The Australian grain supply chain has protocols, processes and practices in place for transporting, marketing and processing many crops including special malting barley, needle wheat, canola, sunflower and corn varieties. Often, as consumers, we do not appreciate these supply chain procedures when we fill our supermarket trolley with pasta and museli, or collect a loaf of bread from the bakery but these underpin the integrity of our grain food products.

Supply chain management processes are driven by standards, quality management, procedures, stewardship programs and commercial contractual arrangements. They support the trade of grain to meet pre-determined and agreed industry standards, customer specifications and regulatory requirements along the supply chain.

Over the years ahead, the Australian grains industry will work together and with international colleagues to examine and understand customer requirements for GM wheat. This process will run parallel to the scientific and agronomic assessment of GM wheat. GM wheat will require regulatory approval in Australia and also in export markets. The timeframe of seven-to-ten years or more provides considerable opportunity to gain a thorough understanding of supply chain requirements to meet customer needs.

WHERE TO FROM HERE?

The United Nations’ Food and Agriculture Organisation (FAO) estimates that global food production will need to double between now and 2050 to feed a population that is estimated to grow to nine billion people. Agriculture in the 21st century will need to increase yield and quality, restore and maintain the environment, be affordable, and include the needs of the poor and under nourished. Crops of the future will have to feed the world’s growing population with safe and healthy food and help to restore and maintain our world. Plant science is striving and looking to the best available technologies to reach these essential goals.

GM crops, including GM wheat, will play an important role in this.

GM wheat is seven-to-ten years away at least. In that time, the science will be further developed and assessed and the grains industry both here and overseas will work with regulators, growers, the grain supply chain, food manufacturers and customers to ensure the successful introduction of GM wheat.
**INTRODUCTION**

For decades scientists, farmers and those working in agriculture have been improving the characteristics of plants to produce crops better adapted to environmental conditions, weed and pest challenges, different landscapes and most importantly to meet the world’s growing need for food.

A great example of this is Teosinte – the ancient form of a food which we now find in the frozen and fresh fruit and vegetable section of our supermarket shelves everywhere – corn.

![Teosinte, from which our modern-day corn is derived](Image)

**The use of gene technology**

just as research and development in telecommunications has given us access to new technologies and allowed us to communicate easily with people around the world, plant science has progressed and researchers are now using new tools and techniques. Plant breeding and improvement utilises a whole suite of technologies including computers and high power microscopy and molecular biology. Gene technology is another one of these tools and it has been around for over twenty years and underpins most molecular biology. It allows scientists to understand the functions of different genes within a plant and to alter those functions to improve the plant's qualities. This could include modifying the genes of a plant to help it perform better under different conditions or to produce a product that is resistant to pest attacks.

The technology is already very widely used in 2009, 134 million hectares of GM crops were grown in 25 countries around the world, including in the United States of America, Canada, Brazil, Argentina, India, China, South Africa and the Philippines. Soybeans, cotton and canola are the main GM crops. More than 75 percent of the world’s 90 million hectares of soy was grown to GM varieties while GM varieties accounted for almost half of the world’s cotton crop and one quarter of the 158 million hectares of corn.

Australian has been growing GM cotton since 1996 and it now accounts for more than 90 percent of our cotton production, which generates fibre for clothing and textiles as well as being used in the production of alcoholic drinks such as vodka, biofuels and a range of industrial goods. It is also used in the production of alcoholic drinks such as vodka, biofuels and a range of industrial goods.

Wheat is the second largest food crop after corn. But for the last decade or so, the area planted to wheat has declined. One of the drivers of this decline is that modern plant science techniques which have been utilised to improve crop and soybean productivity and profitability have not been deployed in wheat.

There are a number of challenges and opportunities facing modern Australian agriculture, including:

- new pests and diseases
- water shortages and climate change
- rising oil and fertilizer costs
- the tensions between food, feed and fuel
- new trading partners and new markets
- the environment – including the need to reduce the footprint of urban communities and agriculture.

Gene technology is an extension of selection and breeding that offers improvements to crops which traditional breeding cannot. Gene technology can help improve yields, sustain farming in marginal areas, overcome adversities such as drought, cold, frost, water logging, soil acidity, salinity and pests and diseases. Gene technology can also improve the nutritional value of our food. All of this can in turn help achieve healthier and more sustainable, and more stable, communities and populations. Producing more wheat with fewer inputs will be critical in meeting the future needs of the world’s population.

**WHO is doing the work?**

In Australia, most of the wheat gene technology research is being undertaken by public research entities in partnership with international companies.

The development of a GM crop takes eight to 13 years, with plants initially undergoing assessment in a laboratory, then a glasshouse and finally in a small field trial. The development of a GM crop takes eight to 13 years, with plants initially undergoing assessment in a laboratory, then a glasshouse and finally in a small field trial.

**WHAT work is being done?**

Australian GM wheat research can be grouped into two main categories:

- for growers - plant science to improve agronomic performance such as developing plants with greater ability to survive and thrive in head drought conditions and to cope with climate change.
- for consumers - research to alter grain composition – such as developing foods that have the potential to address diabetes, heart disease and other life threatening illnesses.

GM wheat research projects approved to be assessed in paddocks under field trial licences in Australia include plants:

- modified for improved drought tolerance and other abiotic stresses
- that have been modified for improved utilization of nutrients
- with increased dietary fibre, and
- with different grain compositions – including characteristics for broad market and a human nutrition value.

Current GM wheat field trials being conducted in Australia include:

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Licence</th>
<th>Crop</th>
<th>Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrolah Dairy</td>
<td>GM132</td>
<td>Wheat &amp; barley</td>
<td>Enhanced nutrient utilization and abiotic stress</td>
</tr>
<tr>
<td>CBIO</td>
<td>GM140</td>
<td>Wheat</td>
<td>Enhanced carbon sequestration in drought and heat resistant environments</td>
</tr>
<tr>
<td>CBIO</td>
<td>GM142</td>
<td>Wheat &amp; barley</td>
<td>Growth and yield characteristics</td>
</tr>
<tr>
<td>CBIO</td>
<td>GM144</td>
<td>Wheat</td>
<td>Enhanced water efficiency</td>
</tr>
<tr>
<td>CBIO</td>
<td>GM145</td>
<td>Wheat &amp; barley</td>
<td>Reduced starch</td>
</tr>
<tr>
<td>CBIO</td>
<td>GM146</td>
<td>Wheat &amp; barley</td>
<td>Modified for drought tolerance</td>
</tr>
<tr>
<td>Abrolah Dairy</td>
<td>GM177</td>
<td>Wheat &amp; barley</td>
<td>Enhanced tolerance to environmental stresses or increased dietary fibre</td>
</tr>
</tbody>
</table>

**WHEN could GM wheat be available?**

Plant science and plant breeding takes a long time to converge and deliver new plant varieties. New fruits and vegetables on our supermarket shelves often take decades of intense development, and the same applies for crops that utilise gene technology.

On the basis of the scientific work currently being undertaken in Australia, GM wheat is at least seven years away from the marketplace. Prior to commercialisation GM wheat varieties will have to undergo a thorough assessment from Australia’s regulatory authorities including the OFTR and Food Standards Australia New Zealand (FSANZ). It will be comprehensively assessed for its human health and environmental safety. Alongside this timeframe, the Australian grains industry will work to address market and trade considerations, just as it does with all new crops. As Australia is a major exporter of crops, grain handling and trading companies understand the requirements of international customers and ensure Australia’s grain handling system meets customer specifications.

**The plant science cycle**

The plant science cycle