Global Developments in Coexistence

Keith Alcock
Molecular Plant Breeding CRC
ktalcock@bigpond.com

Summary

Coexistence of GM and non-GM grain supply chains is now occurring routinely across all continents as a day-to-day component of grain production and marketing. Growers and traders are choosing between GM or non-GM crop varieties based on their judgements of the balance between the production cost/yield benefits of GM and the opportunities for market access/price premiums for non-GM produce.

In practice, non-GM premiums have been small, with estimates ranging between 2 and 9% for soybeans and maize but substantially non-existent for canola and cotton. These numbers are outweighed by the GM production advantages and the supply chains have responded accordingly, with GM crops predominating.

For the most part, operational frameworks for coexistence have been set up and managed within the supply chain, allowing market forces to drive the system. This has allowed the vast majority of growers to capture production advantages of GM, but at the same time has created the opportunity for markets seeking non-GM produce to offer appropriate financial incentives to secure supply. Such has been the case in Australia, with the longstanding coexistence model of GM cotton, which has operated successfully for lint, cottonseed oil and cottonseed meal for over 10 years. Two examples from the Americas are discussed in detail – US maize and Brazilian soybeans.

A contrast is drawn with the European Union (EU) model which has been successfully running for nearly a decade for GM maize, with Spain the main production area. Within the EU, coexistence is officially a matter of 'national competence' and each Member State is responsible for the establishment of a legislative framework on a crop by crop basis. In practice, the supply chain still operates the EU system, and there is a central coordination role for the European Commission (EC), which invests massively in coexistence research.

In the three coexistence examples reviewed, the costs of implementation of coexistence measures have been analysed. In all cases, the analyses showed very modest costs. In the case of US maize and Brazilian soybeans, the costs were met by the non-GM producers from price premiums. In the European maize example, the costs were met by the GM producers out of their considerable production advantages.

Introduction

The rapid and sustained uptake of GM crops around the globe, in 2007 estimated to encompass 114.3 million hectares (James 2008), is testimony to the productivity and economic benefits of the technology. While in the majority of cases GM products have come to dominate the production systems they have entered, some producers and marketers identify the potential for market access or premium price advantages for non-GM production systems in market sectors where there is sufficient consumer demand for non-GM food. The concept of GM and non-GM supply chain coexistence is to provide a commonsense approach to allowing freedom of choice between the contrasting options within a formal framework that is fair and reasonable to all parties.

A lively debate continues over the current and future benefits of the two alternative production systems, informed in Australia by a regular series of Agriculture, Fisheries and Forestry (DAFF) commissioned publications, the latest being Acworth *et al* (2008) and Foster and French (2007). The principle of coexistence is not to pre-empt the debate but to provide a framework whereby the industry can encompass both alternatives.

The merit of a formal framework, whether managed under industry self-regulation or set in place by and overseen by Government is that the principles of fair dealing, non-interference and management responsibility are a set in place ahead of time. Foremost is the establishment of objective, market-based purity standards under which the supply chain can identify appropriate segregation practices, including testing and other quality assurance measures.

An effective coexistence framework will be based on established quality assurance principles. Starting with specifications on seed purity, it will encompass management hygiene (for seeding, harvest, storage and transport), paddock configuration (if cross-pollination is an issue) and include volunteer management in subsequent rotations. Post-farm grain receival, storage and transport will operate to quality assurance guidelines, including an appropriate regime of purity testing.

The important starting point is the opportunity of choice, for individuals and business to weigh the potential benefits from either moving to GM or sticking with non-GM. In overview terms, this choice on is along the lines that:

- Current 'first generation' GM crops offer production benefits in terms of yield and/or more effective or less costly means of controlling weeds or pests. The key GM traits dominating production are glyphosate-tolerance in soybeans, canola, cotton and maize and Bt based insect resistance in cotton and maize.

  Examples are appearing of 'second generation' GM crops with novel quality performance/health attributes, even as far a producing pharmaceutical products or precursors that could command significant market premiums.

- Non-GM crops can offer market access or price premiums in some markets. There are regional differences in consumer reaction to GM crops – in the Americas and through most of Asia, GM acceptance is high. In parts of Europe and in Australia, there is a preference for non-GM food grains, particularly where mandatory labelling requirements would be triggered.

