LIKELY *HELICOVERPA PUNCTIGERA* LEVELS FOR THE 2000-2001 COTTON SEASON

A preliminary report to the Cotton Research and Development Corporation

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Background

In the 1999-2000 cotton season, insect pressure was unusually light. In particular, numbers of *Helicoverpa punctigera* present early in the season were extremely low. This enabled many growers to avoid the use of hard insecticides early in the season, and populations of beneficial insects remained high until well into the growing season. Consequently, overall use of insecticides was down on average, and especially when compared to the 1998/99 season.

In May 2000 CRDC commissioned research from CSIRO Division of Entomology and the University of New England to determine whether these low levels of *H. punctigera* were likely to continue into the 2000/2001 season.

Methods

Information on the distribution of rainfall (the key driving variable for inland populations *of H. punctigera*) has been obtained from the Bureau of Meteorology. NOAA satellite images showing Normalised Difference Vegetation Indices (NDVI; a measure of vegetation greenness) have been obtained from NASA. These data have been used as inputs for a GIS model which predicts the suitability of inland areas for *Helicoverpa* breeding (details of the model can be found on the web site of Dr. Wayne Rochester, University of Queensland, http://pest.cpitt.uq.edu.au/forecast/intro.html). This model was developed as part of earlier CRDC and GRDC funded research on *Helicoverpa* ecology in inland Australia.

Three inland survey trips have been made. In June, a team from the Australian Plague Locust Commission and the University of New South Wales travelled to south western Queensland, using funds provided by an Australian Research Council grant to Dr. V.A. Drake and Dr. P. C. Gregg. A CSIRO Entomology team funded by the CRDC grant travelled to Central Australia in July, accompanied by a UNE team. A further survey will be undertaken by CSIRO in August. These surveys recorded the presence of native host plants which can support *H. punctigera*, and sampled these hosts using sweep nets. Some larvae have been reared on artificial diet to confirm their identity, but most have been given to Glenn Graham of the University of Queensland, who will use them for microsatellite DNA analysis. This will not only confirm their identity, but also help determine whether moths arriving in spring came from inland areas, and possibly locate these areas. Models for predicting the likely emergence times of moths from inland populations, and their possible migration pathways, have also been run. See the Rochester web site listed above for further details on these models.

Results

The 1999-2000 season

Although no surveys were undertaken in this season, the rainfall data and predicted *Helicoverpa* distributions are included for comparison with the current season. The reason for the low *H. punctigera* populations throughout 1999 was probably lack of immigration from inland Australia. Pheromone trap catches in cotton areas at the time when such immigration would have been expected were very low.

Fig. 1 shows the rainfall (3 month decile) in autumn-winter 1999. Rainfall in inland Australia was either average (meaning very dry conditions) or below average (meaning no rainfall, in many areas), in

this time. Reflecting this dryness, the predicted *Helicoverpa* distribution map indicated very few areas where significant numbers of *H. punctigera* might have developed. Unfortunately, due to lack of funding and the absence of some key personnel during winter 1999, no inland surveys were undertaken to confirm this. However, previous experience has shown that large populations do not develop unless there are substantial areas where the probability of finding larvae, according to the distribution model, exceeds 0.8. There were no such areas in 1999.

