Genetically Modified (GM) Soya in South Africa:

Status Quo Report

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Contents

On 7 April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity (ACB). This name change was agreed by consultation within the ACB to reflect the expanded scope of our work over the past few years. All ACB publications prior to this date will remain under our old name of African Centre for Biosafety and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture systems in Africa and our belief in peoples' right to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

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Acronyms

ACB	African Centre for Biodiversity
AFMA	Animal Feed Manufacturers Association
BFAP	Bureau for Food and Agricultural Policy
DAFF	Department of Agriculture, Forestry and Fisheries
DTI	Department of Trade and Industry
GM	Genetically modified
GURTs	Genetic Use Restriction Technology
HT	Herbicide tolerant
IPAP	Industrial Policy Action Plan
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ITAC	International Trade Administration Commission of South Africa
NAMC	National Agricultural Marketing Council
USA	United States of America
WHO	World Health Organisation

Figures and Tables

Terminology

In this paper we use the term 'genetically modified' to refer to transgenic techniques used in genetic engineering.

This Paper

This short briefing paper seeks to give an update on the status of GM soya in South Africa, including: its presence in various foodstuffs found on supermarket shelves, the inextricable link between GM soya and glyphosate use, and the state of play of GM soya research in the country.

Introduction

Genetically Modified (GM) soya was first planted in the USA in 1996 and is the most widely planted GM crop in the world. It accounted for 51% of all global GM crop cultivation in 2015—just under 92 million ha. By comparison, maize, the second largest GM crop, accounted for only 30% of the global GM area in the same year (ISAAA, 2015). The majority of GM soya grown globally is used as animal feed in mostly industrial-scale feedlots (Murphy et al., 2012). GM Soya has been genetically engineered to withstand the herbicide glyphosate, commonly sold under the Monsanto brand name 'Roundup Ready'.

The global soya bean seed industry is worth about US$ 7 billion (Agronews, 2016) with the agrochemical market being worth an additional US$ 9.6 billion (Wynberg, 2015). For Monsanto in particular, the revenues generated by the sale of GM soya bean seed and Roundup has been enormous: in the USA (Mitchell, 2014) and Brazil (Freitas Jr, 2016), the world's two largest soya producers, over 90% of soya bean seed sold is either Monsanto seed or contains Monsanto's patented traits, licensed by other companies. Monsanto's 'agricultural productivity' division made nearly US$ .5 billion in profits for the fiscal years 2013–2015 (Monsanto, 2015).

However, there is a dark side to this rapid expansion of herbicide tolerant GM soya in North and South America, in particular from the aerial spraying of glyphosate. Catastrophic environmental and human health impacts have been reported in Latin America, especially in Argentina (ACB, 2015) while the large-scale persecution of US farmers who farm soya has also taken place, mainly on the grounds of intellectual property infringements (see Box below) (Centre for Food Safety, 2012).

Soya, GM Crops and Seed Saving

Because all GM soya seeds are open-pollinated varieties they can be saved and re-planted for at least three seasons without significant yield-loss. Accordingly, seed saving of GM soya is a common practice, even among commercial farmers. By contrast, all GM maize and cotton seed varieties on the market are hybrid varieties. Re-planted saved seed from hybrid maize and cotton will not stay true to the variety's type and this results in yield loss. Consequently, maize and cotton farmers typically will not replant GM maize and cotton seed. This should not be confused with Genetic Use Restriction Technology (GURTs) which produces sterile seed—these seeds are known colloquially as 'terminator' or 'suicide' seeds. While these seeds already have been developed, they are currently not in use due to the international moratorium on the cultivation of 'terminator seeds'.

Soya Cultivation in South Africa

Soya beans were first introduced into South Africa in 1903 although lack of information about the crop stymied its production for the early part of the twentieth century. Despite government-led efforts to kick-start a domestic soya industry, the area planted under soya beans did not reach 50 000 ha until the early 1990s, and annual production of soya would not regularly surpass 100 000 tons until the year 2000 (Dlamini et al., 2013).

