The Big Six:
A Profile of Corporate Power in Seeds, Agrochemicals & Biotech

By Hope Shand

Sixteen years after GE crops made their commercial debut in the US, what are the benefits for farmers, diversity and society? The following article, adapted, in part, from ETC Group's Who Will Control the Green Economy?, *provides an update on current trends in industrial agriculture and examines the giant firms that control "the first link" in the corporate food chain.*[1]

The Big Six Seed, Biotech & Agrochemical Corporations
Business-friendly court decisions in the 1980s opened the door to exclusive monopoly rights on seeds and other life forms, propelling an unprecedented wave of seed industry concentration. In recent decades, the seed industry has experienced a faster rate of market concentration than any other farm input sector.[2] Monsanto may be the largest, most notorious and conspicuous of all the biotech Gene Giants, but it's important to look at the bigger picture.

The Big Six: The world's six largest seed/agrochemical/biotech firms (BASF, Bayer, Dow Agrosciences, DuPont, Monsanto, Syngenta) have a dangerous chokehold on the global agricultural research agenda. Together these six companies account for almost $50 billion per annum in sales of seeds, biotech traits and agrochemicals; they spend about $4.7 billion annually on ag R&D. After taking over the first link in the industrial food chain – commercial seeds – the Big Six corporations now determine, to an astonishing degree, the current priorities and future direction of agriculture research worldwide.

The Big Six agenda promotes genetic engineering, chemical dependence and monopoly patents that thwart both public and private sector alternatives and innovation. According to agricultural economists, some U.S. farmers adopted industry's genetically engineered (GE) seeds and companion chemicals faster than any agricultural technology in history.

The undisputed commercial success of GE seeds in the U.S. and a handful of other countries illustrates the paradox of new technologies that are introduced in oligopolistic markets with minimal government regulation and oversight: that is, such products don't have to be technically superior (i.e. they don't have to work) or be socially useful in order to be profitable. Although the biotech industry's public relations machine has perpetuated the myth that biotech is spurring agricultural productivity worldwide and feeding hungry people, the reality is far different. Proprietary, high-tech seeds are neither accessible nor suitable to the needs of most of the world's farmers – the small-scale producers who are responsible for feeding the vast majority of the world's population, safeguarding biodiversity, and providing our best hope of confronting climate chaos.

World's Top 10 Seed Companies

Rank / Company (headquarters) | US$ Millions, 2009 | Market Share

1. Monsanto (USA) |$7,297 | 27%
2. DuPont (Pioneer) (USA) / $4,641 | 17%
3. Syngenta (Switzerland) | $2,564 | 9%
4. Groupe Limagrain (France) | $1,252 | 5%
5. Land O' Lakes/Winfield Solutions (USA) | $1,100 | 4%
6. KWS AG (Germany) | $997 | 4%
7. Bayer CropScience (Germany) | $700 | 3%
8. Dow AgroSciences (USA) | $635 | 2%
9. Sakata (Japan) | $491 | 2%
10. DLF-Trifolium A/S (Denmark) | $385 | 1%

Total Top 10 $20,062 | 73%

Sources: ETC Group

Big Six Tech Cartels: It's important to examine the combined power and influence of the Big Six because these corporations aren't just competitors – *they are also collaborators* – in tightly concentrated markets. The Big Six are forging unprecedented alliances that render competitive markets a relic of the past. By agreeing to cross-license proprietary germplasm and technologies, consolidate R&D efforts and terminate costly patent litigation battles, the world's largest seed and agrochemical firms are reinforcing their top-tier market power. For example: Monsanto has cross-licensing agreements with all the other Big 5 companies; Dow has cross-licensing agreements with four of the other five, and DuPont and Syngenta have entered agreements with three of the other companies.[4] In 2009 the U.S. Justice Department initiated a formal investigation into anti-competitive practices in the seed industry, including Monsanto's strong-arm tactics in the licensing of patented biotech traits to other seed companies. The results of the investigation are forthcoming.