  Europe is self sufficient in canola, but imports significant levels of GM corn and particularly GM soybeans for livestock. There is a small market for non-GM soybeans for human consumption, for which an estimated premium of 2-8% is offered.

  There is also a demand in Japan for non-GM soybeans in miso and soy sauce production. Foster (2007) indicated that in 2006, some 15-20% of Japanese soybean imports were certified non-GM and gained a 6-9% premium. He could discern no consistent premiums for non-GM canola imports to Japan.

The demonstrable production benefits of GM crops has largely outstripped the buyers' willingness to meet the large price incentive necessary for supply chains to remain non-GM. Even with the current European and Japanese examples, continuity of supply is contingent on the production advantages being less than the 6-9% premium. The trend towards a pragmatic, market driven view of the GM/non-GM issue has been further underpinned by rising global prices and production shortfalls in key crops. This has already seen far less reluctance from livestock industries around the world to use GM grain and it is now generally accepted that this is not an issue that consumers are prepared to contest.

The Tools of Coexistence

Coexistence measures can be broadly split into two – prevention and cure. As in the old axiom, 'an ounce of prevention is better than a pound of cure'.

Prevention

GM, non-GM coexistence principles and practice cover a broad spectrum of commonsense measures that would be readily recognised by any grain supply chain where segregation carries financial incentives. Included are:

- Seed purity (both in purchased seed and farmer-saved second generation seed),
- Control of volunteers (through sensible rotations and direct weed control),
- Field separation distances, or different flowering times where cross pollination is likely to be significant,
- Field separation augmented by buffer zones or harvest 'discard' (non-GM border rows marketed as GM),
- Cleaning of equipment, (trucks, bins, seeders, headers, silos)
- Effective segregation in post-farm grain handling (segregated receivals, transport and storage) and
- Testing regimes appropriate to pertaining standards.

Cure

As in current segregation systems, cure is most often in the hands of the supply chain. Where testing reveals a failure, batches can be diverted to another market or blended up or down to meet the required standard.

Again as in normal segregation, there needs to be the capacity for legal redress where genuinely innocent parties have been disadvantaged by third party activities. In broad, this field is covered by insurance schemes, contract law, tort law and in rarer cases industry or Government compensation schemes.

Coexistence Frameworks

The drivers for coexistence and the operational frameworks differ throughout the world. In the Americas, the free market determines and manages the framework. Such an approach operates globally in the case of GM cotton, including in Australia which has successfully dealt with marketing both GM and non-GM cottonseed oil and meal without incident or significant added cost for over a decade.

In Europe, as European Union (EU) members move to adopt GM crops, there is greater Government overview of coexistence frameworks, especially at the farm landscape level. There is central European Commission (EC) involvement in establishing purity standards on non-GM and organic produce and in setting guidelines for GM/non-GM field configuration at a landscape level and compiling 'best practice' procedures for on-farm management practices. Except for setting purity and labelling standards and investment in underpinning research into traceability systems, there is very little EC input into the post-farm grain handling aspects of coexistence, which is left to market forces.

The Australian approach to GM canola introduction mirrors most aspects of the EU model, including differences of interpretation at an Australian State Government level as there are between Nation States of the EU.

Three examples are presented of different global approaches to GM/non-GM coexistence.

European maize

Over the past 6-8 years, the EC has massively invested in the development of GM/non-GM coexistence strategies for European production. Amongst many others, the latest round of funding includes the 'Co-Extra' program with an investment of €24 million over four years. The Co-Extra program is focused on tool and methodology development in support of traceability and supply chain management. Other EC investments have focused on on-farm issues of GM containment and have given rise to finely tuned models to help farmers select and manage GM and non-GM crops at a landscape level. The main focus of this massive investment has been maize and oilseed rape (canola).

Since 2003, there has been a biennial information exchange through the International Conference on Co-existence between GM and non-GM based agricultural supply chains. The so-called 'GMCC'series has brought together the latest coexistence science and practical experience to be shared with the research, production and marketing communities and with Government policy makers. Since the first such event in Denmark in 2003, the GMCC has been supported at the highest EC level. The EC Commissioner for Agriculture and Rural Development, Mariann Fischer Boel attended and participated in the first two conferences. The fourth GMCC, the first outside Europe, will be held in Melbourne in 2009.

Under central EC regulatory rules, all aspects of environment and human health risk assessment and labelling and traceability of GMOs in food and feed are made at a central level and coexistence measures are matters of national competence (Figure 1).

