Submission to Senate Standing Committee on Rural and Regional Affairs and Transport Inquiry on "Climate Change and the Australian Agricultural Sector"

ia) **scientific evidence on likely future climate**:

Scientists within the Weeds CRC are not involved in research on the likely future climates in Australia, but use the output from this research in order to understand probable changes in weed profiles and weed management in future climates.

However, there is a real need for an independent scientific review of currently-available modelling tools used to predict how plants, in particular current and potential weedy species, will respond to changing climate scenarios. There are a number of climate-matching models used to predict range-changes in climate-dependent pest species, but the output does not always make sense and consequently may not be acceptable to practitioners with a knowledge of the species involved. For example, a major national resources body recently removed all maps predicting potential spread of various nationally-important weeds from their draft report, because the results were so flawed that they were totally unacceptable. Significant amounts of money and scientific time are being spent on developing and refining models where the basis of the input data may not have been properly validated and the outputs not scientifically verified. This is an important issue and needs to be dealt with. We need reliable and scientifically valid techniques for use by land managers and planners who need to know where invasive plants might spread as climatic conditions change.

ib) implications for current farm enterprises and possible future industries:
General
Overall, climatic changes place existing vegetation, whether native, pasture or crops, under stress. This creates spaces for new species to move into, and species with efficient dispersal mechanisms, whether by bird, wind, water or by human activities, are the best equipped to take advantage of the spaces created. Invasive plants generally have excellent seed transport mechanisms, often by human activity or by birds, and are likely to spread rapidly into new areas, quickly exploiting changing climatic conditions that favour their establishment. Climate change can therefore be expected to favour invasive plants over established vegetation including crops, especially if accompanied by an increase in extreme conditions such as droughts alternating with very wet years.

There is a strong need to modify existing **weed risk assessment systems** (used by AQIS and others for border protection but also widely used by states and regions for post-border weed prioritisation) to take into account possible sleeper weeds that may be favoured by a changing climate. Further research will be needed on a regional basis to determine the most detrimental species within local contexts and to consider possible sleeper weed species establishing across different land uses.

Specific issues:
Impacts of higher temperatures

- All invasive plants can be expected to demonstrate a southward range shift, with tropical and sub-tropical species moving south, and temperate species being displaced southward.

- Weeds currently restricted to the lowlands can be expected to move into higher altitude areas such as the Atherton Tableland in the north, and the Snowy and other mountain ranges further south.
- For temperature sensitive plants such as lantana this shift may be significant and there is some evidence that lantana is already invading higher altitude areas on the Qld-NSW border.
- Frost-intolerant weeds such as rubbervine and chromolaena can also be expected to shift their ranges significantly further south.
- There is a **high risk** that some weed species at present not considered high priorities which are currently limited by temperature and rainfall, may show increased spread with temperature rise and rainfall change.
- Many agricultural chemicals such as herbicides cannot be used in very hot conditions: there will be a reduction in the number of days or hours when these chemicals can be applied.

Impact of increased CO2

- Increased CO_2 can be expected to influence the invasiveness of some plants.
- Many weeds are C3 plants, with a carbon metabolism which benefits greatly from increased CO2 levels, while most of the tropical grasses are C4 plants and will not show increased growth in higher CO2.
- As a result, invasive weeds such as parthenium will be even more competitive in the raised CO2 environment, independently of temperature and rainfall effects.
- Some pasture grasses, both native and introduced, may also benefit and show increased growth.
- Increased CO2 can be expected to influence the reproductive success of some annual weeds of cereals. Weeds such as wild oats will be even more competitive in the raised CO2 environment, independently of temperature and rainfall effects.

Impact of changed rainfall on invasive weeds

- Without good information on changed rainfall patterns, this is difficult to predict for any particular agricultural zone or for Australian agriculture as a whole.
- Reduced rainfall may limit or reduce the distribution of some weeds in some localities.
- Other weeds such as cacti and other succulents (eg *Opuntia* spp. and *Orbea* spp.) may expand their range, especially if there is also a reduction in frosts
- Reduced rainfall will reduce growth of pastures and crops, increasing bare ground and reducing canopy cover which favours weed invasion.
- Reduced winter rainfall and more variable spring rainfall will increase the importance of weed competition for soil moisture, including within crop and by summer weeds. Warm-season deep-rooted perennial crop weeds (eg silverleaf nightshade) will have an extended growth season.
- Increased extremes, eg long dry or drought periods interspersed with occasional very wet years, will worsen weed invasion, because established vegetation, both pastures and crops, will be weakened, leaving areas for invasion. Eg mass germination and spread of prickly acacia has occurred in the past after a series of very wet years.
- More severe cyclones will both disperse weed seeds through wind and floods, and also open up gaps for weed invasion in horticultural crops. This happened after severe Cyclone Larry in north Queensland in 2006.

ii) Need for a national strategy to assist Australian agricultural industries

The existing Australian Weed Strategy needs to be expanded to incorporate impacts of, and adaptation to, climate change scenarios, in particular for weed management in agricultural systems. Changing agricultural systems will result in changing weed issues, and research will be needed into the management of these.

iii) Adequacy of existing drought assistance programs

Drought-assistance programs must be aimed at assisting farmers to change practices and farming systems rather than continue with existing systems when these are no longer sustainable in new climatic conditions. In particular, farmers must be encouraged to adopt integrated weed management practices rather than continued reliance on cultivation or excessive reliance on herbicides which will no longer be sustainable. Pasture over-stocking in dry periods, or failure to allow pastures to recover after drought, also leads to unsustainable levels of weed invasion. Drought-assistance programs must be designed to prevent this kind of response to drought, and rather to encourage farmers to modify their practices to reduce weed problems in the long term.

