



**HOW MUCH
GLYPHOSATE
IS ON YOUR
DINNER PLATE?**

**SA's food safety compromised
by lack of testing**



african centre for biosafety

www.acbio.org.za

PESTICIDES AND GM CROP SERIES

The African Centre for Biosafety (ACB) is a non-profit organisation, based in Johannesburg, South Africa. It was established to protect Africa's biodiversity, traditional knowledge, food production systems, culture and diversity, from the threats posed by genetic engineering in food and agriculture. It has in addition to its work in the field of genetic engineering, also opposed biopiracy, agrofuels and the Green Revolution push in Africa, as it strongly supports social justice, equity and ecological sustainability.

The ACB has a respected record of evidence based work and can play a vital role in the agro-ecological movement by striving towards seed sovereignty, built upon the values of equal access to and use of resources.



©The African Centre for Biosafety

www.acbio.org.za

PO Box 29170, Melville 2109 South Africa

Tel: +27 (0)11 486 1156

Design and layout: Adam Rumball, Sharkbouys Designs, Johannesburg

PESTICIDES AND GM CROP SERIES

CONTENTS

Use of terms	4
Introduction	4
Key findings	4
Glyphosate	5
Glyphosate Tolerant Crops in South Africa	6
Risks to human health	7
Food Safety in South Africa	7
Maximum Residue Limits	7
Regulatory issues	8
No testing of MRLs in locally produced food	10
No monitoring and testing of imported food	10
Testing of food destined for export	11
Promised policy and legislative reform	11
Conclusion	11
References and notes	13

WITHOUT ROUNDUP, ONE COULD SAY THERE REALLY ISN'T A ROUNDUP READY SYSTEM, SO THAT GIVES ME CONFIDENCE THAT ROUNDUP IS STRATEGIC TO MONSANTO; IT IS A BIG PART OF THE OVERALL SYSTEM OF WEED CONTROL, GERmplasm AND TRAITS.

Dean Hendrikson, global lead for Monsanto non-brand herbicide.¹

Use of terms

In this paper, we use the term 'pesticides' to include insecticides, herbicides and fungicides. This is a generally accepted use of the term in the agricultural sector.

INTRODUCTION

This briefing paper forms part of a series of briefing papers on glyphosate to be released later this year by the African Centre for Biosafety (ACB). In this paper, we focus principally on food safety issues, highlighting our grave concerns about the utter regulatory failure concerning particularly, the monitoring, inspection and testing of food for glyphosate residues.

This situation is extremely worrying, given the dramatic increase in the use of glyphosate in food production in South Africa and the risks it poses to human and animal health. Currently, South Africa grows 2.3 million ha of genetically modified crops, 1.8 million of which is planted to genetically modified (GM) maize. 54% of the white GM maize has been genetically engineered to tolerate liberal applications of glyphosate. White maize is a staple food for majority of South Africa's people. All of the GM soya planted in South Africa is glyphosate tolerant. GM soya plantings have risen sharply in the last three years: from 184 000 ha in 2008, to 480 000 ha in 2011. South Africa also imports bulk shipments of GM grain from countries growing herbicide tolerant crops. These grains are traded on the South African market for food, animal feed and processing.

Key findings

1. We have experienced great difficulty in obtaining any information from the Department of Agriculture, Forestry and Fisheries (DAFF) with regard to the registration, re-registration and review of glyphosate. This means that the public is not only kept in the dark, but is not able to participate in the decision-making process with regard to the registration of glyphosate. We are also concerned that no real review takes place and that re-registration is merely a rubber stamping exercise. This is alarming, given the increase in the use of glyphosate in the production of maize – a staple food in South Africa.
2. Current legislation in South Africa regulating glyphosate and all pesticides for that matter, is hopelessly dated and in need of urgent review. Indeed, a Pesticide Management Policy for South Africa published by DAFF in 2010 acknowledges that current legislation does not address the Constitutional requirements with regard to our rights to an environment that is not harmful to human health; access to information; and openness, transparency, and public participation in

decision making. While the Policy document sets out various proposed measures that need to be taken to substantially reform such legislation, very little progress seems to have been made towards the implementation of such measures.