R&D Concentration: The Big Six corporations overwhelmingly dominate global R&D for seeds and pesticides – accounting for over three-quarters of total private sector agricultural R&D spending in the seed sector[5] (76%) and the same share (76%) in the agrochemical sector in 2010.[6] These companies devote, on average, at least 70% of all seed and crop R&D in pursuit of biotech and genetic engineering. They collectively spent $2.2 billion per year on average for crop breeding and biotechnology R&D, from 2007-2010.[7]

Market Concentration: In 1995, the world's top 10 seed companies controlled 37% of the world's commercial seed sales. **Today, the top 10 companies account for 73% of the commercial seed market.**[8] Five of the Big Six companies that sell seeds control at least 58% of the proprietary seed market worldwide.[9] Worldwide market share of the three largest seed firms (Monsanto, DuPont, Syngenta) shot up from 20% of the proprietary seed market in 2002 to 53% in 2009.[10] The same three firms accounted for nearly three quarters of all U.S. patents issued for crop cultivars between 1982 and 2007.[11]

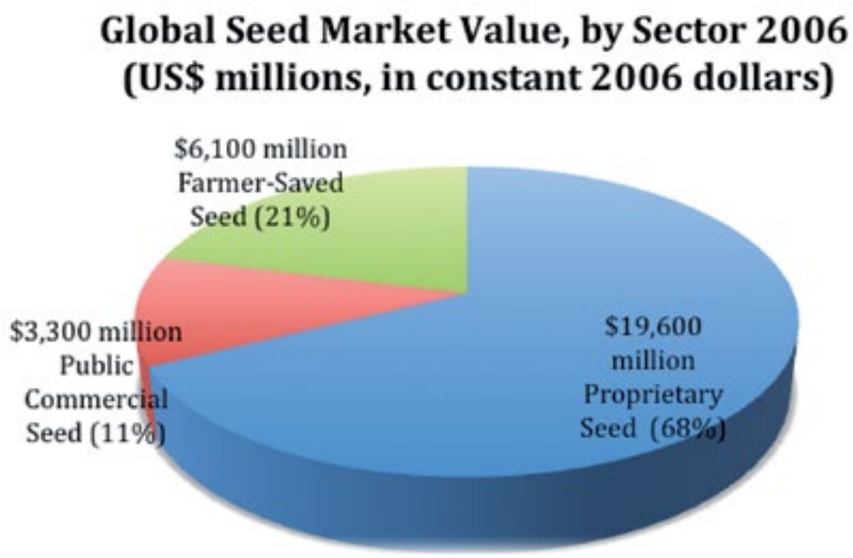
Vegetable Seed Market: Market concentration in the commercial vegetable seed sector is even higher: The top 4 companies controlled 70% of the global market in 2007; the top 8 firms controlled 94% of the market.[12] *Three of the Big Six are major players: Monsanto (with acquisition of Seminis in 2005); Syngenta (after acquiring parts of Advanta in 2004); Bayer (after takeover of Aventis/ Nunhems in 2002).*

Despite the astonishing pace of seed industry concentration, an estimated 1.4 billion people still depend on farmer-saved seeds – the vast majority of whom are based in the global South. Industry sources put the estimated value of farmer-saved seed at $6.1 billion in 2006 – about 21% of the total value of the commercial, proprietary seed market ($22,900 million).[13] Put another way, farmers who are self-provisioning in seed are the seed industry's biggest competitor. Capturing the market for farmer-saved seed in the global South offers the prime opportunity for Big Six expansion. That's why industry giants are acquiring South-based seed companies and pushing hard to introduce intellectual property laws, biotech-friendly

