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Kyoto Protocol**

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Executive summary

Growcom is the peak representative organisation for the fruit and vegetable industry in Queensland. Growcom and horticulture industry members are actively engaged in climate change issues and interested in contributing to solutions.

Fruit and vegetable growing in Queensland is a diverse and dynamic industry with a farm gate value of \$1.7 billion per annum and an overall economic contribution of around \$5 billion per annum. The industry supplies one third of Australia's fresh produce. While the vast majority of produce is destined for domestic markets, largely through the major food retailers, some product is exported. 25 000 people are directly employed through the Queensland growing industry.

The horticultural industry in Queensland and more generally in Australia has much to lose from increases in temperature and reduction in rainfall projected to occur in the next fifty years as a result of increased atmospheric carbon dioxide. For this reason, Australia must take a leadership role in the region in the second round of international negotiations and raise issues such as increased international commitments to emissions reductions, accounting rules for the measurement of soil carbon and bio-char.

Impacts of climate change and climate change policy on horticulture production will be both positive and negative and vary between regions and commodities. Horticultural industries are more sensitive than many other agricultural industries to climate changes, particularly changes to temperature. Projected climate changes in horticultural production zones include increases in both maximum and minimum temperatures; reduced overall rainfall though increased intensity of rainfall events; and an increase in the frequency of severe, damaging storms.

Industry impacts are likely to include reduced water supply security, increased crop water needs, poorer product quality, increased pest management and biosecurity challenges, shifts in seasons that could alter the ability of growers to meet contractual requirements of supply or time production to hit the market windows that underpin the profitability of their crop. Some crop varieties may no longer be able to be grown in current production regions. Climate change is also expected to drive significant increases in input costs and transport costs, however, growers have little or no capacity to pass on these costs through the value chain.

Growcom is concerned that government policies aimed at addressing climate change must be carefully designed, or run the risk of causing more significant impacts on the industry than climate change itself. Growcom, therefore, seeks the opportunity to work closely with the Australian Government to identify critical issues for industry and develop effective policy responses to climate change and carbon emission management. In particular, Growcom seeks commitment from the Australian Government to address the following key issues in the next round of negotiations for the Kyoto Protocol, in finalising the design of Australia's emission trading scheme, and in further developing its climate change policies and response programs:

- Separating natural and human soil carbon losses to allow farmers to manage increases and decreases of carbon from soils.
- Allowing the development of policies that reward increases in soil carbon as a result of practice change without penalising landholders for natural factors which are beyond their control.
- Supporting the development of measurement and monitoring techniques that are cost effective.
- Recognising the potential of bio-char to sequester carbon for extended periods and create opportunities for its use in agricultural as a carbon offsetting practice.
- Investigating the potential for perennial tree plantings in horticultural systems to provide carbon sequestration that can be used as emission offsets in the proposed Carbon Pollution Reduction Scheme.
- Exploring how carbon sequestration in horticultural soils can be maximised and measured and what opportunities there may be to include this in national greenhouse accounting frameworks and the Carbon Pollution Reduction Scheme.
- Preparing rigorous carbon footprinting analyses to provide more detail on the level of emissions from horticulture systems.
- Augmenting current promotional campaigns seeking to increase fruit and vegetable consumption with messages regarding the low emissions status of the industry.
- Conducting detailed socio-economic impact assessments of the implications of the new carbon economy, and the ETS in particular, on horticultural industries.

- Ensuring a reasonable proportion of public funding is channelled towards strategic emissions management and sequestration research in horticultural industries.
- Helping provide industry organisations with the resources to work directly with their members on tackling climate change.

Introduction

As the peak body representing the Queensland horticulture industry, Growcom welcomes the opportunity to provide input to this review of the Kyoto Protocol and Australia's international commitments to reducing greenhouse gas emissions.

Growcom has taken an active interest in climate change issues over a number of years, including early involvement in the Greenhouse Challenge through the Australian Greenhouse Office. In 2007, the Queensland Farmers Federation along with its member industry associations including Growcom, was successful in obtaining funding to review climate science and policy developments in order to prepare climate change response strategies and build climate management into existing industry Farm Management Systems (FMS) programs. An overview of the project is provided in Attachment One.

Growcom is highly concerned about the potential impacts of climate change on horticultural industries. We are also, however, equally concerned that government policies aimed at addressing climate change must be carefully designed, or run the risk of causing more significant impacts on the industry than climate change itself. Growcom, therefore, seeks the opportunity to work closely with Government at all levels to identify critical issues for industry and develop effective policy responses to climate change and carbon emission management.

About Growcom

Growcom is the peak representative body for the fruit and vegetable growing industry in Queensland, providing a range of advocacy, research, communication and industry development services to the sector (for further information see www.growcom.com.au).

We are the only organisation in Australia to deliver services across the entire horticulture industry to businesses and organisations of all commodities, sizes and regions, as well as to associated industries in the supply chain. Our activities ensure we are in regular contact with horticultural business operators and are well aware of the outlook, expectations and practical needs of the industry.

The organisation was established in 1923 as a statutory body to represent and provide services to the fruit and vegetable growing industry. Now a voluntary membership and services organisation, Growcom has grower members throughout Queensland and works alongside other industry organisations, regional producer associations and corporate members. Growcom has approximately fifty staff located in offices in Brisbane, Bundaberg, Ayr, Toowoomba and Tully.

Growcom is a member of a number of state and national industry organisations and uses these networks to promote our members' interests and work on issues of common interest. We work particularly closely with the Queensland Farmers Federation, the Horticultural Australia Council and Horticulture Australia Ltd.

Growcom actively pursues issues of strategic importance to the industry. Recent initiatives include:

- the mandatory code of conduct for trade of horticultural produce between producers and wholesale traders
- monitoring of import risk assessment processes for bananas and apples
- participating in the implementation of the Emergency Plant Pest Response Deed through Plant Health Australia
- Scoping studies for industry skills development needs and labour issues
- Developing a horticulture industry workforce plan
- Development of a memorandum of understanding between the Queensland Government and the Queensland Farmers Federation regarding Farm Management Systems.
- Development of a memorandum of understanding between the Queensland Farmers Federation and the Regional Natural Resource Management (NRM) Groups Collective and strong engagement between horticulture and the regional NRM process.

Growcom has a Land and Water team that has delivered highly successful environmental and water policy and programs for over a decade. The team works to assist horticultural growers to achieve high standards of natural resource management, environmental protection and business profitability.

Growcom also employs Industry Development Officers who support specific commodity growers (currently vegetable, banana, apple, melon, pineapple and macadamia growers) or specialise in issues such as pest management for all commodities.

Growcom's Farm Management Systems (FMS) program is an example of an industry lead initiative which provides growers with a framework and tools to assess business risks and needs and plan, implement, monitor and evaluate responses. The system enables growers to deal with all aspects of their farm and business in an integrated and efficient way.