3. Glyphosate poses unacceptable risks to human, animal and environmental health. An open and transparent process urgently needs to be established to review the use of glyphosate in South Africa.
4. Recently, the ACB was desirous of testing food samples for glyphosate residues. In the course of trying to get these samples tested, the ACB learnt that while there are numerous private testing laboratories throughout South Africa, nine of which are ISO 17025² accredited,³ none were able to test for glyphosate residues in our samples of processed food containing maize and soya. Testing could only be achieved if the samples were sent abroad, at considerable expense.
5. This means that there is a complete lack of testing for glyphosate residues in local market produce! Private sector surveillance and monitoring relies on independent laboratories. However, these do not currently test for glyphosate residues due to technical difficulties and capacity constraints. This is particularly perturbing given that the GMO authorities in the country have seen fit to authorise the commercial cultivation of GM herbicide tolerant crops that increase glyphosate usage, without there being any capacity development for local laboratories to monitor the consequences.
6. Local government health authorities are responsible for the inspection and monitoring of imported foodstuffs in terms of the National Health Act. Capacity constraints appear to be a significant issue throughout the system. Municipalities suffer from severe capacity constraints and do not undertake any testing for exceedance of the Maximum Residue Limit (MRL). According to information from the Health Professionals Council of SA (HPCSA), as of the 31st of March 2012, there were over 165,000 registered qualified health practitioners in South Africa. Of these 3,264 are classified under environmental health, with just 11 (eleven) 'food inspectors' among them. By way of comparison, there are 2,397 registered dietitians on the list. This is a grave concern for us, given that millions of tons of GM grain are imported into SA.
7. Laboratories at the DAFF and the Johannesburg Fresh Produce Market (JFPM) are used for screening and surveillance, principally for microbiological contamination, for which there is regular and careful testing to ensure that exports to international markets comply with phytosanitary requirements.⁴ Regulations for MRLs for food exports, and their enforcement, are established by the DAFF, the South African Bureau of Standards (SABS), the Perishable Products Export Control Board (PPECB), industry working groups, agrochemical companies and other technical experts. This is a well functioning system designed to protect South Africa's export markets and contrasts starkly with the poor system set up for domestic food.

GLYPHOSATE

Glyphosate is the 'active ingredient' in numerous chemically based herbicides that are used in diverse situations including in food production, timber plantations, sports fields and home gardens. Glyphosate is a water soluble, broad spectrum, non-selective herbicide that is absorbed by the leaves and transported to all parts of the plant. It works by inhibiting the enzyme enolpyruvylshikimate-phosphate-synthase (EPSPS), which is a catalyst for the production of three

essential amino acids: phenylalanine, tyrosine, and tryptophan.⁵ These are all vital to plant growth. As the EPSPS is present in all plant life, glyphosate affects all plants and is therefore referred to as a 'broad-spectrum' herbicide.

Other chemicals known as adjuvants or surfactants are added to the glyphosate in herbicide formulations. These enable the herbicide to stick to the plant's foliage, so that the glyphosate molecule can penetrate the plant's cells and enter its circulatory system.⁶ The most common surfactant applied in combination with glyphosate is polyethyloxyated tallowamine (POEA), which itself has been found to exert ecotoxicity, and in synergy with glyphosate, causes the formulated herbicide to be more toxic than the glyphosate alone.⁷

