



**Objection to Monsanto's application for commodity clearance for:
MON 89034 x MON 88017**

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Introduction

The African Centre for Biosafety (ACB) is a non-profit organisation, working on biosafety issues, in the public interest. The ACB hereby places on record its objections to the application made by Monsanto to the Department of Agriculture Forestry and Fisheries (DAFF) for commodity clearance for MON 89034 x MON 88017.

Summary of concerns

- Very little peer-reviewed data is available with regard to the long-term safety of this event, leaving regulators to rely heavily on producer-generated data. Interested stakeholders, such as the ACB, have even more limited access to this data. It is time for our regulators to review the risk assessment procedure and ensure that it is based on sound peer-reviewed science and ensure that independent stakeholders may participate in a fully informed and meaningful way.
- The dossier under consideration is lacking sufficient data to support claims of safety. As this maize will enter the human food chain in South Africa, and maize is a staple for the nation, it is incumbent on our regulators to ensure that outstanding scientific concerns are addressed before approving any new application.
- This dossier uses data from a previous application made to the Executive Council for clearance of MON 89034 x 1507 x 88017 x 59122. Applicants assert that the safety of MON89034 x MON 88017 is assessed under this previous application because “MON 89034 x MON 88017 is one of the combinations present in F2 grain produced from these events”. This constitutes unacceptable biosafety practices as each new event is required to be assessed on a case by case basis.
- The dossier does not consider the impact of the use of greater volumes of herbicides on these food crops and how they might impact health. South African authorities have little capacity to monitor these residues and indeed, before the introduction of herbicide-tolerant crops were introduced, they would not be found in our foodstuffs as their application would have killed the crop.
- Socio-economic impacts: re-opening South Africa’s domestic maize market to cheap imports is short-sighted in the extreme. It is likely to significantly impact upon commercial and emerging maize producers, and could have further impacts along the value chain. There are other issues affecting animal feed producers and consumers (the continuation of cheap chicken imports from the EU, for example), the resolution of which would do more to strengthen South Africa’s agricultural sector. The economies of scale involved are likely to benefit the very largest agri-business in South Africa, who already have an inordinate hold over the sector.

Background

This is an application by Monsanto for commodity clearance of the multi-event stack, MON 89034 x 88017, which is the result of conventional breeding of MON 89034 and MON 88017 or of the genetic segregation of MON 89034 x 1507 x MON 88017 x 59122 (pg11). The applicant asserts that the safety of this event has already been assessed by South African regulatory authorities “under the MON 89034 x 1507 x MON 88017 x 59122 Application for Commodity Clearance”. Therefore,

“throughout the dossier, the applicant will refer to MON 89034 × 1507 × MON 88017 × 59122 Application for Commodity Clearance, where relevant”.

This sleight of hand, in which the applicant posits claim of lack of harm, toxicity, and allergenicity based on data carried out on other lines containing the same transgene/event violates the case by case approach to GMO risk assessment enshrined in the GMO Act 1997 and actively supported by our regulatory authoritiesⁱ. In essence, this event has not been assessed at all in this application, instead claims of safety are based on assumptions. The synergistic and combinatorial effects of stacked varieties is currently a nascent area of scientific inquiryⁱⁱ and as such, the Precautionary Principle is appropriate.

The parent lines contribute the following transgenes: cry1A.105, cry2Ab2 from MON89034, cry3Bb1 and C4-EPSPS genes from MON88107. These genes give the plant resistance to insect herbivores and tolerance to glyphosate.

Biosafety Comments

4.1 (pg 15) Identify all foreign genes in the genetically modified plant.

A description of the methods used for the genetic modification of MON 89034 and MON 88017 and of the nature and source of the DNA elements in the respective plasmids, was provided in Monsanto’s application for Commodity Clearance of MON 89034 × 1507 × MON 88017 × 59122 (Monsanto Company/Dow Agrosiences LLC (2010), Section 4.1, page 18).

The applicant claims that “there is a low likelihood of molecular interactions between the inserts expressed in the stack. Therefore, there is low likelihood of any changes in the molecular characteristics of the inherited inserts in MON 89034 × MON 88017

- a) This information referred to was not made available to the ACB, making informed comment extremely difficult
- b) This risk assessment should be based on MON 89034 × MIN 88017 in accordance with case by case risk assessment
- c) Data regarding transgene location and stability into the host genome are lacking.