In 2007 to 2008, Growcom along with the Queensland Farmers Federation completed a climate change project funded through the Australian Government Department of Agriculture Fisheries and Forestry. Though it was a preliminary and short term project, it has positioned the intensive agriculture sector in Queensland to identify strategic responses to climate change. It has enabled the horticulture industry to begin developing climate risk management tools for incorporation in its FMS program, thoroughly analyse climate change science and policy as it relates to horticulture in Queensland, investigate industry awareness and attitudes, enhance communication and networking and prepare a strategic plan and investment program. The project will guide ongoing investment and action over the coming three to five years. Growcom's draft Queensland Horticulture Climate Change Response Strategy is attached.

About the Queensland Horticulture Industry

Queensland is Australia's premier state for fruit and vegetable production, growing one-third of the nation's produce, including the majority of Australia's bananas, pineapples, mandarins, avocados, beetroot and fresh tomatoes. It includes emerging agricultural industries such as olives, cocoa, coffee, Asian exotic tropical fruits, culinary herbs, bush foods, functional foods and nutraceuticals. A relatively small proportion of product is exported, mostly to Asian and Middle Eastern markets, including citrus, mangoes, chillies, melons and lychees. A detailed overview of the industry is available in the report, *The economic contribution of horticulture industries to the Queensland and Australian economies* (Pinnacle, 2004).

Horticulture is Queensland's second largest primary industry, worth more than \$1.7 billion per annum and employing around 25,000 people. It is an innovative and consumer-focused provider of clean and green produce for domestic and world markets.

Queensland's 2,800 farms operate in a variety of locations and climates and use a range of production methods to produce more than 120 types of fruit and vegetables. There are 16 defined horticultural regions, from Stanthorpe in the south to the Atherton Tablelands in the far north, with a total area under fruit and vegetable production of approximately 100,000 hectares. Horticulture is a high value and efficient user of water and other natural resources. Around 95% of horticultural production is irrigated.

The horticulture industry is a diverse and growing industry. It is often the principal driver of many local communities and economies in rural and regional Queensland. The industry provides employment, enhances economic diversification and adds significant value throughout the food, transport, wholesale and retail industries. Horticulture has achieved continued growth in recent years of around 5% per annum, at a time when many other agricultural industries are stagnant or declining.

Horticulture is the most labour intensive of all agricultural industries; labour represents as much as 50% of the overall operating costs of horticultural enterprises. Horticulture is strongly linked to the tourism industry, providing income for thousands of backpackers and "grey nomads" each year. See Hanson and Bell (2007) for an overview of seasonal labour and migration in the fruit and vegetable industry.

The nature of horticulture business is quite different to many other industries within the agriculture sector. The capital investment is usually relatively high, while profit margins are often tight. Growers operate in extremely competitive markets and the domestic market for fresh produce is dominated by Australia's two major supermarket chains. The significant market power of these retailers along with escalating costs of production limit the capacity of growers to absorb additional costs or manage industry impacts, such as climate change.

Growcom has worked with industry members and stakeholders to define the critical issues for the horticulture industry. These are:

- Climate risks, including climate variability, responding to droughts and natural disasters, and meeting the challenges of climate change.
- Biosecurity.
- Value chains and business development.
- Labour and human capital.
- Natural resource management.

1.0 Negotiation positions Australia should be taking in the second round for international negotiations regarding the Kyoto Protocol

Global commitment to reducing greenhouse gases

Reducing greenhouse gases emission resulting from human activities is a complex scientific and political issue. A global problem of this magnitude requires a global solution. In this way, international cooperation, leadership and a willingness to prioritise the needs of future generations are key ingredients to the development of the second international protocol for the reduction of greenhouse gases.

The horticultural industry in Queensland and more generally in Australia has much to lose from increases in temperature and reduction in rainfall projected to occur in the next fifty years as a result of increased atmospheric carbon dioxide. For this reason, Australia must take a leadership role in the region in the second round of international negotiations while also encouraging other nations to take greater responsibility for their emissions. In particular, Australia should push for further guarantees of emission

reduction targets and leadership commitments from large emitters such the United States. Commitments are also required from nations such as China and India to reduce emissions despite their current rapid rate of economic development.

Increases in the number of countries committed to make emission reductions while helping to lower atmospheric levels of emissions would also assist minimise the trade impacts associated with introducing emission reduction policies such as an Emission Trading Scheme (ETS) in Australia. In particular, increased international coverage would benefit horticulture exporters who with the commencement of an ETS in Australia in 2010 may be in a position of competing internationally with other nations who do not have increased costs associated with an ETS. In the same way, horticultural growers in Australia may soon face competition from imported products from nations without an ETS.

Accounting rules in agriculture

The Australian Government should also take a firm position on the need to modify existing greenhouse accounting rules to encourage further opportunities for reducing and sequestering emissions in the agricultural sector. Agricultural is both a source and a sink for greenhouse gases. In this way, agricultural lands have considerable potential, if appropriately managed, to reduce the amount of carbon dioxide stored in the atmosphere by sequestering it into the soil.

Soil Organic Carbon (SOC) is critical to a range of soil processes. It is a central element of soil structure by improving water holding capacity, aeration, nutrient mobility, and providing a more favourable environment for the establishment of plant roots and beneficial microorganisms. Beyond soil health benefits, increasing SOC removes carbon dioxide from atmosphere and can therefore be considered to assist in reducing the impact of elevated carbon dioxide on climate change.

There is a substantial body of research addressing the potential of agricultural soils as carbon sinks (Paustian et al. 1997; Smith 2004a, 2004b). The global potential for carbon sequestration in agricultural soils is estimated to be around between a quarter and a third of the annual increase in atmospheric carbon levels (Lal 2004 cited in Smith

2004b). Sequestration and emission of carbon dioxide into soils is influenced by both farming practice (conservation tillage and organic farming) and natural processes (drought and fire).

The accounting rules for measuring changes in emissions resulting from cropland management, grazing land management and re-vegetation are recorded in article 3.4 of the Kyoto Protocol. Countries can choose to include this article within their accounting framework in addition to mandatory reporting Articles 3.1 and 3.3 that also deal with greenhouse gases from land based sources and sinks. In Article 3.4 a country reports on the emissions from cropland management, grazing land management and revegetation compared to 1990 levels.

While Article 3.4 allows countries to more comprehensively account for emissions and sequestration in agricultural, it also opens up a new level of risk and liability at both a national and land holder level. This is because emissions from soils are influenced by both farm management practices as well as natural variability such as drought and fire. In general, net soil carbon loss occurs in hot dry periods regardless of the management practices that are in use.

