CONTEXT

FOCUS: BIOTECHNOLOGY

Fertile Ground for Shifting Value

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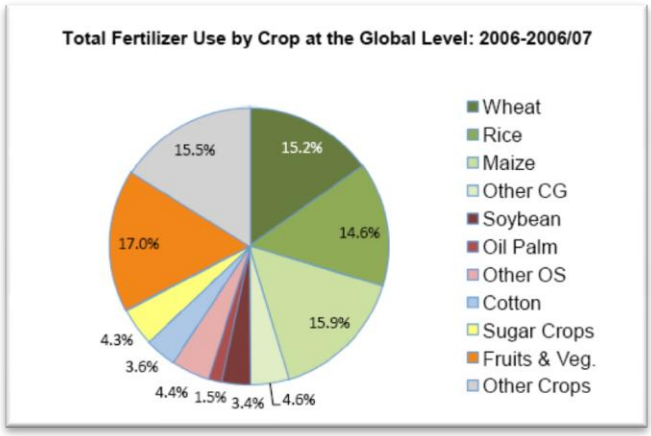
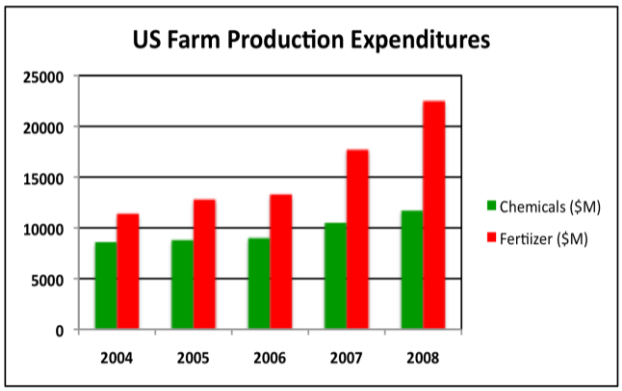
Much has been written and discussed describing shifts in economic value from crop protection products to new biotechnology products. Two widely cited examples have involved shifts in value from herbicides to herbicide tolerant soybean seeds (i.e., glyphosate tolerant soybeans) and from corn rootworm insecticides to insect resistant corn (i.e., corn with a Bt gene conferring CRW resistance).

These biotechnology products, along with several others, have significantly influenced the structures of the crop protection and seed industries. Prior to the introduction and widespread use of these traits, both industries were considered to be relatively separate. More recently, they have been seen as evolving fairly rapidly into one common industry. In an ongoing process that has involved a number of acquisitions, rapid technological advances, an increase in the number of partnerships and collaborations and new go-to-market strategies, the industries are clearly transitioning into a new industry, dubbed by some as the "Plant Science" industry.



Source: *Assessment of Fertilizer Use by Crop at the Global Level 2006/07 – 2007/08. Heffer, P., International Fertilizer Industry Association (IFA). 2009.*



Source: USDA-NASS
(http://www.nass.usda.gov/Charts_and_Maps/Farm_Production_Expenditures/maj_exp.asp)

New biotechnology products and technologies have been instrumental in motivating and facilitating this transition and it appears likely that they will continue, and the trend is likely to expand its scope of influence and reach. One area in particular where this may occur is soil fertility where the science of biotechnology is starting to be used to enhance soil nutrient utilization efficiency. Currently, fertilizer of some type is applied to nearly every crop.

There are two primary motivators for the expansion of biotechnology into the realm of soil nutrient utilization efficiency. One is financial. As an example, in the United States, a 2009 report from a study commissioned by the Fertilizer Institute of America indicated that the industry produced fertilizers with a direct value of $15.1 billion per year. The other is environmental. Particularly for nitrogen and phosphorus, concerns ranging from greenhouse gas contributions

and their effect on global warming (nitrogen) to scarce/limited resource concerns (phosphorus) to water pollution and quality (nitrogen, phosphorous) are challenging the industry to identify and develop new and better ways of delivering soil fertility products.

From a biotechnology point of view, most new technology efforts have focused on nitrogen, the world's highest volume and value soil applied fertilizer. More generally, biotechnology is also behind research under way to develop seed and/or soil applied microorganisms designed to enhance nitrogen utilization as in a number of crops including corn and soybeans.

Although not as prominently reported and apparently somewhat less technically advanced, plant biotechnology work is also under way to identify methods of enhancing the efficiency of phosphorus use by plants (e.g., rice, wheat, forage grasses). Seed applied products promising enhanced phosphorus utilization, have recently been introduced commercially and continue to be the target of ongoing research efforts.

World Fertilizer Consumption
Calendar Year Basis

Mt nutrients	2008	2009 (e)	2013 (f)
Nitrogen, *N*	99.3	101.0	110.4
Phosphorous, P_2O_5	35.9	37.2	43.9
Potassium, K_2O	24.8	25.0	31.0
Total	**160.0**	**163.2**	**185.3**

Source: P. Heffer. IFA. Mav 2009

Thus far, the business of providing soil fertility has generally been considered the domain of firms existing outside the world of biotechnology. Building on past experience, if biotechnology R&D efforts currently under way are reasonably successful, this may change in a significant way in the coming years. The previously described financial opportunity represented by fertilizer sales and the potential environmental and other benefits (e.g., enhanced ease of use, reduced storage requirements) available through biotechnology combine to offer what appears to be an extremely attractive commercial target.

Furthermore, combining potential technology advances under way within the fertilizer industry (e.g., enhanced efficient fertilizers or EEFs, pairing of crop genetics with new fertilizer delivery systems) with advances in biotechnology and precision application technology offers the prospect of valuable opportunities to quite dramatically improve soil nutrient use efficiency across a number of crops and geographies.

Given this scenario, business success will certainly depend on technology development and access. As importantly, it will also depend a great deal on how effectively and quickly current fertilizer and biotechnology industry participants are able to anticipate accept and adapt to the soil fertility enhancements that biotechnology and other technologies may be on the verge of delivering for the benefit of global agricultural community.
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