4.4 (pg 21) Provide information on the rate and level of expression of the foreign genes and the sensitivity of the measurement of the rate and level. State whether expression is constitutive or inducible. Are foreign genes expressed throughout the plant or only in certain organs or tissues?

According to the applicant, “Since the proteins levels expressed in MON 89034 ×1507×MON 88017×59122 are comparable to the corresponding ranges in MON 89034 and MON 88017 and MON 89034 × MON 88017 is the result of either genetic segregation of MON 89034 × 1507 × MON 88017 × 59122 or of the conventional breeding of MON 89034 and MON 88017, it is reasonable to conclude that the protein levels expressed in MON 89034 × MON 88017 are comparable to the protein levels expressed in MON 89034 ×1507×MON 88017×59122, MON 89034 and MON 88017. For further information on the level of the proteins, we refer to application for Commodity Clearance of MON 89034 × 1507 × MON 88017 × 59122 (Monsanto Company/Dow Agrosiences LLC (2010), Section 4.4, page 40)”.

- a) The ACB has not had sight of the information referred to above and therefore is unable to make informed comment on their claims.
- b) Has the EC taken into account recommendations made by SANBI in their research into MON810? In their research, SANBI found that GM plants “grown in the same environment as the near isogenic-parent (non-GM counterpart), respond differently to the same environmental conditions, as shown by the differences in protein expression, for a number of proteins.”ⁱⁱⁱ The reasons for this are as yet unknown and the researchers recommended that, “Further research is needed to understand what types of proteins are expressed differently in different varieties of GM and non-GM plants under different environmental conditions”^{iv}. The implications for post-commercial monitoring are stated as, “Protein expression, and thus many protein-related unintended effects, is largely dependent on the environment and the genetic background of the crop plant. Due to the unpredictable nature of these unintended, unwanted effects, it is essential to monitor and identify such effects in field-based baseline studies in several growing conditions, and with several genetically modified varieties”.^v These are surprise findings on MON810, which is a single trait variety. We are only now learning about false assumptions made about MON810, more than a decade after introducing it into our environment and food chain. The assumptions made by the applicant in a more complex stacked variety should not be taken at face value.
- c) Assessment in this application is not based on the event in question but on an assessment of MON 89034 × 1507 × MON 88017 × 59122

6. Human and animal health (pg26)

The applicant makes the misleading claim that “many food producers in South Africa are likely to preferentially source non-GM maize for some items intended for human consumption” (p26). Perhaps this is the case in the United States, from whence much of the data in this application is drawn. However it is certainly not the case in South Africa. Tests carried out by the African Centre for Biosafety in August 2013 on popular maize-based foodstuffs the following results were reported^{vi}:

- Ace super maize meal contained **78%** GM maize
- Ace maize rice contained **70%** GM maize
- Ace instant porridge contained **68%** GM maize
- Lion samp and beans contained **48%** GM maize and
- Jungle B'fast energy cereal contained **41%** GM maize

6.2 (pg 23) Detail the results of experiments undertaken to determine the toxicity of the foreign gene products (including marker genes) to humans and animals.

On toxicology, the applicant claims that “a thorough evaluation of the safety of the Cry1A.105, Cry2Ab2, MON 88017 Cry3Bb1 and CP4 EPSPS proteins (Monsanto Company/Dow Agrosiences LLC

(2010), Section 6.2) established that it is highly unlikely that these proteins would cause any toxic effects on human or animal health. Furthermore, the conclusions of the safety assessments for the individual proteins are not changed when their combined expression in MON 89034 × MON 88017 is considered". No data is given to support these claims whatsoever.

6.2.2 Allergenicity assessment (pg 24)

Again, claims of safety are not based on the event under consideration, but on MON 89034 × 1507 × MON 88017 × 59122. Furthermore, the ACB has had no sight of the data given to support these claims.

Published mouse experiments have demonstrated that Cry1Ac raises specific immune reactions, and also possesses adjuvant properties by increasing the immunogenicity of proteins intermixed with feed products (Moreno-Fierros et al. 2003; Vazquez et al. 1999; Vazquez-Padron et al. 1999; Vazquez-Padron et al. 2000), (Rojas-Hernandez et al. 2004).