Figure 1. EU regulatory framework for GMOs

<table>
<tr><td rowspan="2">Full harmonisation at EU level</td><td>GMO authorisation and assessment of risks to the environment and human health (Directive 2001/18/EC; Regulation (EC) No 1829/2003)</td></tr>
<tr><td>Labelling and traceability of GMOs and food and feed derived from GMOs (Regulation (EC) No 1839/2003)</td></tr>
<tr><td>National competence</td><td>Socio-economic implications of the cultivation of authorised GM crops, co-existence between GM and non-GM crops</td></tr>
</table>

(Gumbert 2007)

By 2007, 15 of the 25 member states had notified the EC of their coexistence legislation and eight have adopted their measures. In most cases, there is provision for a national register of GM production, with specific provisions for:

- Information to authorities
    - Authorisation procedures (5 countries)
    - Notification/registration (10 countries)
- Information to neighbours and co-users of machinery
- Neighbours' consent (3 countries)
- Training or educational requirements (7 countries)

GM maize has been grown commercially in Europe for over a decade, notably in Spain, but also in France and Germany. In practical terms, this crop forms the major basis of the current EU coexistence guidelines. In general terms, these cover:

- Isolation distances:
    - Crop, seed
    - Non-GM, organic
- Buffer zones:
    - additional or substituting isolation distances
- Temporal isolation (cultivation intervals)
- Volunteer control
- Cleaning of equipment (seeding, harvest, transport)

The major measure adopted is in setting guidelines on minimum separation distances between GM crops and non-GM. In some instances, greater separation distances are specified for organic production. In a number of member states, an option is given for separation distances to be replaced with buffer rows of non-GM maize surrounding the GM crop, but which is harvested and marketed as GM.

To provide coordination across member states and a dynamic flow of information, the EC has set up the European Co-existence Bureau with the purpose of:

- Elaboration of crop-specific guidance documents for co-existence measures
- Where appropriate, include measures aimed at preventing cross-border problems and
- Regionally based recommendations, where farming conditions make farm-level co-existence difficult to achieve (tiny fields/intensive cropping)

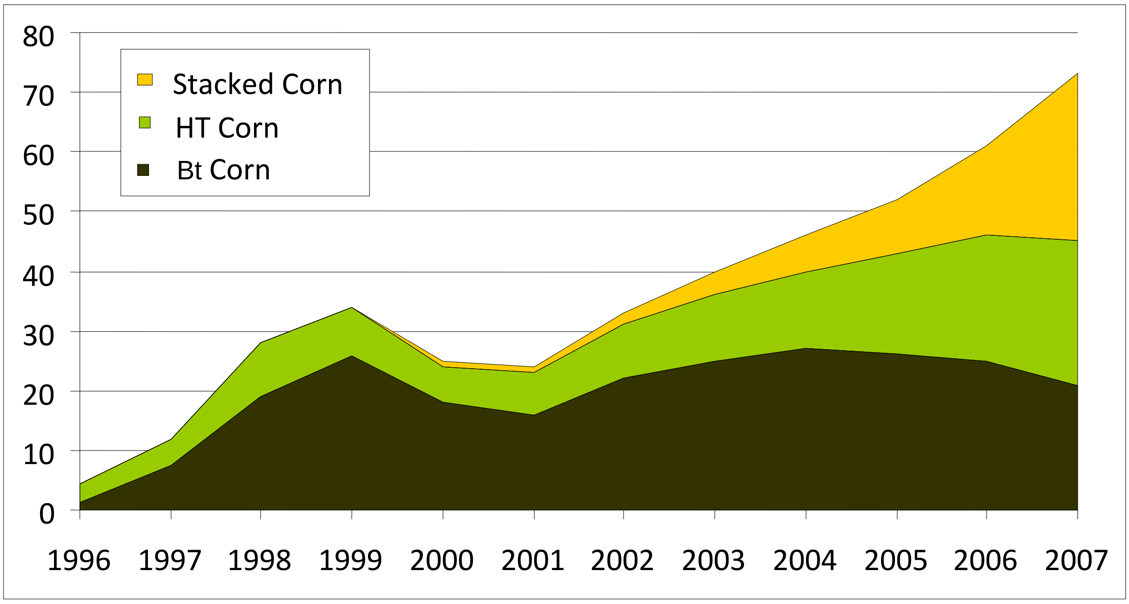
GM maize (Bt European corn borer [ECB] tolerance) has been a major success in Spain, where ECB problems are greatest. Up to a third of Spanish production is GM and an estimated 15,000 Spanish farmers have successfully grown GM maize with major yield and quality benefits. The supply chain, from seed producers through to processors has cooperated to ensure compliance with best practice guidelines and the system has been shown to work.