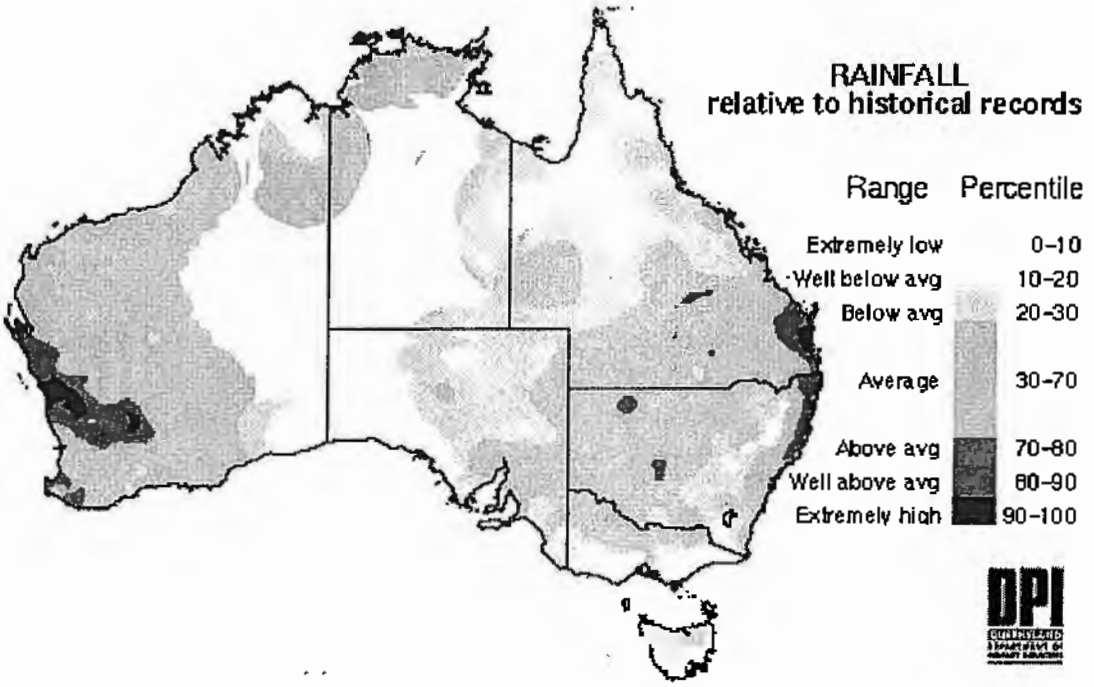

Fig 1: Rainfall (three month deciles) for April-June 1999
Source: The Long Paddock, QDPI web site, http://www.dnr.qld.gov.au/longpdk/lprain.htm

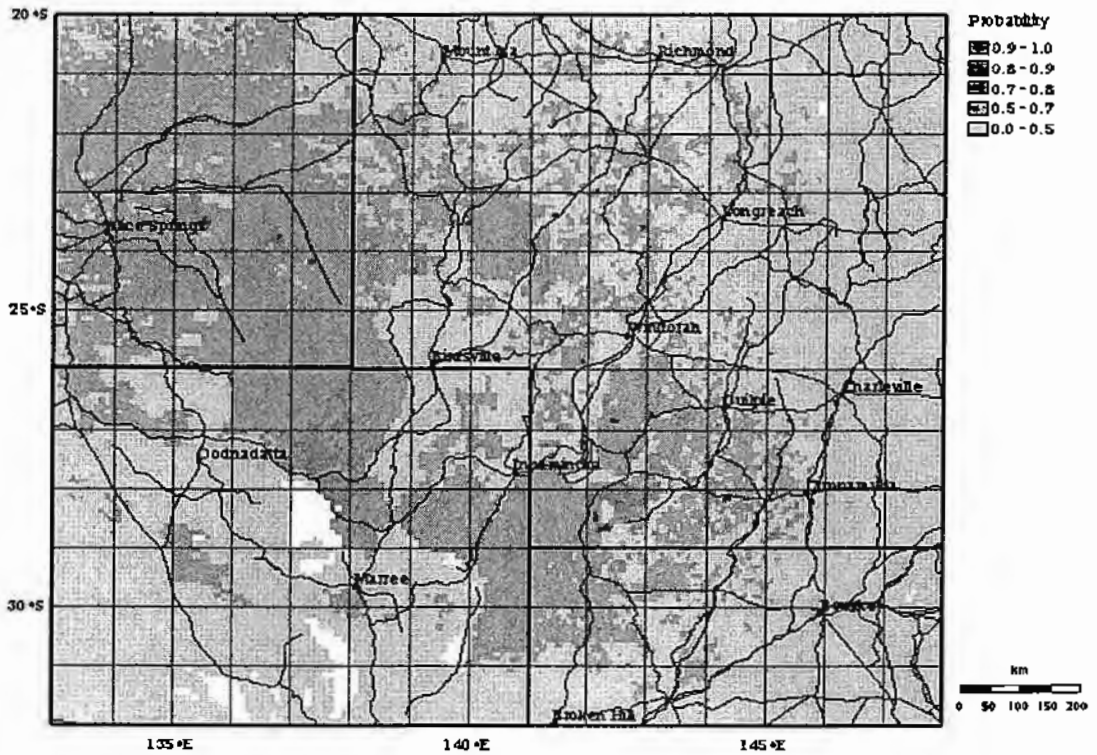

Fig. 2 Predicted *Helicoverpa* spp. distribution, winter 1999. Source: Wayne Rochester's web site, http://pest.cpitt.uq.edu.au/forecast/intro.html.