This may result in increased immunological and allergic responses. In other words, the likelihood of immunological and allergic responses increases if Cry1Ac is administered together with a dietary antigen/allergen. Published data also suggest that Cry proteins may inhibit development of mucosally induced suppressive immune mechanisms referred to as "oral tolerance" against innocuous food proteins (Brandtzaeg 2007). In investigations with Cry1Ab protein, (Guimaraes et al. 2008) did not find a similar type of adjuvant effect elicited against peanut proteins as with Cry1Ac, yet instead found evidence of Cry1Ab acting as an adjuvant leading to early phase production of leukotrienes and increased Th2 and Th17-cytokine production in bronchoalveolar lavage fluids after airway exposure. The implication of possible effects of Cry1Ab to produce allergen-induced cytokine responses is an area of investigation warranting further inquiry."^{vii}

It is as yet unknown if the risk of food allergy increases with the presence of intestinal localized Cry proteins. The use of maize containing multiple Cry proteins, brings up a concern whether there will be a higher incidence rate for food allergy, especially when eaten as a staple by infants, adults, the sick and elderly. In addition, "since the Cry proteins possess adjuvant activity there may be enhanced inflammatory processes. Combinatorial or synergistic effects of recombinant proteins acting as adjuvants to immunostimulatory effects, or as potential allergens are areas of important coming scientific inquiry"^{viii}.

We are anxious to remind the Executive Council that GM maize is not consumed by the general population as a staple anywhere else in the world. Consideration of our local eating habits must be taken into account. We note that a Codex Alimentarius task team has developed a decision making model to assist in allergenicity risk assessment. The team concluded that while the decision-making model improved risk assessment procedures, "due to the wide genetic variability in the human population and different geographical dietary intake, further evaluation for adverse effects of the genetically modified food should be considered once the product has reached the market"^{ix}. They found that further research into allergenicity is still needed and that "further studies are needed to determine the amount of allergen that sensitises and elicits allergic events"^x. With regard to allergies in general, they noted that "Severe reactions can take place after intake of minute amounts of the

offending food, and a safe threshold level below which reaction will not occur has not been defined”^{xi}.

6.2.3 Nutritional analysis (pg 24)

“Like MON 89034 × 1507 × MON 88017 × 59122 , MON 89034 × MON 88017 is nutritionally equivalent to non-transgenic control maize, as well as to maize varieties in commerce”. No data is provided to support this claim

Broiler feeding study for toxicology (pg 25)

“MON 89034 × 1507 × MON 88017 × 59122 application for commodity clearance (Monsanto Company/Dow Agrosiences LLC (2010), Section 6.2), MON 89034 × 1507 × MON 88017 × 59122 maize is compositionally and nutritionally equivalent to the conventional maize. A confirmatory feed performance in broiler chickens was conducted to compare the nutritional value of MON 89034 × 1507 × MON 88017 × 59122 grain and conventional control grain as well as additional commercial maize hybrids, and to provide confirmation of the safety of this hybrid maize. This study confirms the absence of any toxic effects associated to the introduced proteins and the absence of any unanticipated or pleiotropic effects linked to the genetic modification”.

The ACB has not had sight of this information and can therefore not participate in an informed manner. This application lacks any meaningful data on this study, including numbers of chickens in experimental and control groups, the type of feed used for both groups, the length of the studies or the results. In the absence of any peer reviewed literature on the toxicology of this event this cannot be considered sufficient information on which to base a decision to allow a novel foodstuff into our staple food chain.

Human dietary assessment (pg 26)

According to the applicant, “No evidence of toxicity was observed when CP4 EPSPS, Cry1A.105, Cry2Ab2, or Cry3Bb1 proteins were administered to mice at dose levels of 572, 2072, 2198, or 1930 mg/kg, respectively” (pg 26).

Sufficient information on this experimental design is not given to make an informed analysis of the conclusions drawn by the applicant.

Furthermore, the applicant claims that “MON 89034 × MON 88017 is compositionally and nutritionally equivalent to conventional maize and this conclusion extends to the intended foods and feeds derived from MON 89034 × MON 88017” (pg 26). No scientific data is given in this application to support these claims.

Glyphosate residues on our food?

No information is given on the herbicide to which this maize has been engineered to withstand and how this may impact on human health. The ACB is also keenly aware that South African authorities lack the capacity to monitor glyphosate residues in our food^{xii}.