In reviewing the economics of coexistence of Spanish GM maize production, Gómez-Barbero and Rodríguez Cerezo (2007) noted that there was a trend in the EC for the costs of coexistence to be borne by the farmers cultivating GM crops. Their general conclusion was that the costs of coexistence in the Spanish maize system was modest and that the average gross margin benefit enjoyed by GM farmers across regions in Spain between 2002 and 2004 was €81.67 (A$135) per hectare. On this basis, they considered that at the level of costs they anticipated, the industry could well afford the costs of coexistence.

US Corn

After GM soybeans, GM maize/corn represents the largest global uptake of GM technology at over 35% (James 2008) of the GM crop. By far the majority of this production is in the US, where GM dominates US corn production systems. The uptake in the US is a combination of ECB-resistant Bt corn, and glyphosate tolerance (herbicide tolerance – HT). Increasingly the two are combined (Figure 2).

Figure 2. GM share of US corn market (percentage)



Kalaitzandonakes (2007)

While the bulk of production is geared to undifferentiated markets for stockfeed and bioethanol and well suited to the cost-saving and higher productivity of the GM traits, US markets also present opportunities for a variety of specialty corn lines. Based on 2003 data (Elbehri 2007), these include:

- White corn (~350K ha)
- Waxy corn (~275K ha)
- High oil corn (~200K ha)

The 2003 market for non-GM corn was 150-200K ha and organic corn of the order of 50K ha.

The coexistence framework for GM/non-GM corn in the US is the same as for other specialty corn products. The processors/end-user sets the standards and the supply chain provides the detail in terms of best practice guidelines and testing procedures. The price premiums for non-GM corn are modest at US$2-10 per tonne (Foster 2007) and volumes low. However, in 2006/07 30% of elevators were offering a non-GM segregation (Kalaitzandonakes 2007).

With limited outcrossing potential, and large fields across most of US production, the typical field management practices have been shown to be adequate to achieve designated purity levels of less than 1% adventitious presence (AP). The key features of best practice guidelines are:

- Seed with low AP
- Adequate isolation distances and border rows
- Clean planters, harvesters, trucks and storage bins
- Use of dedicated storage and other equipment
- Availability of cost-effective testing procedures

The post-farm grain handling component is greatly facilitated by the relatively high levels of on-farm storage capacity in the US. The US growers ultimately hold the key to successful segregation, working with the receival centres and the marketers to enabling the market driven systems in the US to respond to demand. New segregations of increasing sophistication are emerging under proprietary intellectual rights, which will be grown under contract to whatever quality and purity standards the market is willing to pay for. This is the dynamic that allows US growers the flexibility to choose between the production advantages of mainstream commodity GM lines and market premiums for specialty (GM or non-GM) products.

Soybeans in Brazil

Soybeans production systems have been the major beneficiary of GM technologies and GM soybeans is the largest market sector with nearly 60 million ha under cultivation, over half the world total of 114.3 million ha of GM crop in 2007 (James 2008). After the US, Argentina and Brazil are the two countries with the largest concentration of GM production overall. In 2007 Argentina grew 19.1 million ha, of GM crops (17% of the world's GM crop) and Brazil 15.0 million ha (13%). In both cases, the great majority of GM production was glyphosate-tolerant soybeans (16.0 and 14.5 million ha respectively). Together, GM soybean production of the two Latin American countries amounted to over 25% of world GM production in 2007.

Globally, soybeans are the principal source of protein in livestock feeding rations and form a major part of international grain trading. Most of the key markets are non-discriminating on GM or non-GM soy, notably China, South Korea and Mexico. Europe and Japan however, despite the majority of their imports being GM, retain a small non-GM demand component. The market share for non-GM soybeans in Europe in 2004 was estimated to be 14-17% of total imports and the price premium 2-8% (Brookes, Craddock and Kneil 2005). By comparison, 2006 figures for Japan (Foster 2007) estimate a 15-20% market share and price premiums of the order of 6-9%.