Big Six Profiles at a Glance

Crop seed & biotech sales/US million, 2009	Monsanto	$ 7,797	Big 6 Total $15,837
	DuPont	$ 4,643	
	Syngenta	$ 2,564	
	Bayer	$ 700	
	Dow	$ 635	
	BASF		
% global market share of seed sales, 2009	Monsanto	27%	Big 6 Total 58%
	DuPont	17%	
	Syngenta	9%	
	Bayer	3%	
	Dow	2%	
	BASF		
Agrochemical sales / US millions, 2009	Monsanto	$ 4,427	Big 6 Total $31,744
	DuPont	$ 2,403	
	Syngenta	$ 8,491	
	Bayer	$ 7,544	
	Dow	$ 3,902	
	BASF	$ 5,007	
% global market share of agrochemical sales, 2009	Monsanto	10%	Big 6 Total 71%
	DuPont	5%	
	Syngenta	19%	
	Bayer	17%	
	Dow	9%	
	BASF	11%	
% of crop R&D devoted to ag biotech* (estimate)	Monsanto	80%	Big 6 Total 70%
	DuPont	50%	
	Syngenta	15%	
	Bayer	85%	
	Dow	85%	
	BASF	100%	
Total Ag R&D in US$ millions	Syngenta	$ 1,032	Big 6 Total $4,786
	Bayer Crop Science	$ 955	
	BASF	$ 720	
	Dow Agrosciences	n.a.	
	Dupont	$ 874	
	Monsanto	$ 1,205	
Combined Agrochemical, Seed and Biotech Trait Sales, US$ millions	Syngenta	$ 11,641	Big 6 Total $49,111
	Bayer Crop Science	$ 9,057	
	BASF	$ 5,348	
	Dow Agrosciences	$ 4,343	
	Dupont	$ 9,084	
	Monsanto	$ 9,640	

Source: ETC Group. * Estimates on % of crop R&D devoted to ag biotech from Fuglie et al., 2011, USDA/ERS.[3]



Source: USDA, Economic Research Service using Context Network (2007) figures

regulations and seed technologies that would ultimately reduce or eliminate seed-saving practices in developing countries.

What did society gain from the Big Six takeover of seed/biotech/agrochemical R&D? How do farmers benefit when the Big 6 firms devote an average 70% of their R&D budgets to biotech and genetic engineering?

The mean cost of bringing a single genetically engineered crop trait to market was $136 million from 2008-2012.[14] This compares with the approximate cost of $1 million to develop a useful, conventionally bred inbred line.[15]

Higher seed prices: From 1994-2010, seed prices in the U.S. shot up more than any other farm input, more than doubling relative to the price farmer's received for their harvested crops. According to the USDA, "This increase, was due, in part, to the increase in value-added characteristics developed by private seed and biotech companies through R&D programs."[16] One industry analyst estimates that between 32 and 74 percent of the price of seed for corn, soybeans, cotton and sugar beets reflects technology fees or the cost of seed treatments.[17]

Marginalization of Public Sector Research: Despite seed industry claims to the contrary, concentration in the seed industry has resulted in less innovation – not more. In the US, private sector spending on crop variety R&D increased 14-fold between 1960 and 1996, while public expenditures were flat. In the case of biotech corn, cotton and soybeans, research intensity slowed as seed markets became more concentrated. According to the USDA, "Those companies that survived seed industry consolidation appear to be sponsoring less research relative to the size of their individual markets than when more companies were involved."[18] Not surprisingly, the dominant role of private sector biotech/agrochemical funding has also distorted public research priorities and activities.[19]

In 2007, the combined agricultural R&D budgets of the Big Six companies was over 9 times higher than the crop science R&D spending by the USDA's Agricultural Research Service, and at least 23 times higher than the R&D spending at international crop breeding institutes under the umbrella of the Consultative Group on International Agricultural Research (CGIAR).[20]

In 2007, Monsanto's GE biotech traits accounted for about 85% of all area (trait-acres) devoted to commercial GE crops in 13 countries where GE crops were planted.[21] Just 5 firms – Monsanto, DuPont, Syngenta, Bayer and Dow – accounted for 98% of all biotech trait-acres.[22] The only entity outside of the Big 6 companies with notable GE seed acreage in 2007 was the Chinese Academy of Agricultural Sciences, a public institution, with an estimated 2% of global trait acreage.