Glyphosate is one of the world's most ubiquitous agro-chemicals, and is the most traded active ingredient in the global herbicide market. It is a broad spectrum herbicide that 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. Previous applications for herbicide tolerant GM maize varieties in South Africa have claimed that there is 'a history of consumption of related EPSPS enzymes found naturally in plant material of commonly consumed foods, there is no reference at all to the safety of glyphosate or glyphosate based herbicides. The agro-chemicals industry has claimed glyphosate is benign to humans and animals, a plethora of studies have shown otherwise:

- 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'.^{xiii}
- In order to improve the efficacy of glyphosate as a herbicide, it is combined with other chemicals (called adjuvants) when sold commercially (such as under Monsanto's Roundup brand). These adjuvants are claimed to be benign, and not always listed on the packaging of the herbicide (under the guise of commercial confidentiality). However, research carried out on nine commercial formulations of glyphosate based herbicides revealed that one of these adjuvants, POE-15, was actually more toxic to human cells than glyphosate itself.^{xiv}
- 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 market^{xv}) can impair this process in human embryonic kidney cells.^{xvi} 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^{xvii}. Similar evidence has emerged from Argentina.^{xviii}

Further information

As noted earlier, very little peer-reviewed data on this event has been published. Given the short space of time the ACB had to respond to this application due to the dossier arriving while staff were on December leave, we would like to refer the EC to a thorough assessment of MON 89034 x MON 88017 carried out by GENOK in 2010.

Impact assessment of maize hybrid MON 89034 x MON 88017 from Monsanto.

http://genok.no/wp-content/uploads/2013/03/genok_raad_jan2010_h71.pdf

GENOK's conclusion on this event was that "confidence in the safety of this maize variety ... is scientifically unjustified at this time. Further evidence of lack of harm, including follow up feeding studies of longer duration and higher statistical power are needed". In particular, scientific proof of

lack of toxicological effects on mammalian health, which may be significant, warrant future study before claims of lack of harm can be scientifically established”.

Socio-economic Impacts

Background

In late 2005, at the behest of the Department of Trade and Industry (DTI), a moratorium was put in place on the commodity import of any GM varieties not yet approved for commercial release in South Africa. The DTI was concerned that, by having access to GM varieties that local producers did not, foreign producers would have an unfair production advantage, and that this could have knock on effects in the local economy. A detailed study was completed in 2007, though its findings were not placed in the public record.^{xix}

This moratorium did not prevent the import of over 2 million tons of (already approved varieties of) GM maize from Argentina during 2007, principally for use by the animal feed industry. By the time the moratorium was lifted in 2011, imports from Argentina and Brazil were prohibited on biosafety grounds. South Africa has a zero-tolerance policy on the import of un-approved GM varieties. From 2010 both countries began cultivating GM varieties that had not been approved for commercial release in South Africa (asynchronous approvals), resulting in an immediate cessation of imports into South Africa from South America’s two largest GM producers.^{xx}

The present application is the last remaining GM variety seeking approval, before trade between South Africa, Brazil and Argentina can resume again. Consequently, Monsanto appears to have prepared its risk assessment dossier for MON 89034 × MON 88017 from a trade, rather than a biosafety perspective.

In addition to biosafety data shortcomings, Monsanto makes the spurious claim that grain that ‘may contain’ MON89034 x MON88017 could have been imported into South Africa, from the United States and Canada, in shipments of MON 89034 × 1507 × MON 88017 × 59122 (‘Smartstax), which was granted commodity clearance in 2011 (p.12). This seems most unlikely as, according to the South African Grain Information Service (SAGIS), South Africa has not received any imports of maize from the USA since the 2004/05 season. There is no record of any maize imports from Canada over the same period. Monsanto further goes on to state (p.14) that South Africa ‘does not export to Mexico, the centre of origin of Maize’. Yet, during the 2011/12 and 2012/13 South Africa exported nearly 2 million tons of GM maize to Mexico!^{xxi}

Statements made throughout the document appear to de-couple the issue of asynchronous approvals from wider climatic and economic factors. For example, *“Statistics from the South African Grain Information Services indicated that 422 075 ton maize was imported into South Africa in the 2011-2012 season, but imports during the 2012-2013 season only reached 10 560 ton. (p.13)”*

It should be noted that the beginning of the 2012/13 season in South Africa coincided with international maize prices climbing by 50% in just six weeks^{xxii}, as the US maize belt was hit by a combination of its worst drought in half a century and the third hottest average temperatures on record. Similar conditions also hampered maize production in the Black Sea region, another major global source of maize.^{xxiii} As a result, over the whole course of the 2012/13 season the international

yellow maize price increased by 2.13%, whereas the domestic yellow maize price fell by 0.16%.^{xxiv} Surely these factors had as much influence on the drop in imports as asynchronous approvals?

