Getting the jump on pests

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KNOWING WHAT is likely to happen to the climate a season ahead could have profound impacts on the way farmers and graziers manage weeds, pests and diseases. Computer software that can predict the response of a plant or insect pest to short-term climate variation, given details of the organism's biology, is being developed by CSIRO entomologist Dr Bob Sutherst and his colleagues.

Sutherst, who works with the Cooperative Research Centre for Tropical Pest Management at Brisbane, says the predictions will help state agriculture departments and farmers to devise better control strategies for particular weeds or pests, thus minimising damage.

One of Sutherst's model organisms is the Queensland fruit fly (*Dacus tryoni*), which sometimes breaks out of its tropical haunts to threaten southern orchards. The particular areas at risk of invasion, and the timing of outbreaks, vary with seasonal conditions.

Sutherst says climate prediction will also be important in forecasting the spread of other exotic pests recently discovered in Australia, including the western flower thrip (*Frankliniella occidentalis*), the poinsettia whitefly (*Bemisia tabaci* B strain), the spiralling whitefly (*Aleurodicus dispersus*) and the Changa mole cricket (*Scapteriscus didactylus*).

All of these new pests are major pests overseas. The thrip, the international cut-flower industry's number one pest, attacks the flowers of more than 600 ornamental plants, while the poinsettia whitefly has devastated vegetable crops in the United States, and is resistant to most insecticides, making it difficult to control without damaging its natural enemies with hard insecticides.

Knowing the enemy

Last year (1994), Sutherst's colleagues Gunter Maywald, Jamie Seymour and Dr Don Sands used one of his group's computer programs to predict the timing of the summer generation of the green vegetable bug (*Nezara viridula*) on a large pecan-nut farm at Moree. The bug breeds in grass and weeds that grow between the trees. Sands showed that it could be controlled simply by mowing the grass and weeds before the nymphal bugs moulted into adults. As with most insects, the development rates vary with seasonal conditions. The

The change in distribution of buffalo fly in coastal eastern Australia from 1974 to 1982. A succession of mild winters between 1973 and 1981 contributed to the fly's extensive southward spread in that period.

800-hectare farm is expensive to mow, and the new tactic, timed to exploit the predicted start of the generation, saved the owners $1.9 million dollars.

Sutherst says two other northern pests, the cattle tick and the buffalo fly, also become more troublesome in southern grazing regions in years with warm summers. In its normal range in northern Queensland, the cattle tick (*Boophilus microplus*) is relatively insensitive to temperature variation, but needs warm, moist conditions to cause outbreaks in the most southern areas. An ability to predict the conditions six months ahead would give tick-control agencies, agrochemical suppliers and graziers time to plan their efforts to suit the circumstances.

Timing and favourable conditions are crucial to the economics of tick control. In parts of Queensland where high temperatures allow ticks to produce a new generation every nine weeks, graziers can control ticks and minimise their costs by treating three times at three-week intervals.

But in NSW, under cooler conditions, tick generations take up to 18 weeks and graziers can cut costs and reduce the risk of pesticide residues in their animals if treatments correspond to the spring emergence of ticks, or the hottest months of the year.

These examples illustrate the economic benefits that are possible if scientists can better understand the role that variation in climate plays in determining the numbers of pests in different types of seasons. Predicting climate a few months ahead will add to the industry's ability to anticipate pest problems.

If the seasonal conditions that lead to mass-germination events could be predicted, measures such as biological control and fire could be used to control weeds while they are still at the seedling stage.

Weeding out woody invaders

Sutherst says large areas of former native pasture in northern Australia are today covered by dense thickets of introduced woody weeds, such as parkinsonia and mesquite (*Prosopis*), after several unusually wet seasons in the early 1970s and 1980s resulted in mass-germination events.

'The cost of controlling or eliminating mature woody weeds is several times more than the land itself is worth,' Sutherst says. 'If we could predict the seasonal conditions that lead to mass-germination events, we could use measures such as biological control and fire to control the weeds while they are still at the seedling stage.

'You can allow the seedlings to go through the first season, allowing fuel loads to build up. Then the land is de-stocked and fired to burn out the seedlings before they can flower and seed. Then you bring the livestock back in and keep the stocking rate up during the next year to graze any surviving seedlings.

'It's not just an economic issue. Today we are seeing exotic weeds such as prickly acacia (*Acacia nilotica*), mimosa (*Mimosa pigra*), rubber vine (*Cryptostegia grandiflora*), and Chinese apple (*Zizyphus*) spreading rapidly and displacing native vegetation, and the animals that live in these ecosystems.'

Another notorious pest, the cane toad (*Bufo marinus*) is a climatic opportunist. Sutherst says the computer model CLIMEX predicts that the toad's potential range already extends as far south as Port Macquarie in NSW, but a series of warmer, wetter years could bring it as far south as the Myall Lakes, north of Sydney.

'CLIMEX looks at weekly variations in weather, and allows us to look at extremes that might favour the reproduction of a pest like the cane toad. It can also tell us how long the conditions need to remain favorable for larval survival,' he says.

'We need to extend CLIMEX to look at climatic variation over longer periods, and use it to target the optimum areas for releasing biological control agents for pests and weeds, as well as to understand the role of the El Niño-Southern Oscillation in driving pest problems.'

More about controlling pests

Sutherst RW and Maywald GF (1985) A computerised system for matching climates in ecology. *Agriculture Ecosystems and Environment* 13: 281-299.

Sutherst RW Maywald GF and Skarratt DB (1995) Predicting insect distributions in a changed climate. In: *Insects in a Changing Environment*, R Harrington and N Stork (eds), Academic Press, London, pp 59-92.

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