Fewer Choices/Greater Dependency: Public scientists who wish to conduct independent research on biotech crops have been thwarted by industry's proprietary claims. In 2009, for example, 26 university crop scientists who study maize and insects wrote to the U.S. Environmental Protection Agency complaining that patents on engineered genes were preventing public sector scientists from researching the effectiveness and potential environmental impacts of the industry's genetically engineered crops. "No truly independent research can be legally conducted on many critical questions," the scientists wrote.[23] The 26 scientists who submitted the letter did so anonymously because they feared that the companies would retaliate by cutting them off from company research. One of the scientists told the *New York Times*, "If a company can control the research that appears in the public domain, they can reduce the potential negatives that can come out of any research."[24]

Six Crops; Two Traits: From 1995-2010, the Big Six commercialized six genetically engineered crop species (soybean, cotton, maize, canola, sugarbeet, alfalfa). These six crops were engineered for just two genetic traits: 1) herbicide tolerance; 2) insect resistance (based on *Bacillus thuringiensis (Bt)* – a naturally-occurring soil bacterium).

The number one biotech trait, by far, is herbicide tolerance. Monsanto introduced its first "Roundup Ready" seeds in 1996 – crops engineered to survive a dousing of the company's proprietary weedkiller, Roundup (active ingredient: glyphosate), without killing the crop itself. Because of the time and labor-saving benefits of HT seeds, the Roundup Ready system has been a blockbuster business. Glyphosate usage on just three crops (soybeans, corn and cotton) in the U.S. surged from 7.9 million lbs. in 1994 to 119 million lbs. in 2006.[25] By 2011, 85% of the worldwide area devoted to GE crops contained at least one trait for glyphosate tolerance.[26]

Herbicide Tolerant Weeds Bite Back: Industry has long argued that the adoption of GE herbicide tolerant (HT) crops has promoted the use of safer, less toxic agrochemicals. In reality, over the past 16 years biotech's HT seeds and companion chemicals have entrenched chemical dependency in agriculture and unleashed an epidemic of herbicide resistant "superweeds." One farm official in Arkansas referred to glyphosate resistant weeds as "the single largest threat to production agriculture that we have ever seen."[27] In the U.S. alone there are 16.8 million acres of farmland infested with glyphosate resistant weeds, up from just 2.4 million acres less than 4 years ago.[28] In March 2012 the president of Dow Agrosciences warned that glyphosate-resistant weeds, and weeds that are tough to control, surged 25% in 2011 and now infect 60 million acres of U.S. farmland.[29] Glyphosate-resistant weeds are now spreading rapidly in major Midwestern farm states, including Illinois, Iowa, Missouri, Kansas and Minnesota. According to policy analyst Bill Freese, in the U.S. and Canada at least 12 biotypes of weeds now have multiple resistance to glyphosate and one or more herbicide families that are attributable to Roundup Ready crop systems, all but one type emerged since 2005.[30]

Chemical weed control based on biotech's HT seeds is a failing, unsustainable technology. Yet the Big Six are responding to the crisis of glyphosate resistant weeds by investing hundreds of millions on the development of a new generation of genetically engineered seeds that will survive spraying of two or more herbicides – including older, more toxic and environmentally hazardous ones – such as 2,4-D, a component of the Vietnam War defoliant, Agent Orange, and dicamba, which is chemically-related to 2,4-D. Dow Agrosciences has applied for regulatory approval of 2,4-D tolerant corn, with applications for 2,4-D tolerant soybeans and cotton close behind. According to agricultural scientist Dr. Charles Benbrook, widespread planting of 2,4-D corn could trigger up to a 30-fold increase in 2,4-D use on corn by the end of this decade. But that's

Monsanto's Climate-Ready Gene Technology Fails to Impress

In December 2011 the U.S. Department of Agriculture gave Monsanto a green light for a new maize variety (MON87630) – the first genetically engineered, drought tolerant crop to receive regulatory approval anywhere in the world. But as journalist Tom Philpott reveals, regulators weren't impressed by Monsanto's new drought tolerant corn.[38] In fact, USDA's environmental assessment notes that Monsanto's drought-tolerant maize extends only to moderate drought conditions, and it has the same minimum water requirements as conventionally-bred corn. USDA notes: "Regionally marketed conventional traits apparently have similar drought tolerant properties to those offered by MON87460."[39] The report notes, "Some companies currently offer corn seed that expresses exceptional drought tolerant characteristics, which are generated without using transgenic techniques.[40] In other words, under moderate-drought conditions, existing varieties of conventionally-bred maize will perform just as well as Monsanto's new, genetically engineered trait.

just the beginning: Monsanto & BASF, Bayer, Syngenta and DuPont are all developing chemical weed control systems based on a new generation of herbicide tolerant seeds.