Local beneficiaries of increased imports?

The poultry industry

The problems facing the South African poultry industry have been well documented. The SA Poultry Association (SAPA) has been involved in a long running dispute at the International Trade Commission (ITAC) of South Africa regarding allegations of dumping by poultry producers in Brazil and the European Union (EU), which have been putting local producers at an unfair advantage. Though South Africa has since raised import tariffs on five categories of frozen chicken, these do not apply to imports from the EU, due to a bilateral trade agreement signed with the EU in 1999. In 2009 imports from the EU (which totaled less than 3,000 tons) accounted for 0.5% of total frozen chicken piece imports. During the first 9 months of 2013 this figure had shot up to around 100,000 tons, with the EU expected to account for 80% of all frozen imports for 2013.^{xxv} It would appear that until this issue is resolved, local poultry producers will continue to struggle against cheap imports. Though the availability of cheaper feed imports from South Africa may offer short term relief, the long term consequences could be a severe weakening of South African maize producers.

The Animal feed industry

It is interesting to note that the Animal Feed Manufacturers Association (AFMA) supported SAPA's application for relief from cheap frozen chicken imports, recognizing the impacts of cheap imports along the value chain (including feed producers), while simultaneously lobbying for the re-start of GM commodity imports from Argentina and Brazil.^{xxvi}

Local maize producers

Before re-opening South Africa's borders to GM commodity imports from Argentina and Brazil, careful consideration should be given to the impacts this will have upon domestic producers, from well-established commercial maize farmers to small-scale subsistence and commercially aspirant farmers. For example, the Zivuseni agricultural co-operative from Nigel, Gauteng, have recently begun supplying maize to the World Food Programme (WFP), for food aid to Lesotho.^{xxvii} Zivuseni receives a higher price from the WFP than it would from local commercial maize trader Afgri. However, with the food aid programme scheduled for completion by the end of 2014, Zivuseni will have to begin selling their produce to commercial traders again.^{xxviii}

Though domestic maize prices are expected to rise over the coming months on the back of drought conditions in the North West, will small scale farmers such as the Zivuseni co-operative realize benefit from this if the largest maize traders and processors are able to source cheaper maize from South America? This would seem counterintuitive to the government's stated aims to support small holder production in South Africa.

Small scale maize millers

It also remains to be seen as to what the impact GM commodity approvals will have on small scale millers, both independent companies and those being supported through the Department of Trade

and Industry (DTI). Will a glut of imported maize on the market be more beneficial to the large scale millers and processors, many of whom have already abused their market positions in the past, to the detriment of small and medium sized enterprises?^{xxix}

Conclusion

This submission by Monsanto makes a joke of biosafety risk assessment in that it is not based on the actual event under consideration, but rather, the applicant posits claim of lack of harm, toxicity, and allergenicity based on data carried out on other lines containing the same transgene/event. This violates the case by case approach to GMO risk assessment enshrined in the GMO Act 1997. It also lacks sufficient scientific data to support claims of safety and this is exacerbated by lack of peer reviewed information on this event. In addition, the applicant has not considered the health impacts of the herbicide to which this event is engineered to tolerate. Furthermore, approval of this commodity import is likely to significantly impact upon commercial and emerging maize producers, and could have further impacts along the value chain. There are other issues affecting animal feed producers and consumers (the continuation of cheap chicken imports from the EU, for example), the resolution of which would do more to strengthen South Africa's agricultural sector. It is the opinion of the ACB that this application should be rejected on both biosafety and socio-economic grounds.

REFERENCES

ⁱ For example, in the EC minutes of July 2013, it is stated that the GMO Act requires applicants to apply for each stacked event”.