In regard to land use change in Article 3.3, the distinction is made between manmade and natural emissions, separating anthropogenic and naturally occurring emissions. However, under Article 3.4 change occurring both as a result of natural variation and farm practices must be accounted. While activities defined under Article 3.4 of the Kyoto Protocol may deliver gradual emissions reductions over time (such as reduced tillage), natural events such as drought and fire result in the release of greenhouse gas emissions over much shorter periods. The risks of substantial emissions due to such events are considerable in Australia's highly variable climate. The lack of separation between natural and man made emission sources and sinks means that any benefit of gradually increasing soil carbon levels is significantly outweighed by the risk of potential emissions production.

As a result, neither emissions nor sequestration in agricultural soils are covered in Australia's greenhouse gas accounts. While this result successfully avoids increase liability it provides no incentive for land holders to increase their amount of SOC. This

does little to target the global challenge which the Kyoto Protocol was designed to address. Growcom believes that Australia should address this failing at the second round of international negotiations.

Growcom recommends that the accounting framework for the next commitment period should:

- Separate natural and human soil carbon losses to allow farmers the option of benefiting from increases in SOC resulting from improved management approaches.
- Allow the development of policies that reward increases in soil carbon as a result of practice change without penalising landholders for natural factors which are beyond their control.
- Support the development of measurement and monitoring techniques that are cost effective.

Bio-char

The addition of a product call “bio-char” (a charcoal or biomass-derived black carbon) to soils has shown promising results for long term fixation of atmospheric carbon dioxide in terrestrial ecosystems. Bio-char is produced when a biomass is heated in the absence of oxygen commonly between 350–500 degrees (Lehmann, Gaunt & Rondon 2006). Bio-char production can also be used to produce a bioenergy co-product that can be used to produce heating, electricity generation and other applications. The quality of bio-char depends on the feedstock materials and heating conditions. Potential fuels include green waste, forestry waste, poultry litter, cattle feedlot manure, cane trash, mill mud and bagasse. Bio-char is a relatively stable form of mineral carbon that has the potential to remain in the soil much longer other forms of SOC.

Studies into the agronomic benefits of bio-char in radishes found significant yield increases when the application of bio-char was accompanied by nitrogen fertiliser application (Chan et al. 2007). These results demonstrate the improve soil fertility and health benefits of bio-char beyond the positive effects in reducing emissions and increasing the sequestration of greenhouse gases (Lehmann, Gaunt & Rondon 2006). Despite these benefits, the high cost of bio-char means that the use of this product in the large scales required in agricultural lands is prohibitively high. However, recognising the

application of bio-char as an official emission reduction practice and offset could help overcome this price barrier.

Although, vegetation is recognised as an emission reduction practice under the Kyoto Protocol, emerging technologies such as bio-char with a similar capacity to sequester carbon for long periods of time are not included. Furthermore, the sequestration potential of bio-char is limited by the constraints associated with increase SOC in Article 3.4.

While bio-char is an organic product that can be applied to the soil, the potential of bio-char to store sequester carbon over long periods of time is much greater than other the management practices that change soil carbon levels. For these reasons the accounting framework for the next commitment period should:

- Recognise the potential of bio-char to sequester carbon for extended periods and create opportunities for its use in agricultural as a carbon offsetting practice.

2.0 Opportunities and obligations arising from ratification of Kyoto Protocol, including Australia's development of an emissions trading scheme

2.1 Carbon sequestered in perennial trees

The ratification of the Kyoto Protocol and the planned commencement of emissions trading in Australia in 2010 create a number of new opportunities and obligations for the horticultural industry in Queensland. The carbon cycle is fundamental to agricultural and as such creates numerous opportunities for growers to increase the carbon stored in horticultural production systems.

One such opportunity is the sequestration of carbon into perennial trees such as macadamias. The proposed voluntary inclusion of forestry in the Carbon Pollution Reduction Scheme means that if a grower's orchard met the requirements under Kyoto for a "forest" then such plantings could be included in the scheme and permits allocated accordingly. This would appear to be possible based on the definition of a forest under the current accounting rules in Australia which defined eligible forest as having a minimum area of land of .2 hectares, a minimum vegetation width of 10 metres, potential

height of at least two metres and crown cover of at least 20 per cent, being established since 1 January 1990 on land that was clear of forest at 31 December 1989 and established by direct human induced methods, i.e. planting, direct seeding (Australian Greenhouse Office 2006).

Despite the apparent potential to include perennial trees within an ETS, research by Kerckhoffs and Redi (2007) into potential for orchards to be included as offsets in New Zealand's ETS found that the potential for carbon credits based on standing (aboveground) biomass for most orchards are limited when compared with forest stands like *Pinus radiata*. Kerckhoffs and Redi (2007) found that orchards could only achieve around 70 tonnes of carbon per hectare compared to forest stands that could attain 300-500 t carbon per hectare. Despite these findings, the advantages of timber plantations over horticultural perennial trees deserves further exploration especially considering the large number of productive trees (sometimes greater than 500,000) planted in some horticultural enterprises. Further clarification and consideration of this issue is needed from the federal government in the design of the Carbon Pollution Reduction Scheme. Additional detail is also required on the implications for measuring other on farm emissions (such as nitrous oxide from fertilisers) if growers were to voluntarily opt in to the Carbon Pollution Reduction Scheme. Therefore we recommend that:

- The Australian Government work with horticultural industries to further investigate the potential for perennial tree plantings in horticultural systems to provide carbon sequestration that can be used as emission offsets in the proposed Carbon Pollution Reduction Scheme.

2.3 Soil carbon

Potential also exists to increase the levels of soil carbon in horticultural enterprises through undertaking improved management practices and the application of sequestration products such as bio-char. Although there is potential for opportunities for increasing the levels of SOC in horticultural systems, this process will be limited by the continued use of carbon in crop production and the current accounting rules associated with the Kyoto Protocol. Despite such constraints, we recommend that:

- The Australian Government work with horticultural industries to fully investigate how carbon sequestration in horticultural soils can be maximised and measured

and what opportunities there may be to include this in national greenhouse accounting frameworks and the Carbon Pollution Reduction Scheme.

2.3 Fruit and vegetables as a low emission food source

Increased public awareness of the need to reduce emission on a national and international level creates new opportunities to promote fruit and vegetable as a low emissions food source. Although data on emissions from different agricultural systems, and horticulture systems in particular, is still quite low, initial indications are that horticultural systems are a highly efficient food producing systems with a low carbon footprint compared to industries such as livestock (refer Table 1). The low emission nature of horticulture production in Australia also creates opportunities to market produce overseas. However, more research is needed to more firmly establish the level of emissions from horticulture production in Australia compared to other developed and developing nations.