Attachment: Weeds CRC Briefing Note, 'Invasive plants and climate change'

References:

Gallagher, R., Beaumont, L., Downey, P.O., Hughes, L. & Leishmann, M.R. 2006. Assessing the potential impacts of climate change on weeds in New South Wales: establishing priorities. In: *Proceedings of the 15th Australian Weeds Conference*, eds. C. Preston, J.H. Watts & N.D. Crossman (Weed Management Society of South Australia, Adelaide). pp. 35-39.

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Kriticos DJ, Sutherst RW, Brown JR, Adkins SW, Maywald GF (2003) Climate change and the potential distribution of an invasive alien plant: *Acacia nilotica* ssp *indica* in Australia. *Journal of Applied Ecology* **40**, 111-124.

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briefingnotes

Invasive plants and climate change

Weeds CRC briefing notes

Expected climatic changes

Current predictions for the future climate of Australia in the next 30+ years are for a general increase in mean temperatures with a larger increase in mean minimum temperatures as well as a reduction in frost days.

Changes in rainfall are less certain: in the tropical north there is expected to be an increase in rainfall especially in the north-west, with reduced rainfall in south-west WA and eastern and south-eastern Australia generally.

In all areas, an increase in extreme events, including droughts, floods, severe storms and extended wet seasons, is expected. There is no clear picture for cyclone patterns although more severe cyclones are expected.

Impacts on invasive plants

- All invasive plants can be expected to demonstrate a southward range shift, with tropical and sub-tropical species moving south, and temperate species being displaced southward.
- Species currently restricted to the lowlands can be expected to move into higher altitude areas such as the Atherton Tableland in the north, and the Snowy and other mountain ranges further south.
- For temperature sensitive plants such as lantana this shift may be significant and there is some evidence that lantana is already invading higher altitude areas on the Qld-NSW border.
- Frost-intolerant species such as rubbervine and chromolaena can be expected to shift their ranges significantly further south.
- There is a high risk that some weed species not presently considered high priorities and which are currently limited by temperature and rainfall may show increased spread with temperature rise and rainfall change.

Impact of increased CO_2

Increased CO_2 can be expected to influence the invasiveness of some plants.

- Many weeds are C3 plants, with a carbon metabolism which benefits greatly from increased CO_2 levels, while most tropical grasses are C4 plants and will not show increased growth in higher CO_2.
- As a result, invasive weeds such as parthenium will be even more competitive in the raised CO_2 environment, independently of temperature and rainfall effects.
- Some pasture grasses, both native and introduced, may also benefit and show increased growth.

Impact of changed rainfall on invasive weeds

- Until the new rainfall patterns are clear it is difficult to predict where weeds will move.
- Increased rainfall, with associated increased flood severity and frequency, will spread weeds such as athel pine or mesquite.

All invasive plants can be expected to demonstrate a southward range shift

Gamba grass creates very high fuel loads, up to seven times that of native grasses. These intense fires destroy native plant communities. Gamba grass forms dense patches and grows to 4m tall, out-competing native plants. Gamba is currently limited to the NT and north Qld.

Increased rainfall will spread weeds

The worst infestations of Athel pine occur along 600 km of the Finke River in Central Australia near Alice Springs. A single tree can produce thousands of seeds/year. Outbreaks occurr throughout inland Australia in SA, Qld, NSW and WA. Based on climate, athel pine could potentially infest inland watercourses throughout Australia, including parts of NW Vic.

Temperature sensitive plants may shift into higher altitude areas

Lantana forms impenetrable thickets that take over native bushland and pastures on the east coast of Australia. Mature plants can produce up to 12,000 seeds/year. It is now found across 4 million ha east of the Great Dividing Range. Climate change could see it extend its range.

Climate change can be expected to favour invasive plants over established native vegetation, especially if accompanied by an increase in extreme conditions such as droughts alternating with very wet years.

- Increased rainfall may also increase the distribution of some weeds, such as lantana, mist flower, and fireweed, which are currently limited to higher rainfall zones.
- Reduced rainfall may limit or reduce the distribution of many weeds such as lantana and the vine species growing in riparian areas.
- Reduced rainfall will also reduce growth of pastures and crops, increasing bare ground and reducing canopy cover which favours weed invasion.
- Increased extremes, eg long dry or drought periods interspersed with occasional very wet years, will worsen weed invasion because established vegetation, both native and crop, will be weakened, leaving areas for invasion. For example, mass germination and spread of prickly acacia has occurred in the past after a series of very wet years.
- More severe cyclones will both disperse weed seeds through wind and floods, and also open up gaps for weed invasion in areas of pristine native vegetation, especially in the wet tropics. This happened after severe Cyclone Larry in north Queensland in 2006.

General

- Overall, climatic changes force range changes in native vegetation. Species with efficient dispersal mechanisms, whether by bird, wind, water or human activities, are better equipped to make these range changes.
- Invasive plants generally have excellent seed transport mechanisms, often by human activity or by birds, and are likely to spread rapidly into new areas, quickly exploiting changing climatic conditions that favour their establishment. Climate change can therefore be expected to favour invasive plants over established native vegetation, especially if accompanied by an increase in extreme conditions such as droughts alternating with very wet years.
- There is a strong need to modify existing weed risk assessment systems to take into account possible sleeper weeds that may be favoured by a changing climate. Further research will be needed on a regional basis to determine the most detrimental species within local contexts and to consider possible sleeper weed species establishing across different land uses.

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