The 2000-2001 season

As shown in Fig. 3, the rainfall for April-June 2000 has been very much above average throughout southwestern Queensland, and at extremely high levels in the Simpson Desert and Birdsville area. There has also been well above average rainfall in northwestern NSW, around the Bourke-Hungerford area. We know from past experience that these conditions favour extensive Helicoverpa breeding during winter. The GIS model indicates this, with extensive areas showing a probability of finding Helicoverpa larvae of 0.8 or above. (Fig. 4). However, in view of the very low numbers of H. punctigera throughout 1999-2000, we were not sure whether sufficient numbers of moths would find these suitable breeding areas, to produce large numbers in the spring immigrant generation. The purpose of the surveys was to determine whether this was so.

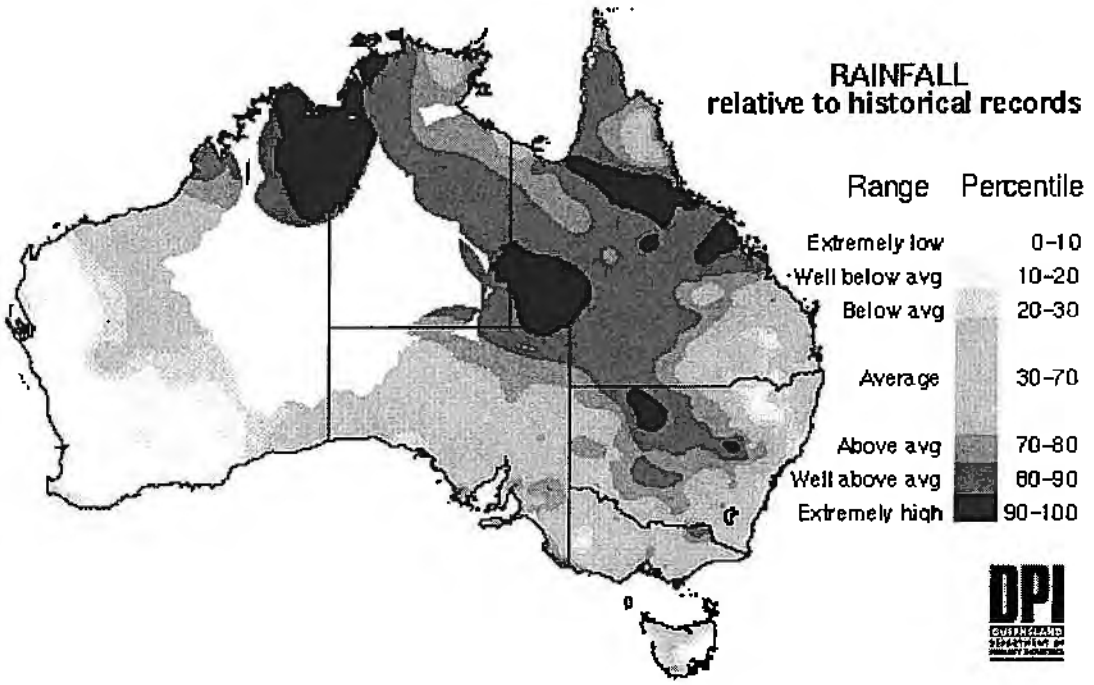

Fig. 3: Rainfall (three month deciles) for April-June 2000
Source: The Long Paddock, QDPI web site, http://www.dnr.qld.gov.au/longpdk/lprain.htm

Figure 4 shows the numbers of *Helicoverpa* larvae found per 100 sweeps at approximately 200 sites sampled during the three survey trips. The black line indicates the survey routes taken, and where there are distances of more than 40km with no survey sites, it indicates that no suitable Helicoverpa hosts were found.