Bt Resistance: Biotech's second engineered trait – insect resistance – is also encountering evolved resistance in at least one target insect. Scientists have long warned that escalating use of *Bt* corn hybrids that are genetically engineered to resist European corn borer and/or corn rootworm could trigger evolved resistance in pests.[31] In November 2011, the Environmental Protection Agency warned that Monsanto's genetically engineered corn with built-in insecticidal genes (*Bt* gene) may be losing its effectiveness against corn rootworms in four states. EPA also noted that Monsanto's self-regulated program for monitoring suspected cases of evolving resistance to *Bt* is "inadequate."[32] Scientists are urging farmers in some areas to stop planting corn with anti-rootworm genes, or to use these varieties intermittently. Other scientists believe that the only way to slow evolving resistance of corn pests is to plant larger "refuge" areas of non-GE corn.[33] It is troubling, however, that the recommendation can't be implemented because there's reportedly not enough conventional seed corn (non-*Bt*) available to plant larger refuges.[34]

Big Six Capturing Climate Genes: Farmers and gardeners all over the world are on the front lines of climate change. In response, the Big Six are stockpiling monopoly patents on "climate ready" genes and traits that they claim will enable engineered crops to withstand environmental stresses associated with climate change (i.e., drought, heat, cold, floods, saline soils, etc.). The potential global market for drought-tolerant corn is an estimated $2.7 billion.[35] A 2010 report by ETC Group examined 1663 patents and patent applications published between June 2008-June 2010 that make specific claims to environmental stress tolerant genes and technologies associated with climate change.[36] According to ETC Group, the Big Six (DuPont, BASF, Monsanto, Syngenta, Bayer and Dow) and their biotech partners (Mendel Biotechnology and Evogene) controlled 201 or 77% of the 261 patent families[37] related to genes for environmental stress. Just three companies – DuPont, BASF, Monsanto – accounted for 173 or 66%. The public sector held only 9%.

Can patented techno-fix seeds provide the adaptation strategies that farmers need to cope with climate change? ETC Group warns that these proprietary technologies are poised to further concentrate corporate power, drive up costs, inhibit independent research, and further undermine the rights of farmers to save and exchange seeds.

Conclusion: There is no societal benefit when six corporations are allowed to monopolize the very basis of the world's food supply. The Big Six are all about industry profits, not diversity, sustainability or food security.

In reality, the Big Six takeover of the first link in the industrial food chain offers a very incomplete picture of today's food and farming landscape. Members and supporters of Seed Savers Exchange are among those who treasure seed diversity and are building a grass-roots network for sharing, conserving and using our priceless fruit and vegetable heritage. People who are growing food to feed their families and local communities are part of a vast movement to build and strengthen alternative food and farming systems – both rural and urban – based on diversity, democracy and sustainability. The good news is that civil society, social movements, farmers' organizations, scientists and consumers are joining forces like never before to challenge corporate food hegemony and promote food sovereignty based on agro-ecological practices. In recent months, for example:

In December 2012 Pesticide Action Network (PAN) Asia & the Pacific hosted a Permanent People's Tribunal in Bangalore, India where the Big Six pesticide and biotech firms were brought to trial for human rights violations. In the words of Javier Souza, chair of PAN International: "It is time that the global community takes notice of the extent of the harm to humanity and the planet caused by agrochemical TNCs, and takes action to hold them to account."[41]

In April 2012 over 150 groups and more than 365,000 citizens from across the U.S. called on the USDA to reject Dow Chemical's application for a GE corn that is resistant to the herbicide 2,4-D.[42]

At the Rio+20 Earth Summit in June there is concern that governments will embrace "green technology" and new techno-fixes to address planetary crises. Civil society and social movements will hold up GM technology as a text book case of why independent monitoring and assessment of emerging technologies must be part of good governance.[43]

About the Author:

Hope Shand is a lifetime member of SSE and former research director of ETC Group. She conducts research & writes on agricultural biodiversity and the impacts of new technologies with ETC Group and others.

Endnotes & Additional Resources

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