In 2001 GM soya beans (NK603—Monsanto's 'Roundup Ready' variety) were approved for commercial cultivation in South Africa, and now account for 90% of all soya bean production (Esterhuizen, 2015). Soya bean production has increased dramatically over the

last decade, growing at an average annual rate of 13%, from 2005 to 2015. Despite the recent drought experienced by South Africa, during the 2015/16 cropping season South African farmers planted a record 687 000 ha of soya beans (Department of Agriculture, Forestry and Fisheries (DAFF), 2015). The major soya producing areas in South Africa are located in Mpumalanga, which accounts for 43% of the country's total production, and the Free State (which accounts for 33%) (DAFF, 2014).

Since its approval in South Africa in 2002, the area of GM soya in the country has expanded rapidly; in 2015 GM soya accounted for 618 000 ha—of the total area of 687 000 ha under soya. This has coincided with an overall increase in all GM crop cultivation, due to a concerted effort led by the Department of Trade and Industry (DTI) to increase domestic soya production in South Africa.

When compared with maize, sunflower and groundnuts, soya bean is the only major grain crop that has shown significant production increases since 2004, although yields have remained at roughly 1.12 tons/ha over the period (Grain SA, 2015). In 2012 the area under soya surpassed that of the area under sunflower for the first time. Soya is now considered South Africa's most important oilseed crop (Bureau for Food and Agricultural Policy (BFAP), 2015).

Further expansion of the area under soya is envisaged. The Bureau for Food and Agricultural Policy (BFAP), a multi-disciplinary think tank based at the Universities of Stellenbosch and Pretoria, predicts that the total area under soya in South Africa will rise to over 1 million ha by 2024, and production is expected to exceed 2.1 million tons (BFAP, 2015). If the current rate of GM soya adoption is maintained (as has been the case over the last three seasons), this will mean nearly 1 million ha of GM soya cultivation in South Africa within a decade.

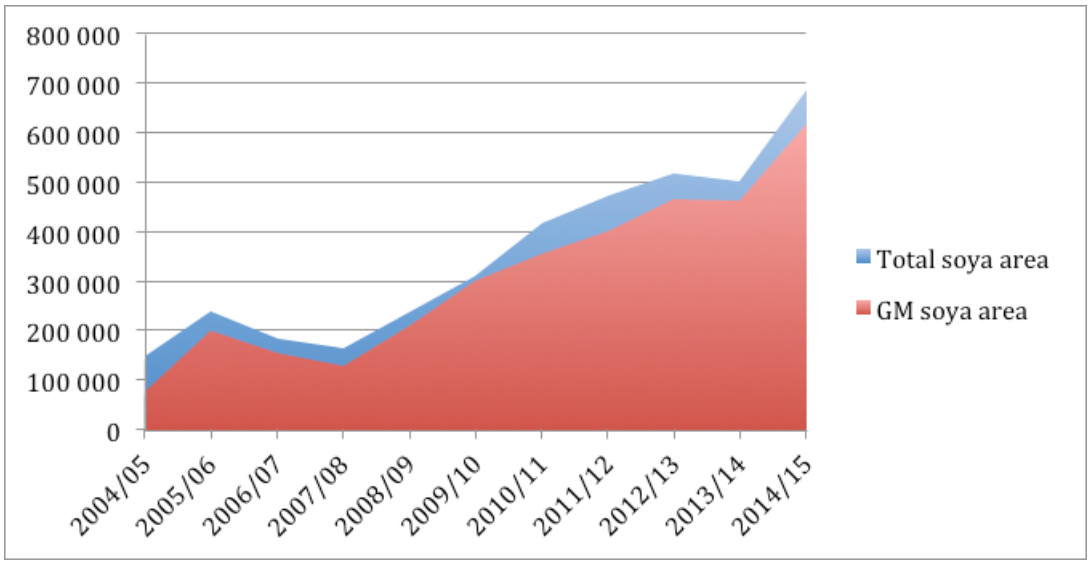
'GREEN GOLD'—GM SOYA AROUND THE WORLD

Since 1996 no plant has been more important to the spread of GM crops around the world than the soya bean. In 2015, of the 180 million ha of GM crops planted worldwide, GM soya bean accounted for fully 51% of this. In its latest global annual status report for GM crops, the International Service for the Acquisition of Agri-biotech Acquisitions (ISAAA) claims that an estimated 83% of global soya bean production is due to GM seed (ISAAA, 2015).

