FECCA House
Suite 2
4 Phipps Close
DEAKIN ACT 2600
Tel 02 6163 6200
Fax 02 6162 1297

ABN 13 115 589 707

Ref: 087

12 March 2008

The Secretary
Senate Standing Committee on Rural and Regional Affairs and Transport
PO Box 6100
Parliament House
CANBERRA ACT 2600

Dear Secretary

The Cooperative Research Centre for National Plant Biosecurity Ltd (CRCNPB) was established in 2005 in recognition of the need to strengthen the plant biosecurity scientific capacity of Australia. The strategic analysis that underpinned the bid had identified that climate change presents a significant risk for the future plant biosecurity status of Australia. Since establishment, the CRCNPB has continued to strategically analyse the potential impact of climate change on plant biosecurity and has commenced research activities in this area.

The Mission of CRCNPB is *"to foster scientific collaboration and engage stakeholders to deliver plant biosecurity technologies that will reduce risk to, and ensure sustainability of, Australia's plant industries".*

The research activities of CRCNPB will assist in addressing the second term of reference of the inquiry 'Climate Change and the Australian Agricultural Sector':

ii) the need for a national strategy to assist Australian agricultural industries to adapt to climate change

Background

Climate Change

The potential impacts of climate change have become the focus of much political and social debate e.g. the Stern Review (Stern 2007. The 4th Intergovernmental Panel of Climate Change (IPPC) report regards climate warming as "unequivocal" with a "very high confidence" that the cause can be attributed to human activities (Alley *et al.* 2007).

Over the last century, the mean temperature in Australia has risen by 0.7°C, leading to an increase in the number of very warm days and a decrease in frost and cold days. The total annual rainfall over Australia has also increased by about 6% over the last hundred years. The prognosis is for an acceleration of climate change during the rest of this century (Pittock *et al.,* 2003).

Climate Change and Plant Biosecurity

A poleward shift in the geographical range of some pests and pathogens has been observed during the last century. For example, the northerly spread of sudden death syndrome of soybean, caused by *Fusarium solani f. sp. glycines*, in the US is well-documented (Roy *et al.,* 1997) and is a major threat to US soybean production. Rising temperatures associated with climate change are predicted to be associated with the future poleward movement of other emergency plant pests (EPPs) (Coakley *et al.,* 1999; Harvell *et al.,* 2002; Rosenzweig *et al.,* 2001). A recent modelling analysis indicated that if citrus canker had become established in Queensland, the

geographical range of the pathogen, *Xanthomonas axonopodis* pv.*citri*, was predicted to extend further south to major Australian citrus growing regions with a 1-5ºC temperature increase (van Rijswijk *et al.* unpublished).

Climate change will alter the risks associated with the biosecurity of Australia's cultivated and natural flora and the access of its agricultural products to international markets. Biosecurity policy will also be strongly influenced by climate change in a number of ways e.g. the re-defining of quarantine zones under future climate change scenarios or the need to modify post-entry quarantine based on new and emerging threats. Understanding these new threats (and opportunities) will enable Australia's plant industries and quarantine agencies to be better prepared to adapt and respond to any risks.

The effects of climate change on most of Australia's key biosecurity threats are not well understood. It is not known how climate change will affect the biology and distribution of known plant hosts in Australia. Nor do we understand the effects of climate change on our currently identified Emergency Plant Pests (EPP). Modelling tools are available to predict the geographical range of plants and their pests and pathogens but often they do not take into consideration the specific biology of the host, pest or pathogen and their interaction.

While future spatial distribution can be predicted under climate change scenarios using models and examining historical trends, there appears to be limited knowledge of how climate change will impact on the biology of the EPPs (e.g. pathogenicity) and how the interaction with their host responds to potentially many climatic factors. Major climate change factors identified that affect plant pest infestation and diseases include increased atmospheric CO_2, frost, heavy and unseasonal rains, increased humidity, drought, cyclones and hurricanes, and warmer temperatures. The need for further work in this area has been highlighted in adaptation experiments using twice-ambient CO_2, which increased the aggressiveness (Chakraborty and Datta, 2003) and fecundity (Chakraborty *et al.,* 2000) of *Colletotrichum gloeosporioides*, which causes the fungal disease anthracnose of tropical legumes.