Table 1: Per annum emissions across the profile of the agricultural sector

Sub - sector	Number of entities	Annual emissions (2005) Mt CO2 - e
Beef cattle	36,000	42
Dairy cattle	9,900	10
Wool	13,000	17
<hr/>		
Sheepmeat		
<hr/>		
Mixed sheep/beef cattle	8,300	Included in other sub - sectors
Mixed grain, sheep/beef cattle	17,200	Included in other sub - sectors
Pigs	900	1
Poultry (meat and eggs)	1,100	1
Grains	12,700	4
Sugar	4,600	1
Cotton	600	<1
Rice	2500	<1
Horticulture & fruit	20,000	1

Total	130,000	79
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Source: Department of Climate Change (2008)

Growcom recommends that:

- The Australian Government supports efforts in horticultural industries to prepare rigorous carbon footprinting analyses and augment current promotional campaigns seeking to increase fruit and vegetable consumption with messages regarding the low emissions status of the industry.

2.4 Increased efficiency of production systems

The introduction of an emissions trading scheme could enhance incentives for growers to pursue further business efficiencies in energy use, water use, fertilizer use and other aspects of production or key inputs. Growcom is concerned, however, that input cost increases, driven by the introduction of an ETS, are likely to impact on growers' financial capacity to invest in efficiency measures and may further erode growers already slim profit margins. This issue will be discussed in greater detail later in this submission.

Growcom recommends that:

- The Australian Government commit to conducting detailed socio-economic impact assessments of the implications of the new carbon economy, and the ETS in particular, on horticultural industries.

2.5 Research opportunities

The introduction of the new carbon economy brings with it a range of new research needs. In particular, research is needed into the potential of good management practice approaches (eg minimum till or improved fertiliser application) to reduce emission from fertilisers and increase soil carbon levels. Fortunately, significant overlap appears to exist between practices that improve the productive capacity of soils and practices that reduce emissions. These practices are also likely to contribute to minimising the impact of farming activities on downstream water quality. Further research is needed to understand these connections within an Australian context, and more specifically, within Queensland's semi-tropical and tropical environments.

Despite the many opportunities that exist for research into emissions and emission reduction practices in horticultural systems, Growcom is concerned that the limited public funding for research will be allocated to other industries that have higher emissions (such as the livestock industry). Despite the low level of emissions from horticulture compared to other agricultural industries, the price impact on inputs such as fuels, fertilisers and electricity will exist over all industries and therefore research into how to achieve energy and fertiliser efficiencies in horticultural systems is just as critical as in other industries.

Growcom is also concerned that the pool of resources available to invest in research in the horticulture sector is already overstretched, so there is likely to be limited capacity to pursue research projects focussed on improved carbon management and emission reduction through industry R&D funding bodies. We recommend that:

- The Australian Government ensure a reasonable proportion of public funding is channelled towards strategic emissions management and sequestration research in horticultural industries.

3.0 Present and prospective impacts of global warming and climate change on horticulture in Queensland

3.1 Physical impact of climate change

Impacts of climate change and climate change policy on horticulture production will be both positive and negative and vary between regions and commodities. Horticultural industries are more sensitive than many other agricultural industries to climate changes, particularly changes to temperature. Changing temperature, rainfall and water availability will mean that existing growing windows, production seasons and conditions are likely to change in the future. In general, the cumulative impact of increased temperature, reduced rainfall and increased carbon fertilisation will result in hotter, dryer production conditions with reduced chilling and maturing times and increased threat of pest and disease activity. These changes are likely to combine to make certain commodities in existing regions unviable in the future and further increase the cost of fruit and vegetables to the consumer.

More hot days and a decline in rainfall or the security of irrigation water supplies are also likely to reduce yields and impact crop quality. Heat stress and reduced winter chilling will impact production in some marginal growing regions. Water resources are also likely to be further stressed due to increasing demand yet decreasing precipitation and storage efficiency. A decline in annual rainfall with higher evaporation rates would lead to a tendency for reduced run-off into rivers, with significant implications for security of irrigators' water entitlements. Finally, droughts and extreme weather events in Queensland are likely to become more frequent and more severe.

From a positive perspective, changing growing seasons and regions may create new opportunities to access market windows or expand production into previously unfavourable or marginal areas. Increasing temperatures and atmospheric carbon dioxide concentrations will also mean that crops are likely to mature more rapidly and may be more water efficient. Similarly, projected increase in summer rainfall may offer enhanced opportunities for water collection and storage, if water harvesting regulations allow some flexibility.

The past resilience of horticulture in Australia's highly variable climatic conditions is evidence that with appropriate support horticultural industries can respond to this new challenge. Developing new fruit and vegetable varieties more adapted to elevated temperature will help reduce the impact of increasing maximum and minimum temperatures. Similarly, reassessing planting and harvest times and the location of growing regions will assist growers to maximise new production opportunities resulting from positive influences such as elevated carbon dioxide levels and minimise the impact of negative change such as increased heat stress. Various management responses also exist to increase water use efficiency (such as deficit irrigation) and lessen the impact of temperature increase (such as evaporative cooling). However, little information currently exists on the impact of climate change on specific growing regions and therefore it is difficult for growers to know if they are likely to need to use such practices in the future. The current lack of information also limits the ability of the industry to identify strategic R&D projects. To help build an improved knowledge base for industry responses to climate change, Growcom in partnership with the Queensland Department of Primary Industries is commencing a project that investigates how increasing temperatures are likely to impact on the production of key horticultural commodities.

3.2 Impacts of climate change policy

Beyond the physical impacts of climate change, the Australian Government's proposed Carbon Pollution Reduction Scheme poses additional challenges to the maintenance of profitable and productive horticulture enterprises in Queensland. Though not included in an ETS in the initial stages, horticultural growers will still face higher costs of farm inputs such as electricity and fertiliser. Industry estimates are that input costs will rise by at least 5-10% under an ETS. This means growers will be doubly disadvantaged: not only will they bear the burden of adapting to climate change with potentially little government support they will also face significant cost increases from an ETS.

While it is often assumed that cost increases will be passed onto consumers, the highly competitive nature of the horticultural industry and the dominance of the two major supermarket chains, Coles and Woolworths, mean that growers are price takers with limited capacity to pass costs on. This is further exacerbated by regular calls for fresh produce to be cheaper to encourage Australians to improve their diets to combat the obesity epidemic. Furthermore growers have limited capacity to meet additional requirements to measure and report emissions if agriculture is included at a later stage of the Carbon Pollution Reduction Scheme.

In adapting to climate change policy, growers also need to be equipped to minimise (and document) the carbon impact of their enterprises and farming operations and engage with the emerging carbon economy. In particular, future research is needed into the emissions from fertiliser use, methods to increase soil carbon levels and the overall cost impact of the Carbon Pollution Reduction Scheme on horticulture in Queensland. This information will help increase growers awareness, reduce emissions and address the root cause of climate change.