The US is the dominant supplier of GM and non-GM soybeans to Japan at 70-75% of imports. As with maize, the US soybean industry sector has set in place a coexistence framework under which the market is supplied with product meeting market specifications for adventitious presence. Brazil is the major supplier of both GM and non-GM soybeans to Europe and achieves this through effective coexistence strategies.

As in the US, market forces drive the coexistence process. Unlike the US, where on-farm storage is high and traders can manage receivals, storage and transport in a phased manner, only 15% of Brazilian farmers have such storage capacity on farm (dos Santos 2007). Accepting the challenge, the grower cooperatives and grain traders have set in place traceability systems from seed purchase through to delivery at port whereby GM grain is segregated from non-GM and the appropriate level of testing is applied through the system. A quality assurance overview is applied through the appointment of certifying organisations.

These systems in Brazil are then integrated with corresponding systems managed by the international grain handlers and shippers and complementary systems are applied on landed produce in Europe and followed through to the processors and grain users.

Under the EU Co-Extra program, the export traceability system from Brazil to France was analysed (Soler *et al* 2007) to establish costs and effectiveness. The study found that the system worked well and that in reference to costs:

- Added costs in Brazil were low, even taking in the chain from non-GM seed certification, harvest material cleaning, transport cleaning, segregation at receival and at ports and tests along the chain. The estimated cost was €0.24-0.80 (~A$0.40-1.30) a tonne or less than 1% of the value of the product.
- In Europe, no new investment in equipment was necessary and the major changes were involved only in system cleaning where GM and non-GM products were processed in the one plant. All up cost were estimated at €1.0 (~A$1.65) a tonne.

As with the US maize situation, the costs of coexistence are borne by the non-GM producer in pursuit of market premiums. In the Brazilian example, the costs are certainly bearable against the market returns. The further question is the balance between the net gains and the productivity advantages foregone by electing not to use GM varieties.

Conclusions

Examples are presented of three contrasting models for GM, non-GM coexistence that have each proven successful. The large scale examples of US maize and Brazilian soybeans rely on market forces and present a dynamic model that has demonstrated a capability to adjust to different market demand. In both cases, the non-GM component is small, tempered by the willingness of the marketers (on behalf of consumers) to pay sufficient incentive for the supply chain to forego the production advantages of GM.

The market driven approach is contrasted with the Government regulatory system under development in the European Union. In the short term, the costs of coexistence in Europe are attributed to the GM grower to be paid from their increased profitability. In the only example to date, GM maize in Spain, the economics have been shown to work as the production advantages of GM maize are sufficient to meet the costs of coexistence.

References

Acworth, W., A. Yainshet and R. Curtotti (2008). Economic impacts of GM crops in Australia. ABARE Research Report 08.4.

Brookes, G., N. Craddock and B. Kniel (2005). The Global GM Market Implications for the European Food Chain. An analysis of labelling requirements, market dynamics and cost implications. PG Economics Limited.

dos Santos, R.R. (2007). Traceability systems for certified non-GM soy in Southern Brazil. Proceedings GMCC-07 Seville, November 2007.

Elbehri, A. (2007). The changing face of the US grain system. USDA ERS Economic Research Report Number 35.

Foster, M. (2007). Challenges for agricultural markets: Coexistence, segmentation of grain markets and opportunities. Paper presented at GMCC-07 Seville, November 2007.

Foster, M. and S. French (2007). Market Acceptance of GM Canola. ABARE Research Report 07.5

Gómez-Barbero, M. and E. Rodríguez-Cerezo (2007) Economic impact of GM maize: room for coexistence costs. Proceedings of GMCC-07 Seville, November 2007.

Gumbert, A. (2007). Co-existence regimes in EU Member States. Paper presented at GMCC-07 Seville, November 2007.

James, C. (2007). Global Status of Commercialized Biotech/GM Crops: 2007. ISAAA Brief No. 37. ISAAA: Ithaca, NY.

Kalaitzandonakes, N. (2007). Maize supply chain: Organizational and economic impact of coexistence. Proceedings of GMCC-07 Seville, November 2007.

Soler, L.G., M.LeBail, R. Bourgier and A. Trouillier (2007) GM and non-GM soy chains for feed: The terms of co-existence. Proceedings of GMCC-07 Seville, November 2007.