Despite these huge numbers, GM soya bean production is heavily concentrated in Argentina, Brazil and the USA. In 2015 these countries were responsible for 95.6% of global GM soya production, and 82% of all soya production. The same three countries are also the world's major soya exporters. In 2015 an astonishing 88% of global soya bean exports originated in these three countries (SoyStats, 2016).

Approximately 85% of the global soya bean harvest is processed into soya bean meal and oil, and 98% of this soya bean meal is processed further into animal feed. Because of the relatively high processing costs of soya bean oil compared with palm oil, huge economies of scale are required for this industry to remain competitive. For example, 71% of the soya harvest in the USA is processed by just three companies: Bunge, Cargill and Archer Daniels Midland (ADM) (Oxfam, 2012).

Figure 1. South African farm land under soya, 2004/05–2014/15 (ha)



Source: Crop Estimates Committee.

Soya Consumption in South Africa

Once harvested soya beans can be consumed in three forms: whole as food, as full-fat products (such as milk), or as crushed oil and oilcake (Grain SA, 2015). The major food use is textured soya protein or textured vegetable protein, followed by isolates, soya blends, soya-flours and meals, and concentrates. There are two distinct markets for soya as a protein in human consumption: a low-income market where soya is used as a meat substitute, and a high-income health and vegetarian market (ACB, 2010). Human consumption is said to account for just 7% of total soya consumption in South Africa (National Agricultural Marketing Council (NAMC), 2011).

Soya-Based Food Products on the South African Market

Soya and its derived products are found in literally hundreds of food products on our supermarket shelves. Previous GMO testing conducted by ACB has found very high levels of GM soya present in breakfast cereals and bread; soya flour helps baked products to rise, prevents dough from sticking and increases the volume and softness of bread (ACB, 2014). Soya mince is now a popular protein substitute for meat and leading brands feature among products from Pick 'n Pay, Imana, Knorrox and Top Class.

Glyphosate and GM soya

The use of glyphosate, which is associated with increased herbicide tolerant (HT) soya planting, has increased in South Africa in recent years—although not as dramatically as it has with maize production. In 2006 soya farmers used approximately 800 000 litres of glyphosate. By 2012 this had increased to 1.3 million litres although there was a significant drop, to around 400 000 litres per year,

between 2007 and 2009. In 2012, 53% of all herbicide expenditure for soya bean production was related to glyphosate (Gouse, 2014). Unfortunately, owing to the general secrecy around glyphosate use in South Africa, more up to date figures on glyphosate use in agriculture are very difficult to come by.[1]

The dire health and environmental implications from huge increases in glyphosate applications are well known. These were given substantial backing when the International Agency for Research on Cancer (IARC), part of the World Health Organisation (WHO), re-classified glyphosate as being "a probable human carcinogen" (ACB, 2015).

There is also burgeoning literature on the impacts of glyphosate on soil health and fungi. Some fungi, such as mycorrhizal fungi, appear to be sensitive to glyphosate while others, including rust and blight fungi, can increase under glyphosate application. Studies have found that the roots of glyphosate-treated herbicide tolerant soya and maize have between 2 and 5 times as many fusarium numbers as untreated plants (Tappeser et al., 2014). This is significant—fusarium causes Sudden Death Syndrome (SDS) in soya bean plants, one of the most devastating soil-borne diseases for this particular plant (Westphal et al., 2008). The first report of SDS for soya bean in South Africa, caused by Fusarium virguliforme, was recorded in February 2013 (Tewoldemedhin and Lamprecht, 2014).

The Rapidly Expanding GM Soya Industry

While consumption of food and full-fat soya products has remained fairly constant over the previous decade, the consumption of crushed soya oil and oilcake has increased dramatically over the same period; it is currently estimated to be around 880 000 tons (Grain SA, 2015). The animal feed industry, in response to the demand from the broiler industry (which is now the largest single contributor to the agricultural sector) has been the primary driver of this huge increase. From 2001 to 2012 the consumption of chicken in South Africa increased by 74%. Even though this trend is expected to decrease to 38% until 2024, this will still account for 65% of all additional meat consumption over the period (BFAP, 2015).