Growcom is concerned that government policies aimed at addressing climate change must be carefully designed, or run the risk of causing more significant impacts on the industry than climate change itself. Growcom, therefore, seeks the opportunity to work closely with the Australian Government to identify critical issues for industry and develop

effective policy responses to climate change and carbon emission management.

Growcom recommends that:

- Industry organisations are given responsibility and resources to work directly with their members on tackling climate change issues as industry groups are best placed to design programs that work with the business, market and regulatory needs of producers.

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Draft Queensland Horticulture Climate Change Response Strategy

2008 – 2011

An industry strategy coordinated by Growcom

INDUSTRY CONSULTATION DRAFT
June 2008

Introduction

Concern about the potential impact of climate change on horticultural industries has been growing for a number of years. In 2007, the Queensland Farmers Federation and its member organisations, including Growcom, were granted funding through the Australian Government Department of Agriculture, Forestry and Fisheries to review climate change issues and prepare responses for the intensive agriculture sector in Queensland.

Through this project, Growcom has:

- initiated communication and discussions within industry regarding climate change issues,
- undertaken an extensive literature review and issues analysis,
- prepared this draft Queensland Horticulture Climate Change Response Strategy for industry consultation, and
- commenced work on a climate risk management module for inclusion in the Growcom Farm Management Systems program.

This strategy provides the fruit and vegetable industry with the opportunity to:

- consider the findings from climate change research and the latest scientific modelling for regional climate change projections in Queensland
- take stock of the issues arising from climate change and government's policy responses to climate change;
- assess the potential impacts and opportunities posed by climate changes and
- consider how the industry should respond.

The strategy focuses on actions that should be taken over the next three years. The original intent was to prepare a five year strategy, however, it was decided that given the rapid developments in knowledge and research regarding climate change and the highly dynamic government policy environment, a three year scope would be more sensible.

This draft strategy will now be presented to members of the fruit and vegetable industry for their consideration and feedback. The outcomes of the industry consultation process will drive the refinement of the strategy and a final version will be prepared by October 2008.

The strategy outlines the range of actions that need to be taken by industry to address climate change issues. These actions could be led by a range of stakeholders, including Growcom, other horticultural industry groups, growers, government agencies, research

organisations or other stakeholders. The consultation process will help to identify appropriate roles for various players and build widespread endorsement, commitment and support for the proposed actions. Following the consultation process, the strategy will include an action plan and clearly defined implementation, monitoring and review arrangements.

Feedback welcome

This document is an industry draft for consultation purposes. We welcome any comments and feedback.

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Why does the Queensland horticulture industry need a climate change response strategy?

There are a number of reasons driving the need to develop the strategy. The primary purposes of the strategy include to:

- Inform industry members and stakeholders about climate change and facilitate the development of a common understanding of the baseline issues.
- Define the actions that Growcom and other organisations need to take over the next 3 to 5 years to help the industry respond to climate change.
- Guide growers' responses at farm and business scales.
- Influence the actions and policies of other players in government and industry and encourage collaborative action between climate change stakeholders.
- Provide a business case for government funding and investment in the horticulture industry's climate change response activities.
- Guide industry Research and Development (R&D).

- Increase public awareness of the industry's contribution to the management of global warming and build public support for the industry's actions to respond to climate change.

Who should read this strategy?

This strategy aims to influence and inform a broad range of people and groups, including:

- Growcom – senior management and staff;
- fruit and vegetable growers in Queensland;
- industry stakeholders, service providers, value chain members (eg fertilizer or seed suppliers);
- Commonwealth, Queensland and Local Governments;
- Government agencies, in particular:
 - Qld Department of Primary Industries & Fisheries
 - Qld Department of Sustainability, Climate Change and Innovation
 - Qld Department of Natural Resources and Water
 - Australian Government Department of Agriculture Forestry and Fisheries
 - Australian Government Department of Water, Environment, Heritage and Arts
 - Australian Government Department of Climate Change;
- Horticulture Australia (HAL) and other R&D organisations such as Land & Water Australia;
- Horticulture Australia Council (HAC), national and state commodity organisations, regional industry groups and Local Producer Associations;
- Queensland Farmers Federation;
- regional natural resource management organisations in Queensland.

Glossary of terms

A glossary of terms will be attached to the final document.

Principles that underpin the development of the strategy

- Initial discussions with fruit and vegetable industry members show that growers have been following the climate change debate and are keen to play their role in slowing global warming / reducing their carbon emissions. There is a strong history in the horticulture industry of growers being proactive about meeting community expectations and seeking to protect their “clean and green” reputation. This strategy aims to build on this positive attitude.
- The strategy emphasises that responding to climate change is a business management imperative rather than an environmental issue or campaign.
- In developing and promoting this strategy, Growcom does not intend to preach to growers. Our aim is simply to ensure that industry members have access to

relevant and up-to-date information so that growers can make up their own minds.

- The strategy aims to address the fact that governments are implementing dramatic policy responses to climate change and carbon emissions issues that may cause serious economic and social impacts on horticultural growers. There is a need for industry organisations to participate in the policy development process to limit the damage these could cause to industry.
- Growcom believes that an industry response to climate change will require influencing the majority of growers, rather than focusing only on industry leaders.
- This strategy acknowledges that climate change may bring both impacts and opportunities for the horticultural industry.
- This strategy emphasises industry self-management and proactive responses rather than waiting for government leadership or assistance.
- The strategy aims to encourage collaboration with the nursery and garden industry to facilitate a whole-of-horticulture industry response to climate change.

Goal

Our goal in developing a climate change strategy is to ensure the Queensland horticulture industry is well positioned to remain viable and sustainable in the face of changing regional climates and federal and state government policies aimed at addressing climate change.

Objectives

The objectives of the Queensland Horticulture Climate Change Response Strategy are to

1. Ensure horticulture industry members and stakeholders in Queensland are well informed about climate change issues, particularly
 - a. current climate science,
 - b. best available regional climate projections
 - c. anticipated industry impacts and opportunities
 - d. government and industry policy settings and directions
2. Identify effective actions that can be taken by industry to respond to climate change challenges and be well positioned
 - a. to minimise any impacts;
 - b. capitalise on any opportunities;
 - c. contribute to carbon emission reductions;
 - d. influence government policy development and
 - e. make smart investments in R&D, communication and business management.

3. Encourage collaboration on climate change actions between stakeholders.
4. Influence the development of government programs aimed at supporting industry responses to climate change while optimising access to government programs.
5. Guide strategic investment in R&D that assists industry to respond to climate change.