Though it was first synthesised in 1950, it was not until 1974 that glyphosate's potential for use as a herbicide was identified by Monsanto scientist, John Franz. Glyphosate is also traded under the name 'Roundup' by Monsanto and has, since the 1990s, been the world's most traded active ingredient in herbicides. In addition to its application as an agricultural weed killer, glyphosate is also registered for weed control on roadsides, pavements, railways, and even in domestic gardens.⁸ The oft forgotten 'war on drugs' was also a lucrative outlet for glyphosate, as thousands of tons of it were sprayed indiscriminately over fields and forests in Mexico and South America.⁹

Glyphosate is used prolifically in conjunction with herbicide tolerant (or 'Roundup Ready') GM crops. From an initial planted area of 600,000 ha in 1996,¹⁰ the global area planted to GM herbicide tolerant crops has increased to nearly 118 million ha in 2011, accounting for 85% of all GM crops grown world-wide.¹¹ Cultivation is heavily concentrated in the United States, Brazil and Argentina, which in 2011, grew 69 million, 30 million and 22 million ha respectively.

INTERNATIONAL REVIEWS, BANS AND RESTRICTIONS

Several countries have undertaken scientific re-evaluation of glyphosate, with some initiating partial bans. In Denmark, following a major government study on the leaching of pesticides into groundwater, glyphosate is now banned from being sprayed on hard surfaces. Half of all municipalities in Sweden have also prohibited its use.¹² When it was announced in Argentina in 2009 that glyphosate had caused deformations in amphibian embryos, a government committee was established including the ministries of health, environment and agriculture to investigate its health and environmental impacts.¹³

In the USA the Environmental Protection Agency (EPA) placed glyphosate under review in 2009, and has set a deadline of 2015 to determine whether it should continue to be sold, or be subjected to limitations.¹⁴ The European Union last approved glyphosate in 2002, a decision which was due for a review in 2012. However, this has been delayed until 2015.

GLYPHOSATE TOLERANT CROPS IN SOUTH AFRICA¹⁵

South Africa's commercial farmers are rapidly embracing HT crops. The first HT cotton variety was commercially released in South Africa in 2000, followed by HT varieties of soybean and maize in 2001 and 2002 respectively. Adoption rates for HT maize hovered around the 30% mark but increased markedly to over 50% in 2010/11.

In the 2010/2011 season, about 77% of all maize seed sold in South Africa was GM. This means that about 1.8 million hectares were planted to GM maize during that period. Nearly 50% of the GM white maize planted in that year was tolerant to glyphosate.

The latest available data shows that 95% of the cotton now planted in South Africa contains the HT gene, though cotton production in South Africa, which is all GM now, is marginal (equivalent to less than 1% of total GM cropped area).

HT soya cultivation has risen from 165,000 ha in 2008 to 472,000 ha in 2012. Experts in the sector predict that over 650,000 ha will be planted in South Africa by the end of the decade.

From 2008 to 2012, the number of GM maize varieties registered for plant breeders rights that contained the HT gene trebled. Over the same period 24 new varieties of HT maize (many stacked in combination with insect resistance) have undergone field trials. Additionally, HT varieties accounted for nearly three quarters of all GM seed imports since 2008.

Risks to human health¹⁶

Human health

- Glyphosate formations can induce cell death in human umbilical, embryonic and placental cells. The same study further added that 'adjuvants in Roundup are not inert'.¹⁷
- Cell exposure to glyphosate can trigger programmed cell death (to prevent the growth of tumours, for example). Research has revealed that Bt toxins (produced by the other significant GM trait on the commercial market¹⁸) can impair this process in human embryonic kidney cells.¹⁹ This could have severe implications, as 'stacked' GM crops, which contain both traits, are becoming more and more prevalent.
- In Ontario, Canada, glyphosate use has been associated with an increased risk of spontaneous and late abortions among farm-workers.²⁰ Similar evidence has emerged from Argentina.

