processes for the preparation thereof
4	6,616,074	Broadcast spreader with movable deflector
5	6,415,956	Hand holdable pump spray apparatus
6	6,408,568	Compressed blends of coconut coir pith and a non-coir/non-peat materials, and processes for the production thereof
8	6,312,493	Water soluble fertilizer compositions
9	6,296,866	Insect combatant controlled/prolonged delivery device
11	6,254,655	Processes for preparing granular composite fertilizer compositions and products produced thereby
13	6,189,260	Compressed mixtures of coconut coir pith and peat moss and processes for the preparation thereof
16	6,139,597	Controlled release fertilizer compositions and processes for the preparation thereof
20	6,039,781	Precoated controlled release fertilizers and processes for their preparation
22	5,993,505	Controlled release fertilizer compositions and processes for the preparation thereof
23	5,948,956	Transgenic plants and method for node segment transformation
28	5,652,196	Timed release of water-soluble plant nutrients
31	5,567,221	Compositions and methods for use in aquaculture
33	5,492,553	Solubility compound fertilizer compositions
34	5,466,274	Abrasion resistant coatings for fertilizers
35	5,454,850	Calcium phosphate and urea phosphate soluble compound fertilizer compositions
37	5,405,426	Processes for the preparation of sulfur coated fertilizers and products produced thereby