Summary of Information Report / Issues analysis

Climate science overview

Queensland's climate is likely to become warmer, with more hot days and fewer cold nights. For example, the number of days above 35 degrees in 2030 in Brisbane could double. While low to moderate warming may help plant growth in some frost sensitive species, more hot days and a decline in rainfall or irrigation could reduce yields. Warmer winters are also likely to reduce the yields as a result of heat stress and reduced winter chilling. Water resources are also likely to be further stressed due to increasing demand yet decreasing precipitation. A decline in annual rainfall with higher evaporative demand would lead to a tendency for reduced run-off into rivers. Finally, droughts and extreme weather events in Queensland are likely to become more frequent and more severe

Horticulture industry overview

Queensland is Australia's premier state for fruit and vegetable production, growing one-third of the nation's produce, including the majority of Australia's bananas, pineapples, mandarins, avocados, beetroot and fresh tomatoes. It includes emerging agricultural industries such as olives, cocoa, coffee, Asian exotic tropical fruits, culinary herbs, bush foods, functional foods and nutraceuticals. A relatively small proportion of product is exported, mostly to Asian and Middle Eastern markets, including citrus, mangoes, chillies, melons and lychees.

Horticulture is Queensland's second largest primary industry, worth more than \$1.7 billion per annum and employing around 25,000 people. It is an innovative and consumer-focused provider of clean and green produce for domestic and world markets.

Queensland's 2,800 farms operate in a variety of locations and climates and use a range of production methods to produce more than 120 types of fruit and vegetables. There are 16 defined horticultural regions, from Stanthorpe in the south to the Atherton Tablelands in the far north, with a total area under fruit and vegetable production of approximately 100,000 hectares. Horticulture is a high value and efficient user of water and other natural resources. Around 95% of horticultural production is irrigated.

The nature of horticulture business is quite different to many other industries within the agriculture sector. Horticulture is the most labour intensive of all agricultural industries; labour represents as much as 50 per cent of the overall operating costs of horticultural enterprises. The capital investment required for horticultural production usually relatively high, while profit margins are often tight. Growers operate in extremely competitive markets and the domestic market for fresh produce is dominated by Australia's two

major supermarket chains. The significant market power of these retailers along with escalating costs of production limit the capacity of growers to absorb additional costs or manage industry impacts, such as climate change.

Critical industry impacts

Industry impacts of climate change are wide ranging. Changing temperature, rainfall and water availability will mean that existing growing windows, production seasons and conditions are likely to change in the future. In general, the cumulative impact of increased temperature, reduced rainfall and increased carbon fertilisation will result in hotter, dryer production conditions with reduced chilling and maturing times and increased threat of pest and disease activity. Furthermore, increased temperatures are likely to encourage more active pest and disease activity, placing further pressure on horticulture production systems. These changes could combine to make certain commodities in existing regions unviable in the future and further increase the cost of fruit and vegetables to the consumer.

Beyond the physical impacts of climate change, government policy on emissions trading also threatens to pose additional challenges to maintain profitable and productive horticulture enterprises in Queensland. At a minimum, the introduction of an Emissions Trading Scheme will increase the cost of basic inputs such as fuel, fertilisers and electricity. While it is often assumed that cost increases will be passed onto consumers, the highly competitive nature of the horticultural industry and the dominance of major supermarket chains such as Coles and Woolworths mean that growers are price takers with limited capacity to pass costs on.

Summary of industry opportunities

Although climate change is likely to create significant impacts, opportunities will also exist. With changing growing seasons and regions come new opportunities to access market windows and expand production into previously marginal areas. Increasing temperatures and atmospheric carbon dioxide concentrations will also mean that crops are likely to mature more rapidly and potentially be more water efficient. Similarly, projected increase in summer rainfall, presents opportunities for water collection and storage.

At a policy level, while the commencement of an Emissions Trading Scheme poses considerable challenges, potential does exist to explore opportunities in horticultural production systems for capturing carbon in agricultural soils. Similarly, opportunities exist for the horticultural industry to engage in the new carbon economy appealing to the environmentally conscious through promoting products as clean and green.

Priority needs for the Queensland horticulture industry

- A. More detailed and specific information about how climate changes will affect the horticulture industry and horticultural production regions is needed.
- B. Growers need to be well informed about climate change issues and potential impacts in order to make effective business management decisions and

responses.

- C. Growers need tools that can be used to:
 - a. better predict and manage seasonal climate variability,
 - b. assess the risks and opportunities posed by climate change to their enterprise, and
 - c. plan how to adapt to projected climate changes.
- D. Growers need access to information on management practices and responses that are effective for climate change adaptation.
- E. Growers need advice on how to minimise the carbon impact of their enterprises and farming operations.
- F. Growers need to be well informed about the emerging “carbon economy” and equipped to assess the opportunities or impacts.
- G. The horticulture industry needs to be able to influence national, state and regional policies aimed at addressing climate change and carbon emission management.
- H. The horticulture industry needs to influence water planning and management arrangements to ensure they effectively incorporate climate change considerations and protect the security of water entitlements.
- I. The horticulture industry needs to conduct its own detailed analyses (especially agronomic issues) at commodity and regional scales, identify issues and invest in solutions.
- J. The horticulture industry needs to address changes to pest management issues arising from climate change
- K. Information sharing within and between industry, government, consumers and the general public is vital to underpin sound management decisions.

Strategies

A1 Build a detailed understanding of how climate change will affect horticultural industries and horticultural production regions

Context: Climate science and information that is directly relevant to horticultural crops and production regions needs to be generated through further research, modelling and analysis. While some research focused on horticulture has been done, the technical report, “*Climate change and horticulture in Queensland: risks, opportunities and responses*”, highlights a number of specific horticulture industry research priorities and information needs. This information would underpin the identification of industry responses to climate change, assist with analysing the potential benefits or impacts of government policies and identify support or assistance needed.

A1.1 Seek ongoing investment in work aimed at continuing to improve climate modelling tools that allow [credible] climate projections to be prepared for regional (and finer) scales and improve the capacity of researchers to estimate secondary climate parameters and impacts.

A1.2 Seek ongoing investment in further work to identify horticultural regions and commodities most vulnerable to projected climate changes and develop targeted strategies and adjustment or adaptation programs as required.