Animal health

- Glyphosate-based herbicide mixtures and glyphosate itself have been found to interfere with key molecular mechanisms regulating early embryonic development in both *Xenopus* (frogs) and Chickens.²¹
- Fresh testicular cells from mature rats were exposed to glyphosate and its formulation at residues from 1 to 10,000 mg / kg (the range in some human urine and the environment to agricultural levels). Cell damage was recorded within 24 hours. At lower so-called non-toxic concentrations of Roundup and Glyphosate (1 mg / kg), testosterone decreased by 35%.²²

FOOD SAFETY IN SOUTH AFRICA

Maximum Residue Limits

Pesticide residues on crops are monitored through the use of **Maximum Residue Limits** (MRL), which are based on the analysis of the quantity of a given chemical remaining on food product samples.

TABLE: Maximum Residue Levels for Glyphosate

This table sets out the MRLs set by various countries in respect of a small group of foodstuff.²³

	parts per million / mg / kg						
	USA	Codex	EU	Australia	Brazil	Canada	SA
Banana	0,2	0,05	0,1	0,2	0,02		0.1*
Bean, dry	5	2	2	0,1			2**
Sugarcane	2	2	0,1	0,3	1	–	0,5
Pea, dry	8	5	10	5	0,1	3	10*
Maize, grain	5	5	1	1	0,1	3	2
Sunflower seed	85	7	20	0,2			20*
soybean, dry	20	20	20	10	10	20	20**
Wheat, grain	30	30	10	5	0,05	5	30**
Rape seed	20	20	10	20	2	10	20**

Notes: * defers to EU, ** defers to codex

Generally speaking, MRLs are based on formulas which determine the actual level of pesticides found in the diet, and the accepted daily intake of a specific pesticide. The determination of pesticides found in the human diet uses a combination of observed pesticide levels in food, based on field studies mimicking common agricultural practices, and national consumption data (daily per capita consumption of maize in South Africa, for example). Once this 'dietary exposure' has been established, it is compared to an 'accepted daily intake' (ADI), based on toxicological studies.²⁴

In South Africa, the MRL is determined by a number of factors, including: the minimum effective dose, the standard application dose rate, the interval between harvest and consumption and climatic conditions that may influence the efficacy of the pesticide. Once the most appropriate MRL has been selected by the Department of Agriculture, Forestry and Fisheries, (DAFF) this is sent to the Department of Health (DoH), which determines whether or not it will compromise human health and safety. If the MRL is not deemed a health risk, it is published under the Foodstuffs, Cosmetics and Disinfectants Act (no. 54 of 1972).

Regulatory issues

The South African government's oversight of our food system is fragmented across 14 separate Acts of Parliament, and administered at all three tiers of government (national, provincial and local). The three bodies mandated with developing and enforcing food safety standards are:

- Department of Health (DoH);
- Department of Agriculture, Forestry and Fisheries (DAFF); and
- South African Bureau of Standards' (SABS) Directorate of Regulatory Affairs and Consumer Protection.²⁵

Accordingly, policy execution has been hampered by a lack of clear demarcation regarding mandates, responsibilities and accountability. Government recognises that many of the current pieces of legislation regulating pesticide use are hopelessly outdated and in need of substantial and urgent revision.

The use of agricultural pesticides (including glyphosate) in South Africa requires registration under the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947). This Act is administered by the Department of Agriculture, Forestry and Fisheries (DAFF), Directorate: Food Safety and Quality Assurance.

To have a pesticide registered in SA, an applicant (typically an agrochemical company such as Bayer or Syngenta) will provide DAFF with a dossier containing toxicology data for human health, efficacy data and residue trial data.

Toxicology data is shared with the Department of Health, Directorate: Food Control for evaluation. Toxicological levels for the Acceptable Daily Intake (ADI) and Acute Reference Dose (ARfD) are determined, whereupon, a final decision on whether the DoH recommends registration of the pesticide is made to the Registrar of Act 36 of 1947.