During the first decade of the twenty-first century, with domestic soya production failing to keep up with demand, GM soya imports from South America were the major source of animal feed. From 2000 to 2007, overall imports of soya products into South Africa almost doubled, from 600 000 tons to more than 1.3 million tons. The majority of these imports were for soya bean oilcake, which increased from 400 000 tons to nearly 1 million tons over the same period (ACB, 2010). In South Africa in 2006/07 members of the Animal Feed Manufacturers Association (AFMA) imported 87% of the 653 463 tons of soya bean oilcake used in the country (AFMA, n.d.).

In 2011 the DTI, under its Industrial Policy Action Plan (IPAP), embarked upon a soya bean strategy to increase overall domestic soya production and processing, and to reduce South Africa's dependence upon imports. The DTI worked closely with the soya bean industry and South Africa's International Trade Administration Commission (ITAC), who undertook to review the tariff dispensation for the soya value chain (DTI, 2013).

In the intervening period R1 billion has been invested in South Africa's domestic soya processing industry. This has increased its soya crushing capacity from 600 000 tons in 2012 to approximately 1.75 million tons at present (2016). This figure could rise to 2.5 million tons if dual processing plants were switched from sunflower to soya bean processing (BFAP, 2015). Notable investments include the joint venture by multinational grain trader Bunge, with local agribusiness firm, Senwes, to develop grain and oilseed value chains (ACB, 2011); a

1. In Gouse (2014) the author uses a combination of proprietary industry data, farm-level surveys and crop-budget estimates from Grain SA to arrive at figures for glyphosate use and costs. Only the information from Grain SA, which is essentially aggregated cost data, is publically available.

Table 1: GM soya commodity imports and exports (bulk shipments of GM soya beans)

Year	Imports (MT)	Exports (MT)	Major markets
2016	60,000	0	Paraguay
2015	374,000	0	Brazil, Paraguay
2014	68,000	0	Brazil
2013	0	55,000	Malaysia, Indonesia
2012	0	281,400	Malaysia, Indonesia
2011	0	520	Malaysia

Source: DAFF.

R600 million investment by Singapore-based Noble Resources in a soya bean crushing plant in Mpumalanga (SA Government, 2013); and Cargill's US$ 12.5 million expansion of its animal feed premix facility in Pietermaritzburg (Cargill, 2015).

As a result, imports of soya oilcake (the major ingredient in animal feed) decreased by 51% from 2010/11 to 2014/15. This is "a clear sign of the structural change taking place in the South African soya market as a result of the local soya strategy", according to AFMA (AFMA, 2015). There was even a brief period, from 2011 to 2013, when South Africa became a net exporter of GM soya beans, sending some 337 000 metric tons to Malaysia and Indonesia (DAFF; 2011, 2013).

Imports of GM soya

Nonetheless, South Africa still imports significant quantities of oilcake. In 2014 oilcake imports amounted to 511 014 tons, which is a 41% share of domestic consumption and 99% of these imports were from Argentina (Grain SA, 2015). South Africa continues to import raw GM soya beans from South America (see table above), though the quantities are significantly lower than at the height of soya imports in the period 2007–2009.

Unlike previous shipments, which contained only Monsanto's original Roundup Ready varieties (GTS 40-3-2), recent shipments include a number of new GM soya varieties, including Monsanto's stacked variety MON89788 X MON87701 and BASF's CV127 varieties. CV127 is tolerant of the imidazolinone class of pesticides which have been associated with cancer of the colon and bladder and its use is restricted in the European Union (Greenpeace, 2015). In 2013 South Africa's GM regulators took a highly contentious decision to grant import approval to Dow AgroSciences for its GM soya bean variety DAS-44406-6, which is tolerant to herbicides based on 2,4-D, a chemical that has been linked with various forms of cancers for a number of years. In 2015 the WHO's IARC classified 2,4-D as "possibly carcinogenic to humans"[2] (ACB, 2015).