Elevated CO_2 may modify pathogen aggressiveness and/or host susceptibility and affect the initial establishment of the pathogen, especially fungi, on the host (Coakley *et al.,* 1999; Matros *et al.*, 2006; Plessl *et al.,* 2005). In most examples, host resistance has increased, possibly due to changes in host morphology, physiology and composition. Increased fecundity and growth of some fungal pathogens under elevated CO_2 has also been reported (Chakraborty *et al.,* 2000; Coakley *et al.,* 1999; Hibberd *et al.,* 1996). However, it has been reported that greater plant canopy size, especially in combination with humidity and increased host abundance, can increase pathogen load (Chakraborty and Datta, 2003; Manning and Tiedemann, 1995; Mitchell *et al.,* 2003; Pangga *et al.,* 2004).

CRCNPB Response – Current Research

CRCNPB has initiated a major research and development program and facilitated the inputs of leading plant biosecurity and climate change researchers. As a first step, a national workshop to identify the issues related to climate change and biosecurity was held in 2007 which brought together national experts in the field of climate change and plant biosecurity. The major research gaps identified were, as follows.

1. A need for refining predictive models to incorporate plant host responses to climate change, life stages of insects, aggressiveness and pathogenicity and other biological parameters.
2. Analysis of trends in expansion of geographic ranges of EPPs and their hosts.
3. Expansion of case studies to include further key EPPs.
4. Real-time experiments investigating effects of, for example, increased temperature or CO_2 on EPPs interacting with their host and environments.
5. Predicting the extent of the potential damages to crop (Aurambout *et al.,* 2006).

Based on the finding of this workshop the CRCNPB has commenced a project entitled '*Understanding and responding to the risks associated with climate change and plant biosecurity*'. To ensure the scientific rigour of the research, CRCNPB has developed a partnership with the Pratique bid to the European Commission. The

Pratique bid brings together 13 research organisations from across Europe and the CRCNPB involvement in this project will enable a global strategy on the potential impact of climate change in plant biosecurity to be evaluated.

The research project will examine the potential risks associated with climate change using pests and diseases identified in partnership with industry. The key outcomes of the research will be:

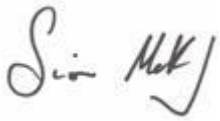
- alignment of plant pest and disease capabilities with spatial modelling capabilities in a collaborative national project;
- first plant pest and disease research in Australia conducted in the field under high CO_2 conditions;
- enhanced understanding of the circumstances leading to EPP outbreaks;
- new knowledge concerning EPPs response to climate change (FACE environment simulating Australian climatic conditions in the future; e.g. year 2050);
- novel spatial dynamic modelling capability, coupling pest and disease models with climate models and host physiology models enabling more accurate predictions on the impacts of climate change on plant biosecurity for industry and government;
- an increased level of preparedness for government and industry to respond to the uncertainty of climate change;
- a decision support framework designed predominantly for government and biosecurity policy makers to take pre-emptive action on the influence of climate change EPPs, and
- an international leading position in the field of climate change and biosecurity strengthened by international publications based on new modelling tools and novel research conducted in the FACE facility.

These outcomes will assist Australia's plant industries to respond to future climates through inclusion in a national strategy which may require changes to industry practices and government policies. The work undertaken to date by CRCNPB and the partnership with Pratique have identified the need for a national strategy to assist Australian agricultural industries to adapt to climate change. The research findings of the CRCNPB activities will form the basis for the assessment of the impact of climate change on plant biosecurity.

In conclusion, CRCNPB is well positioned to undertake the development of components of a national strategy and would welcome the opportunity to discuss how a strategy could be initiated, developed and implemented.