It is questionable whether the DOH retains, or has the requisite toxicological expertise in-house, that is needed to make these assessments. Certainly, a practise has developed within the DOH to outsource these assessments to external consultants who also do work for industry. A further concern is that the data on which human health assessments are based is derived from healthy 70kg men in the Northern hemisphere, and does not take into account local conditions or vulnerabilities. Furthermore, there appears to be little transparency in the process, with the public not being able to see the data upon which decisions are made.

The ACB has been hopelessly unsuccessful in obtaining any information from the Registrar of Act 36 of 1947 with regard to the registration, re-registration and review of glyphosate. This means that the public is not only kept in the dark but is not able to participate in the decision-making process with regard to the re-registration of glyphosate.

All registrations of agricultural remedies have to be renewed annually. Depending on the ruling of the Registrar of Act No.36 of 1947, such an application may have to include the submission of further efficacy, phytotoxicity and residue data.²⁶ However, it is questionable whether real capacity exists for such review, and whether the renewal process is merely a rubber stamping exercise.

The Foodstuffs, Cosmetics and Disinfectants Act (Act 54 of 1972) is the most important health legislation in terms of addressing the food safety of foodstuffs manufactured, sold or imported into the country. The Act empowers the Director General of the DoH to perform a number of functions, including the appointment of inspectors and analysts, and to take necessary action over food imports in contravention of health and safety requirements (ordering their confiscation, destruction, or return to port of origin, for example).²⁷ The enforcement of the FCDA is required to take place at local government level for foodstuffs manufactured and sold in South Africa as well as for imported foodstuffs. The Act does not extend to exports, which are overseen by the DAFF, the Perishable Products Export Control Board (PPECB) and a variety of industry bodies.

No testing of MRLs in locally produced food

During May 2012, the ACB was keen to test samples from various maize and soya products on the South African market known to contain between 60 and 100% GM content.²⁸ The first hurdle we encountered was that we could not find any laboratories in South Africa that were able to test for glyphosate residues in food. If we wanted to have food samples tested, we would have to send the samples to an accredited laboratory in Europe, at great expense.

Private sector general food safety surveillance and monitoring typically involves local authorities, public and private testing laboratories, and the major fresh produce retailers. South Africa's major supermarket chains and the National Fresh Produce Markets, which sell the majority of fresh produce in the formal economy, use independent laboratories. Freshmark, which procures all fresh fruit and vegetables for Shoprite, use the laboratories of the SABS, and Hortec, a smaller independent lab in the Western Cape.

However, the SABS does not currently test MRLs for glyphosate due to technical difficulties, though they are hoping to be in a position to do so later this year.²⁹ According to Hortec, it has the capability to test glyphosate in soya, though 'do not typically test for it'.

There is no legal requirement for the testing of glyphosate MRLs in fruit and vegetables thus no such testing is undertaken.³⁰ The argument for this lack of testing is that unlike insecticides, herbicides are not intended to be applied directly onto the plant. For an unexplained reason, Pick and Pay, also does not test for glyphosate although they submit fresh produce for testing of other residues.³¹ This is of concern given that HT crops allow for indiscriminate spraying that directly covers both weeds and the crop; thus requiring urgent investigation and review of this policy by government.

The Johannesburg Fresh Produce Market (JFPM), the largest of its kind in Africa, has on site testing facilities, which it uses for random sample testing on a daily basis. Sampling is done in accordance with a seasonal sampling plan, with results produced weekly. Insecticides and fungicides are the main focus of testing of fresh fruit and vegetables presently, but this is not carried out on maize and soya products. JFPM liaises with the City of Johannesburg's (COJ) Department of Environmental Health on all matters relating to MRL testing and monitoring.³²

There are numerous private testing laboratories throughout South Africa, nine of which are ISO 17025³³ accredited.³⁴ After exhaustive enquiries, the ACB was unable to find any that could test for glyphosate residues for maize and soya in our food samples.

The ACB's experience, and the constraints detailed above, begs the question: on what basis is the DAFF monitoring food products to ensure that these are not tainted with unsafe levels of pesticides.