<http://www.nda.agric.za/doaDev/sideMenu/biosafety/doc/Minutes%20of%20the%20meeting%20of%20the%20Executive%20Council%2023%20July%202013.pdf>

ⁱⁱ Genok 2010. Impact assessment of maize hybrid MON 89034 x MON 88017 from Monsanto.

http://genok.no/wp-content/uploads/2013/03/genok_raad_jan2010_h71.pdf

ⁱⁱⁱ SANBI (2011). **Monitoring the environmental impacts of GM maize in South Africa: The outcomes of the South Africa – Norway biosafety co-operation project (2008 – 2010)**. *Department of Environmental Affairs*. <http://www.sanbi.org/node/1958/reference>

^{iv} ibid

^v SANBI (2011). **Monitoring the environmental impacts of GM maize in South Africa: The outcomes of the South Africa – Norway biosafety co-operation project (2008 – 2010)**. *Department of Environmental Affairs*. <http://www.sanbi.org/node/1958/reference>

^{vi} **GM maize: lessons for Africa – cartels, collusion and control of South Africa’s staple food.**

<http://acbio.org.za/index.php/publications/rest-of-africa/449-gm-maize-lessons-for-africa>

^{vii} Bohn, T., Myhr, A.I., Quist, D., Traavik, T., Wilmark, O.G (2010). **Impact assessment of maize hybrid MON89034 x 1507 x NK603 from Monsanto and Dow Agro Sciences**. *Genok Centre for Bisoafety*. http://genok.no/wp-content/uploads/2013/03/genok_raad_jan2010_h65.pdf

^{viii} ibid

^{ix} **FAO/WHO. 2001 Evaluation of Allergenicity of Genetically Modified Foods. Report of a Joint FAO/WHO. Expert Consultation on Allergenicity of Food Derived from Biotechnology. 22-25 January 2001.** <ftp://ftp.fao.org/es/esn/food/allergygm.pdf> accessed 12 June 2013

^x ibid

^{xi} ibid

^{xii} ACB. How much glyphosate is on your plate?

<http://www.acbio.org.za/index.php/publications/gmos-in-south-africa/388--how-much-glyphosate-is-on-your-dinner-plate-sas-food-safety-compromised-by-lack-of-testing>

^{xiii} 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

^{xiv} Mesnage R., Bernay B., Seralini G-E. (2013, in press). **Ethoxylated adjuvants of glyphosate-based herbicides are active principles of human cell toxicity**. *Toxicology*

<http://dx.doi.org/10.1016/j.tox.2012.09.006>

^{xv} 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

^{xvi} 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

^{xvii} 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 Perspect 109:851–857

^{xviii} Antoniou, M. Robinson, C. Fagan, J (2012). **GMO myths and truths: An evidence based examination of the claims made for the safety and efficacy of genetically modified crops.** Earth open source

^{xix} ACB (2012). **Hazardous Harvest: Genetically Modified Crops in South Africa, 2008 – 2012**

^{xx} Ibid.

^{xxi} DAFF GMO Permit lists 2011 – 2013.

<http://www.nda.agric.za/doaDev/sideMenu/biosafety/permits.html>

^{xxii} **AFMA chairman's report 2011/12.** Animal Feed Manufacturers Association.

<http://www.afma.co.za/index.htm#CHAIR> (accessed 15/01/2014)

^{xxiii} Larsen, J. **Heat and Drought Ravage U.S. Crop prospects – global stocks suffer.** 14th September 2012. Earth Policy Institute. http://www.earth-policy.org/data_highlights/2012/highlights30 (accessed 15/01/2015)

^{xxiv} NAMC (2013). **Food price monitor May 2013.** National Agricultural Marketing Council.

^{xxv} Hofmeyr, I. **Too chicken for the truth?** AFMA Matrix Magazine. January – March 2014. Animal Feed Manufacturers Association.

<http://www.afma.co.za/imgs/Matrix%20Jan%202014%20Complete.pdf>

^{xxvi} Ibid.

^{xxvii} Van der Walt, A. 23rd October 2013. **Finding Food for Africa.** Farmer's Weekly.

<http://www.farmersweekly.co.za/article.aspx?id=46524&h=Finding-food-for-Africa> (accessed 15/01/2014)

^{xxviii} Themba Ncongwane, Zivuseni co-operative telephonic interview. 11th December 2013

^{xxix} ACB (2013). **GM maize: lessons for Africa – cartels, collusion and control of South Africa's staple food.** <http://acbio.org.za/images/stories/dmdocuments/GM-Maize-Report.pdf> (accessed 15/01/2014)