GM soya research in South Africa

In South Africa in recent years, despite large increases in both the area under soya and the domestic processing capacity, very little field trial activity involving new GM soya bean varieties has been undertaken. Since 2011 only three events have been tested in the field: 356043 x 40-3-2, stacked with tolerance to glyphosate and ALS inhibitors; 305423, which contains a modified fatty acid profile and tolerance to sulfonylurea; and 305423 x 40-3-2, in which the latter is stacked with glyphosate tolerant event 40-3-2. Thus far, 356043 x 40-3-2 has been trialled in only one season, in 2011/12, while the other two events were trialled for two seasons, from 2013/14–2014/15. No subsequent permits were granted in 2015.

Even though glyphosate resistant weeds are not yet a major problem in South Africa, the fact that Monsanto is funding research into

2. A substantial minority of the IARC working group considered there to be enough evidence for the higher classification of "probable" human carcinogen.

Table 2: GM soya bean field trials in South Africa

Year	Event	Trait	Company
2014	305423 x 40-3-2	Modified oil/fatty acid x HT (glyphosate x sulfonylurea)	Pioneer
	305423	Modified oil/fatty acid, HT (sulfonylurea)	Pioneer
2013	305423 x 40-3-2	Modified oil/fatty acid x HT (glyphosate x sulfonylurea)	Pioneer
	305423	Modified oil/fatty acid, HT (sulfonylurea)	Pioneer
2011	356043 x 40-3-2	HT (glyphosate & ALS inhibitors)	Pioneer

Source: DAFF.

glyphosate resistant weeds at the University of Pretoria indicates its concern regarding this potential difficulty. Should widespread resistance to glyphosate in GM soya production start to emerge, South Africans should expect a deluge of new GM soya varieties tolerant to a variety of toxic chemicals, including 2,4-D, dicamba, glufosinate, imidazolinone and isoxaflutole—as has been the case in the USA where glyphosate resistance now is widespread (ACB, 2015).

Conclusion

Soya is now one of South Africa's most important crops and has surpassed sunflower as the country's major oilseed crop. In 2015/16 South African farmers planted a record 687 000 ha of soya beans, yielding a harvest of over 1 million tons. Monsanto's Roundup Ready soya varieties, first approved for commercial cultivation in South Africa in 2002, now account for 90% of all soya grown in the country. The BFAP predicts that by 2024 over 1 million ha of soya will be grown locally.

While only 7% (approximately) of South Africa's soya crop is for human consumption, it is found in one form or another, in countless food items on our supermarket shelves. Previous testing by the ACB has found GM soya in breakfast cereals and bread. As is the case around the world, the overwhelming majority of soya grown in this country is crushed into soya oil and oilcake for use in the animal feed industry.

Previously, the bulk of animal feed requirements were imported from South America, which is the largest production region in the world of GM soya, as either raw soya beans or processed oilcake. From around 2011, following the implementation of a soya bean strategy by the DTI, the production of domestic soya and its processing capacity have both expanded dramatically. Some of the world's largest grain traders, including Bunge, Cargill and the Noble Group, have invested in new soya bean crushing facilities in South Africa.

Despite this transformation in the domestic soya industry, South Africa still grows only the Monsanto original Roundup Ready soya bean varieties, first approved in 2002. Field trial activity, which is a good barometer for research activity in a landscape where access to information is largely controlled by private companies, has been limited. The last field trials for any GM soya bean varieties took place in 2014.

The introduction of GM soya has led to dramatic increases in the use of glyphosate-based herbicides around the world. In South Africa glyphosate use among soya farmers increased from 800 000 to 1.3 million litres, from 2006 to 2012. Though not as dramatic as the increases in maize production, this is still noteworthy, particularly given the prediction of further increases in soya production over the coming decade. Weed resistance to glyphosate, which has been catastrophic in the USA, does not appear to be a major issue in South Africa—yet—although the fact that

Monsanto is funding research into this issue at the University of Pretoria suggests it is a likely possibility. That being the case, and given South Africa's current agricultural trajectory, it is highly likely that the 'solution' to glyphosate tolerant weeds in South Africa will be GM soya varieties which will be tolerant of an ever increasing number of toxic chemicals.

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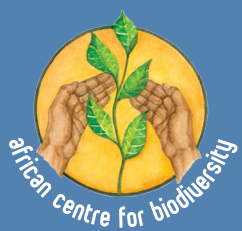

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