No monitoring and testing of imported food

Local government health authorities are responsible for the inspection and monitoring of imported foodstuffs in terms of the National Health Act, 2003 (Act 61 of 2003). Capacity constraints appear to be a significant issue throughout the system.³⁵ According to information from the Health Professionals Council of SA (HPCSA), as of the 31st of March 2012, there were over 165,000 registered qualified health practitioners in South Africa. Of these 3,264 are classified under environmental

health, with just 11 (eleven) 'food inspectors' among them. By way of comparison, there are 2,397 registered dieticians on the list.³⁶

Municipalities suffer from severe capacity constraints and do not undertake any MRL testing. Laboratories at the DAFF and the Johannesburg Fresh Produce Market (JFPM) are used for screening and surveillance principally for microbiological contamination for which there is regular and careful testing to ensure exports to international markets comply with phytosanitary requirements.³⁷

Testing of food destined for export

Over the course of 2010/11 South Africa exported close to R50 billion worth of agricultural produce, including R6.9 worth of citrus fruit, R4 billion in maize, and R3.2 billion of apples, pears and quinces. Of this, 20% went to the United Kingdom and the Netherlands.³⁸

Regulations for MRLs for food exports, and their enforcement, are established by the DAFF, the South African Bureau of Standards (SABS), the Perishable Products Export Control Board (PPECB), industry working groups, agrochemical companies and other technical experts.³⁹

The PPECB, established in 1926, through the Perishable Products Export Control Act, is the primary government agency in this regard. Its objective is 'to bring about the orderly and efficient export of products from the Republic of South Africa.' During 1991, to align its functions with the newly promulgated Agricultural Product Standards Act, it was appointed as an assignee (by the then Department of Agriculture) to perform product quality certification on all consignments of regulated agricultural products of plant origin destined for export.⁴⁰ This includes testing produce for pesticide MRLs. It performs these services from more than 30 offices spread across 11 production regions. More than 75% of the PPECB's income (derived from inspection and export levies and other services rendered) comes from the fruit industry.

The well resourced PPECB is also the implementing agency for the Pesticides Initiative Programme (PIP), a capacity building initiative funded by the European Union (EU) to ensure South African exporters remain compliant with present MRL levels, and thereby maintain EU market access.

Promised policy and legislative reform

In December 2010, DAFF published a Pesticide Management Policy for South Africa.⁴¹ The Policy acknowledges the current legislative problems including that Act 36 of 1947 does not address Constitutional requirements with regard to our rights to an environment that is not harmful to human health; access to information; and openness, transparency, and public participation in decision making. The policy sets out various proposed measures that need to be taken to substantially reform the Act. However, to date, it seems as if little progress has been made in implementing these measures.

CONCLUSION

We are extremely concerned about the state of affairs with regard to the regulation of glyphosate and urgently call upon government to implement measures to bring outdated legislation regulating pesticides in line with South Africa's Constitution and Bill of Rights.

PESTICIDES AND GM CROP SERIES

Government must urgently disclose when glyphosate has been registered and when it will come up for re-registration. We call upon government to establish an open and transparent public participation process before glyphosate is allowed to be approved for re-registration for use in South Africa.

That said, we are of the opinion that a moratorium should be placed on the further use of glyphosate until such time that capacity exists in South Africa to monitor and test for residues in locally produced and imported food.

The veil of secrecy that surrounds the regulation of pesticides on the part of DAFF is unacceptable. We call upon DAFF to make the following information available to the public:

1. Data on glyphosate residues in food, water, and soil as a result of the introduction of glyphosate resistant GM crops;
2. Details of its surveillance of glyphosate in food, agricultural and natural systems;
3. What support it is giving to South African labs to establish the requisite capacity to monitor MRLs in our food; and
4. What progress has been made since the publication of the Pesticide Management Policy with regard to legal reform.