A1.3 Direct research towards critical knowledge gaps and information needs for the horticulture industry, including:

- Define marginal thresholds for production of key horticultural commodities and regions;
- Develop a credible, consistent and rigorous methodology for assessing carbon footprints of horticultural production systems or enterprises;
- Develop methodologies to measure and account for carbon emission and sequestration in horticultural systems;
- Identify optimum rates of nutrient application to balance productivity and minimisation of carbon emissions;
- Identify carbon emissions factors for fertiliser usage in a variety of [contexts];
- Develop and communicate recommended practices for carbon emission reduction within horticultural enterprises;
- Assess the impact of climate changes on the spread and control of key pests and review integrated pest management (IPM) strategies to address new challenges resulting from climate changes;
- Investigate how changing regional climates may affect catchments, water yields, water storage and water resource planning;
- Investigate options to improve water management at farm, irrigation scheme, catchment and broader scales, particularly develop the next generation of on-farm water use efficiency practices eg deficient irrigation;
- Further develop the knowledge base on soil carbon in horticultural systems, including
 - The opportunities offered by bio-char;
 - The impact of different farming practices on carbon sequestration in soils;
 - The links between soil health enhancement strategies and soil carbon retention;
- Social and economic analysis of the potential consequences for horticultural industries of the proposed national emissions trading scheme through its various stages;
- Assess the social and economic implications of proposed climate change policies of governments and retailers;
- Investigate how projected climate changes could affect the security of food production in Queensland and Australia and what government policy responses may be required.

A1.4 Meet with key R&D agencies and brief them on the outcomes of this project and the research priorities identified in this strategy.

B2 Deliver an industry information campaign to increase awareness and knowledge of climate change amongst fruit and vegetable growers

B2.1 Prepare a package of information resources (including fact sheets, briefing papers, presentation materials) for use in the extension strategy

- Growcom is well positioned to develop these information resources.

B2.2 Develop an extension strategy to deliver climate change information to fruit and vegetable industry members and stakeholders using a wide variety of methods including

- Fact sheets;
- Media and industry communication avenues;
- Regional industry workshops;
- Incorporation of climate change information into related industry extension, training, business management, professional development or leadership programs;
- Delivery of climate change information via industry service providers and value chain members eg resellers, farm advisors, financial advisors, financiers, or insurers.

B2.3 Maintain and further develop Growcom's database of climate change information.

C3 Develop management tools that help growers assess the risks and opportunities of climate variability and change, and plan responses in their business and farming operations

Context: Horticulture enterprise managers need access to information and tools to support sound business decision-making regarding climate change. Management tools should be informed by the best available climate change projections and models. Advanced business planning would incorporate assessment of the possible effects of climate changes in the business's production regions, as well as that of their domestic and international competitors' and target markets'. Despite the recent emphasis on climate change it should be noted that in Australia's highly variable climate, horticultural growers have proven their capacity to adapt to subtle shifts in climatic conditions over a long period of time. The opportunity now is to refine decision making processes and better draw on available projections and data.

C3.1 Develop and deliver seasonal weather and climate variability forecasting tools customised to needs of horticulture

- Eg the vegetable industry requires weather forecasting tools that provide for a 3-4 month lead in time and 4-6 week season length.

C3.2 Promote the use of, increase access to, and enhance weather and climate-related web-sites commonly used by horticultural growers.

C3.3 Develop a climate risk management module for inclusion in Growcom's Farm Management Systems Program

- The module would provide farm business planning and risk assessment tools that support a thorough assessment of climate change implications for the business and development of management responses.

C3.4 Work with governments, financiers, insurers and retailers to ensure that the management tools used in the horticulture industry to assess climate change issues and drive management responses are accepted and can be formally recognised in other relevant initiatives if required (such as the national emissions trading scheme).

D4 Develop and deliver information on management practices and responses that are effective for climate change adaptation.

Context: Practices and management approaches need to consider adaptation and mitigation together. This approach will ensure that practices used to adapt to climate change do not generate additional emissions and therefore create an even greater problem.

D4.1 Review existing literature to identify cost effective management practices that enable growers to respond to expected challenges of climate change without adversely affecting production.

D4.2 Incorporate this information into the existing information sources and industry programs such as the Growcom Farm Management Systems Program, the Farmcare Code of Practice and Department of Primary Industries advisory services.

E5 Identify and promote practices that reduce the carbon emission and increase carbon absorption in horticulture production systems

Context: Industry consultation has shown that growers are interested in promoting their operations as carbon neutral or having low emissions to demonstrate that the horticultural industry is environmentally responsible and proactive. However emissions reductions and uptake practices should not be seen in isolation but rather be developed along with energy and water efficiency and water quality and soil health improvement practices.

E5.1 Build on previous work to identify and further document key emissions sources and sinks in horticultural production systems.

E5.2 Establish an accepted methodology for measuring the carbon footprint of horticultural enterprises.

E5.3 Benchmark the footprint of different horticultural production systems using an accepted footprinting method.

E5.4 Build on previous work to identify and document specific on-farm practices that reduce emissions from farming activities and/or increase carbon uptake (minimum till, fertiliser use efficiency, controlled traffic, stubble retention, orchard management).

E5.5 Identify and promote any financial and or production efficiency benefits associated with use of emissions reduction or uptake practices.

E5.6 Encourage partnerships between research organisations and growers to increase the body of knowledge on increasing soil organic carbon and reducing emissions from soils in horticultural systems.

E5.7 Communicate current level of knowledge on emission reduction and uptake practices in horticulture through specific case studies and fact sheets.

E5.8 Integrate information on emission reduction and sequestration practices with existing farm management systems to highlight the connection between broader nutrient management, water use efficiency and emission reduction and sequestration practices.

F6 Equip growers to participate in the emerging “carbon economy”

Context: Over the past ten years public awareness of climate change has significantly increased. During this time businesses have moved to establish voluntary carbon offsets schemes, the Australian Government has commenced design of a national Emissions Trading Scheme (ETS) and the Kyoto Protocol has established a global framework for carbon emission management. As a result a new “carbon economy” is emerging. In this new economy, organisations are keen to be perceived by the public as “climate friendly”. Under an emissions trading scheme, companies that emit significant amounts of greenhouse gases will soon be required to pay for the right to pollute. With this new obligation to pay for pollution will come new opportunities to sell pollution offsets. Horticulture needs to engage with this new economy and better understand the constraints, opportunities and impacts it may offer.

F6.1 Investigate and assess how horticultural enterprises could participate in and benefit from emerging carbon offset markets with specific reference to soil carbon and perennial horticultural plantings.

F6.2 Investigate the implications for the horticulture industry of the commencement of a national ETS and financially quantify the potential costs and benefits.

F6.3 Provide growers with information to guide decision making regarding engagement with both the voluntary and formal carbon market. Such information should include a checklist of considerations before committing to an offset scheme and identification of quality training courses on emissions trading.

F6.4 Educate growers on the fundamental principles on the ETS and the specific opportunities and risks for horticulture production systems through fact sheets, market simulations and workshops.

F6.5 Educate growers on the risks and opportunities in green marketing and “carbon neutral” business promotion.

F6.6 Explore the potential for large industry organisations to collectively market carbon offsets and act as a carbon credit collection point for smaller growers.

F6.7 Develop simple, accurate and rigorous record keeping system that allow growers to account for emissions changes resulting from current and future practices.

F6.8 Maintain a watching brief on retailers plans to introduce carbon accounting requirements and/or product labelling.