The surveys showed that there were very few *Helicoverpa* larvae found in western Queensland, east of the Simpson Desert. Although the NDVI images had indicated that some of these areas were green, vegetation surveys showed that most of the greenness was due to native grasses, which are not *Helicoverpa* hosts. Summer and early autumn rain generally produces grasses rather than the daisies and other broadleaf plants which are good *Helicoverpa* hosts. Thus, the broad band of country running from about Mt. Isa southeast to Charleville, which was predicted to be suitable for *Helicoverpa* breeding, was found not to be so. The influence of rainfall timing in GIS model is being adjusted to correct this false positive in future.

The Simpson Desert and the region around the Plenty Highway, east of Alice Springs, and Central Australia southeast of Alice Springs, was predicted to be very suitable for *Helicoverpa* breeding. This was confirmed by surveys, which found an abundance of flowering hosts in these regions. Moderate to

very large numbers of larvae were found throughout this area. In some cases, the numbers of larvae found exceeded 200 per 100 sweeps, which is comparable to the numbers found in very severe infestations in crops such as sorghum and chickpeas. The source of the considerable numbers of moths which would have been required to generate populations of this magnitude is not known. However, it is likely that there was significant breeding of *H. punctigera* in western Australia in the 1999-2000 season.

The region around Bourke-Hungerford did not contain many larvae. Previous experience has shown that this area is usually too cold for true winter breeding, but can be colonised by moths from sources in the Channel country of southwest Queensland, or from Central Australia, in late winter and early spring. This might lead to a second generation of moths emerging in mid to late spring, which can affect cotton areas. However, vegetation surveys showed that, like the Mt. Isa-Charleville band, the greenness was mainly due to grass. Unless significant rain falls during August, it is unlikely that native hosts in the Bourke-Hungerford area will act as a staging ground for a mid spring generation.

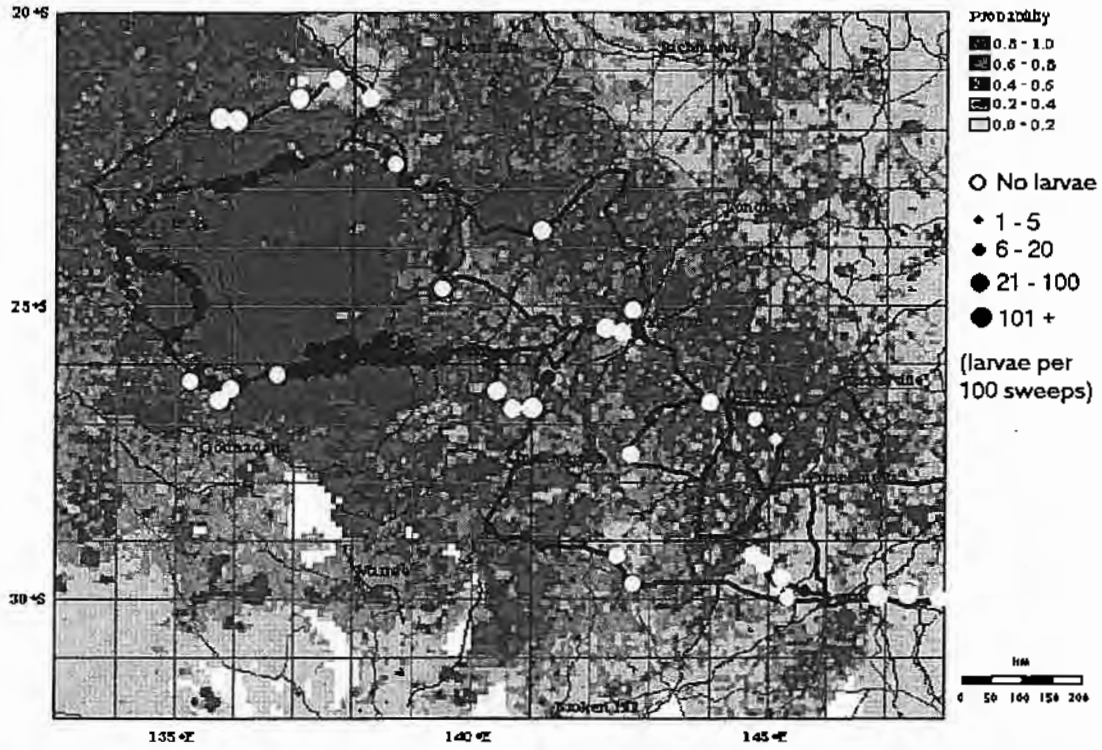

Fig. 4: Predicted *Helicoverpa* spp. distribution, winter 2000. Source: Wayne Rochester's web site, http://pest.cpitt.uq.edu.au/forecast/intro.html. Routes taken by the three survey parties during June and July are shown. Dark circles indicate the presence of *H. punctigera* larvae, white circles indicate negative samples.