REFERENCES AND NOTES

- 1 Frabotta, D. February 2010. **Monsanto refocuses glyphosate business**. Farm Chemicals International. <http://www.farmchemicalsinternational.com/companyreports/bigsix/?storyid=2366>
- 2 ISO 17025 is the recognised international standard for competence of testing and calibration laboratories.
- 3 Quinn, L.P. de Vos, B.J. Fernandes-Whaley, M. Roos, C. Bouwman, H. Kylin, H. Pieters, R. van den Berg, J (2011). **Pesticide use in South Africa: One of the largest importers of pesticides in Africa**. Intech. DOI: 10.5772/16995
- 4 Dries Pretorius, Director: Food Control, Department of Health. Personal correspondence, 07/06/2012.
- 5 Reinhardt, C (2012). **Glyphosate: History, utility and toxicology**. Presentation to SANBI / DEA workshop on monitoring and research priorities for herbicide tolerant crops. University of the North West, March 2012.
- 6 Riley, P. Cotter, J. Contiero, M. Watts, M. (2011). **Herbicide tolerance and GM crops: Why the world should Roundup glyphosate**. Greenpeace.
- 7 Szekacs, A. & Darvas, B (2012). **Forty years with glyphosate**. Intech. <http://www.intechopen.com/books/herbicides-properties-synthesis-and-control-of-weeds/forty-years-with-glyphosate>
- 8 http://www.monsanto.com/products/Documents/glyphosate-background-materials/back_history.pdf
- 9 Szekacs, A. & Darvas, B (2012). **Forty years with glyphosate**. Intech. <http://www.intechopen.com/books/herbicides-properties-synthesis-and-control-of-weeds/forty-years-with-glyphosate>
- 10 James, C (1997). **Global status of transgenic crops in 1997**. ISAAA Briefs No.5. ISAAA: Ithaca NY. <http://isaaa.org/resources/publications/briefs/05/download/isaaa-brief-05-1997.pdf> (accessed 18/06/2012)
- 11 James, C (2012). **Global status of commercialised biotech / GM crops: 2011**. ISAAA Brief No.43. ISAAA: Ithaca, NY. <http://isaaa.org/resources/publications/briefs/43/default.asp>
- 12 Riley, P. Cotter, J. Contiero, M. Watts, M. (2011). **Herbicide tolerance and GM crops: Why the world should Roundup glyphosate**. Greenpeace. <http://www.greenpeace.org/international/Global/international/publications/agriculture/2011/363%20-%20GlyphoReportDEF-LR.pdf>
- 13 Valente, M. 15th April, 2009. **Health-Argentina: Scientists reveal effects of glyphosate**. Inter Press Service. <http://www.ipsnews.net/2009/04/health-argentina-scientists-reveal-effects-of-glyphosate/>
- 14 Gillam, C. 8th April, 2011. **Cancer cause or crop aid? Herbicide faces big test**. Reuters. <http://www.reuters.com/article/2011/04/08/us-glyphosate-epa-idUSTRE7374WX20110408> (accessed 14/06/2012)
- 15 Information in this section from the recent ACB publication 'Hazardous Harvest: Genetically Modified Crops in South Africa, 2008 – 2012', unless otherwise stated.
- 16 In one of forthcoming briefing papers, we deal in detail with environmental risks and regulation.
- 17 Nora Benachour & Gilles-Eric Seralini (2009). **Glyphosate formulations induce apoptosis and necrosis in human umbilical, embryonic and placental cells**. *Chemical Research in Toxicology*. 22. Pp .97-105. DOI: 10.1021/tx800218n
- 18 Monsanto's drought tolerant maize was granted approval in the United States at the end of 2011, though Herbicide Tolerant and Insect resistant GM crops remain the two major varieties sold up until now.
- 19 Mesnage, R. Clair, E. Gress, S. Then, C. Szekacs, A. Seralini, G.E (2011). **Cytotoxicity on human cells of Cry1Ab and Acry1Ac Bt insecticidal toxins alone or with a glyphosate-based herbicide**. *Journal of applied toxicology*. DOI 10.1002/jat.2712
- 20 Tye E. Arbuckle, Zhiqiu Lin, and Leslie S. Mery (2001). **An Exploratory Analysis of the Effect of Pesticide Exposure on the Risk of Spontaneous Abortion in an Ontario Farm Population**. *Environ Health Perspectives* 109:851–857
- 21 Alejandra Paganelli, Victoria Gnazzo, Helena Acosta, Silvia L. López, and Andre´s E. Carrasco (2010). **Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by Impairing Retinoic Acid Signaling**. *Chem. Res. Toxicol.*
- 22 Émilie Clair, Robin Mesnage, Carine Travert, Gilles-Éric Séralini (2012). **A glyphosate-based herbicide induces necrosis and apoptosis in mature rat testicular cells in vitro, and testosterone decrease at lower levels**. *Toxicology in Vitro*, 26, pp. 269 - 279
- 23 While the international body, The Codex Alimentarius Commission acting under the auspices of the United Nations set MRLs for agricultural pesticides in food, countries still set their own MRLs.
- 24 **Evaluation of the impact of glyphosate residues in food on human health**. European Commission. http://ec.europa.eu/environment/ppps/pdf/ma_reding_annex4.pdf (Accessed 09/07/2012)
- 25 Siphugu, L (2009). **SA food and agricultural import regulations and standards – narrative**. USDA Foreign Agricultural Service. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Food%20and%20Agricultural%20Import%20Regulations%20and%20Standards%20-%20Narrative_Pretoria_South%20Africa%20-%20Republic%20of_8-12-2009.pdf