F6.9 Integrate information on the emission trading and green marketing with existing farm management systems used in horticulture to identify specific risks, opportunities and response strategies for individual growers.

G8 Influence national, state and regional policies aimed at addressing climate change and carbon emission management

Context: There is a risk that government climate change policies, if they are poorly designed, could cause greater impacts on the horticulture industry than the actual shifts in climate conditions. The horticulture industry needs to be proactive in communicating to governments the potential impacts of policy decisions on growers and seeking government commitment to means of mitigating them or refining policy. There is a particular need for the industry to engage in discussion on the proposed national emissions trading scheme to seek the best possible outcomes for horticulture.

G8.1 Establish and maintain strong connections with policy makers in relevant Australian Government departments and Ministers' offices and clearly communicate industry's needs regarding climate change management, adaptation and mitigation. Key issues include the need for well targeted and positive support programs, transition arrangements and impact mitigation strategies as required.

G8.2 Play an active role in discussions towards the development of the national ETS with particular regard to the inclusion of agriculture and horticulture in the scheme. Attention should be given to promoting alternative options for including agriculture in an ETS such as promoting of emission reductions through incentive based "good agricultural practice" scheme.

G8.3 Promote the importance of developing a national policy on food security to underpin policies and schemes addressing carbon emission management, bio-fuels and other climate change issues.

G8.4 Advocate for government underwriting of multi-peril crop insurance as a key risk management strategy for growers in the context of an increasingly variable climate.

G8.5 Review the Queensland Climate Smart Strategy and other Queensland Government policy initiatives to identify key linkages and opportunities to progress actions identified in this strategy.

G8.6 Identify the appropriate regional scale planning and management frameworks to incorporate and address regional climate projections and horticulture industry impact and vulnerability assessments.

H9 Influence water planning and management arrangements

Context: Climate change projections need to be linked with water planning. Without this connection current water use will not reflect future supply and future water security will be jeopardised.

H 9.1 Maintain involvement in the National Water Initiative to ensure climate change considerations are incorporated in an appropriate manner.

H 9.2 Participate in policy discussions with the Qld Department of Natural Resources and Water to seek changes to the modelling processes used to underpin the Water Resource Plans (WRPs) to better incorporate regional climate projections.

- Currently the technical basis of WRP's is the Integrated Quality and Quantity Model (IQQM) which is based on historical rainfall data. The modelling for the preparation of WRPs requires adaptation to incorporate projected changes in rainfall and runoff patterns and therefore changes to harvesting and storage opportunities.

H 9.3 Work with the Qld Department of Natural Resources and Water to ensure operating rules in ROPs for water storages and supplemented water supplies are designed utilising best available climate projections and analysis of expected hydrological changes.

H 9.4 Work with the Qld Department of Natural Resources and Water to explore options for allowing an increased emphasis on flood and overland flow harvesting and on-farm storage within WRPs and Resource Operations Plans (ROPs), if it can be demonstrated that this would take better advantage of expected shifts in rainfall patterns and intensities, and not be detrimental to environmental flow objectives.

H 9.5 Discuss climate change, storage operating rules, alternative water sharing rules, innovative water products and drought management strategies with SunWater and the Queensland Bulk Water Supply Authority.

H 9.6 Seek ongoing Queensland Government funding for the Water for Profit program that assists the horticulture industry to optimize water management and water use efficiency. In particular, work directly with growers to identify how they can make optimal use of their water entitlement through enhanced design or management of on-farm storages and irrigation systems, minimizing evaporation, and considering underground storage.

I10 Encourage horticultural commodity and regional scale action and research investment in climate change issues

Context: A holistic response will be needed successfully adapt to the challenges of climate change. Identification and prioritisation of risk and access to accurate information will be the key to adaptive management. The variations in climatic systems, response strategies and commodities create a large research gaps in a variety of fields. Due to the diversity of horticulture systems, funded research is limited in its capacity to fully understand all of these options. The horticulture industry will itself have to be proactive in filling these gaps in understanding and fostering an attitude of innovation

I10.1 Encourage growers and commodity organisation to research and experiment with adaptation responses to key climate change issues.

I10.2 Review horticultural commodity strategic plans and R&D plans to assess the extent to which climate change is addressed.

I10.3 Seek discussions with the executive officers, boards and R&D committees of major horticultural commodity organisations to provide an overview of this strategy and seek a commitment to addressing climate change issues.

J11 Address changes to pest management issues arising from climate change

Context: A strong connection exists between pest activity and climate signals. Threats from pests such as the fruit fly, heliothis moth, diamond back moth and silverleaf whitefly all are likely to increase with under projected increases in temperature. Pest management approaches will need to be improved to cope with the increased threat to horticulture production from pest and disease activity.

J11.1 Encourage horticultural commodity associations to review biosecurity response plans based on an in-depth analysis of likely consequences of climate changes and associated environmental changes eg shifts in the ranges of key pest species or ideal conditions for diseases.

J11.2 Encourage growers to maintain and develop integrated pest management plans

K12 Develop communication plans to guide information sharing and flow within and between industry, government, consumers and the general public regarding climate change and horticulture issues.

Context: Over the last decade climate change has emerged as a new priority in Australia. Responding the issue of climate change is a complex problem that will require high levels of communication between various disciplines and organisations.

K12.1 Develop and implement a public communication strategy to inform the community and consumers of the low carbon impact of horticulture, how industry could be affected by climate change and what industry is doing to manage and respond to climate change.

K12.2 Develop and implement an industry communication strategy that complements and enhances the climate change extension strategy.

Action Plan and Implementation

To be completed following further industry consultation

Monitoring, Review and Ongoing Strategy Development

To be completed following further industry consultation

Summary

Horticulture faces many challenges from climate change. In the past, growers have proven their capacity to cope with change and remain viable in a highly viable climate. However, the climatic changes projected to occur in future years are expected to be of a greater scale and occur at a more rapid rate and will therefore require a new level of risk management and adaption. Stakeholders at all levels need to be aware of the challenges that lie ahead for the horticultural industry, especially in the context of the horticulture industry's contribution to Australia's food supply.

In order to effectively respond to climate change, growers need to be well informed about climate change issues, impacts and responses to increased temperature, decreased rainfall, elevated carbon dioxide and increasing pest and disease activity. Growers also need to be equipped to minimise (and document) the carbon impact of their enterprises and farming operations and engage with the emerging carbon economy. This awareness will help reduce emissions and address the root cause of climate change.

In areas where adaption and emission reductions are hindered by a lack of knowledge, additional research and development needs to be undertaken by both industry and government to further minimise the impact of climate change on the horticultural industry. Combining information on adaption and mitigation with the support of appropriate decision making tools such as the Growcom FMS will maximise the effectiveness of the climate change response in the horticultural industry into the future.