I would be happy to discuss the strategy and the benefits that could be derived for Australia's agricultural industries. Further information on the research project currently being undertaken by CRCNPB can be obtained by contacting myself.

Yours sincerely



Dr Simon McKirdy
Chief Executive Officer

References

Aurambout, J.-P., Constable, F., Luck, J., Sposito, V., 2006. The impacts of climate change on plant biosecurity, Victorian Government Department of Primary Industries, Melbourne, Victoria.
Chakraborty, S., Datta, S., 2003. How will plant pathogens adapt to host plant resistance at elevated CO_2 under changing climate? *New Pathologist* 159, 733-742.
Chakraborty, S., Pangga, I.B., Lupton, J., Hart, L., Room, P.M., Yates, D., 2000. Production and dispersal of *Colletotrichum gloeosporioides* spores on *Stylosanthes scabra* under elevated CO_2. *Environmental Pollution* 108, 381-387.
Coakley, S.M., Scherm, H., Chakraborty, S., 1999. Climate change and plant disease management. *Annual Review of Phytopathology* 37, 399-426.
Harvell, C.D., Mitchell, C.E., Ward, J.R., Altizer, S., Dobson, A.P., Ostfeld, R.S., Samuel, M.D., 2002. Climate warming and disease risks for terrestrial and marine biota. *Science* 296, 2158-2162.
Hibberd, J.M., Whitbread, R., Farrar, J.F., 1996. Effect of elevated concentrations of CO_2 on infection of barley by *Erysiphe graminis*. *Physiological and Molecular Plant Pathology*. 48, 37-53.
Malmstrom, C.M., Field, C.B., 1997. Virus-induced differences in the response of oat plants to elevated carbon dioxide. *Plant, Cell and Environment* 20, 178-188.
Manning, W., Tiedemann, A., 1995. Climate change: potential effects of increased atmospheric carbon dioxide (CO_2), ozone (O_3), and ultraviolet-B (UV-B) radiation on plant diseases. *Environmental Pollution* 88, 219-245.
Matros, A., Amme, S., Kettig, B., Buck-Sorlin, G.H., Sonnewald, U., Mock, H.P., 2006. Growth at elevated CO_2 concentrations leads to modified profiles of secondary metabolites in tobacco cv. Samsun and to increased resistance against infection with potato virus Y. *Plant, Cell and Environment* 29, 126-137.
Mitchell, C.E., Reich, P.B., Tilman, D., Groth, J.V., 2003. Effects of elevated CO_2, nitrogen deposition, and decreased species diversity on foliar fungal plant disease. *Global Change Biology* 9, 438-451.
Pangga, I.B., Chakraborty, S., Yates, D., 2004. Canopy size and induced resistance in *Stylosanthes scabra* determine anthracnose severity at high CO_2. *Phytopathology* 94, 221-227.
Pittock, B., Arthington, A., Booth, T., Cowell, P., Hennesy, K., Howden, M., Hughes, L., Jones, R., Lake, S., Lyne, V., McMichael, T., Mullet, T., Nicholls, N., Torok, S., Woodruff, R., 2003. Climate Change: an Australian guide to the science and potential impacts. Australian Greenhouse Office, Canberra, pp. 239.
Plessl, M., Heller, W., Payer, H.D., Elstner, E.F., Habermeyer, J., Heiser, I., 2005. Growth parameters and resistance against *Drechslera teres* of spring barley (*Hordeum vulgare* L. cv. Scarlett) grown at elevated ozone and carbon dioxide concentrations. (Special Issue: Mechanisms in resource allocation). *Plant Biology* 7, 694-705.
Rosenzweig, C., Iglesias, A., Yang, X.B., Epstein, P.R., Chivian, E., 2001. Climate change and extreme weather events: Implications for food production, plant diseases, and pests. *Global Change and Human Health* 2, 90-104.
Roy, K.W., Rupe, J.C., Hershman, D.E., Abney, T.S., 1997. Sudden death syndrome of soybean. *Plant Disease* 81, 1100-1111.