- 26 DAFF (2000). **Agricultural remedies registration procedure policy document.**
<http://www.nda.agric.za/doaDev/topMenu/services/arpd.htm> (accessed 05/07/2012)
- 27 DoH. **Role and responsibility of the public health sector in South Africa regarding the control of imported foodstuffs.**
http://www.doh.gov.za/docs/foodcontrol/trainingmanuals/2012/imported_foodstuffs.pdf
- 28 African Centre for Biosafety Press Release 'Unlabelled food tests positive for GM' March 2012
<http://www.acbio.org.za/index.php/media/64-media-releases/373-unlabelled-food-tests-positive-for-gm>
- 29 Chris Meyer, Standards Communicator, SABS. Personal correspondence. 24/05/2012
- 30 Pieter de Vries. Hortec. Personal correspondence. 09/05/2012
- 31 Denise Engelbrecht. Technical manager, corporate brands – Johannesburg. Pick and Pay. Personal correspondence, 14/05/2012/
- 32 Craig Pillay, Quality Assurance manager, JFPM. Personal correspondence. 03/07/2012
- 33 ISO 17025 is the recognised international standard for competence of testing and calibration laboratories.
- 34 Quinn et al (2011).
- 35 Agenbag, M. & Balfour-Kaipa (2008). **Developments in Environmental Health.** From the South African Health review 2008. Health Systems Trust. http://www.hst.org.za/uploads/files/chap10_o8.pdf
- 36 **Number of registered health care practitioners 31st March 2012.** Health Professions Council of South Africa.
<http://www.hpcs.co.za/statistics.php>
- 37 Dries Pretorius, Director: Food Control, Department of Health. Personal correspondence, 07/06/2012.
- 38 DAFF (2012). **Strategic Plan 2012/13 – 2016/17.**
<http://www.nda.agric.za/doaDev/topMenu/StratPlan201213-201617.pdf>
- 39 Siphugu, L (2009).
- 40 PPECB. **Strategic plan 2013 – 2015.**
http://www.ppecb.com/index.php/cat_view/26-publications/30-strategic-plan.html
- 41 <http://www.nda.agric.za/docs/Policy/PesticideManag.pdf>