Future developments

Most of the larvae found in the Simpson Desert and Central Australia will now be pupating. Running the development rate model on the Rochester web site indicates that the moths will emerge from late August through to mid September. At this time the annual native host plants will be drying off. The moths will therefore migrate. The direction and distance will depend on the prevailing wind systems at those times. Moths migrate preferentially on northerly or westerly winds because they are warmer than winds from other directions, and this favours flight activity. Winds from these directions are usually strong enough to enable moths to cover hundreds, even thousands, of km on one to three nights of flight. In 1991, we believe that moths reached cotton areas in northern New South Wales from the far

west of South Australia. We therefore believe they are quite capable of migrating from the Simpson Desert.

Indeed, we believe that some have already done so. Catches of *H. punctigera* in pheromone traps around Narrabri rose to up to 100 per trap during the last week in July. It is very unusual to get such large numbers in mid winter. They are higher than the numbers which were recorded throughout the last growing season. There have also been reports of *H. punctigera* in pheromone traps from Griffith, which is well south of the winter breeding limit for *H. punctigera*.

In order to determine whether these moths came from central Australia, we ran the migration model assuming three-night flights beginning on 22 and 23 July, from Poeppel Corner (where SA, Qld and NT meet, in the Simpson Desert). The predicted fallout patterns are shown in Fig 5. They show that migrants could have reached Narrabri and Griffith from this source, and this may well explain these winter pheromone traps. We are hoping to get confirmation from the microsatellite DNA work of Glenn Graham.

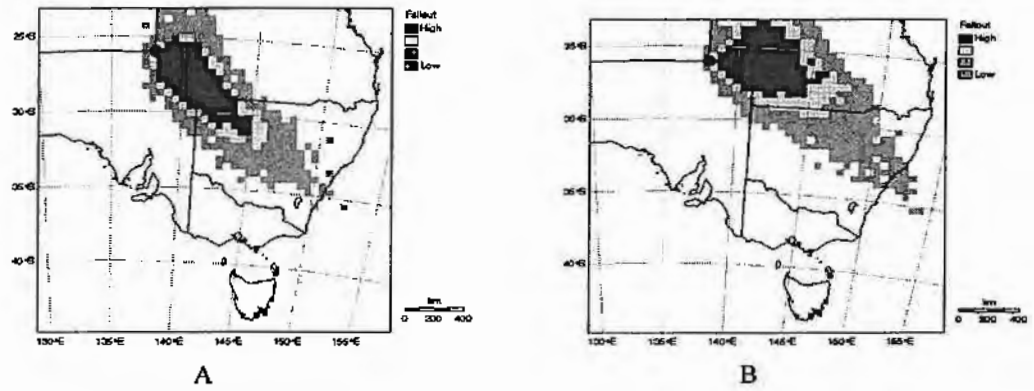

Fig. 5 Fallout patterns generated by the migration model, assuming three night migrations from Poeppel Corner beginning on 22 July (A) and 23 July (B)

However, it is likely that the main migrations will take place at the end of August or in early September. The further the source is from the cotton areas, the more chance there is of the bulk of the moths missing cotton areas. This year, the main source is a long way away. It is possible, for example, that the wind systems will take moths more to the south, where they will affect spring legume crops in the Riverina or western Victoria. However, it seems unlikely that all of the moths will miss the northern cotton areas. Even if they do, late spring or early summer migrations of the next generation, from the southwest, might bring them back to cotton areas.

The immigrant generation does not directly affect cotton. It is the first local generation, which is bred from the immigrants, which initiates problems in cotton around November. The breeding success of this generation will depend on the availability of hosts, both uncultivated and cultivated, during August-October. These hosts include grain legumes such as chickpeas and faba beans, native plants such as medics and daisies, and weeds such as sowthistle. At the time of writing it appears that there has been sufficient rain in northern NSW to guarantee at least moderate numbers of hosts. Additional rain in August-September would only enhance breeding. However, in the Darling Downs it has been drier and the first local generation may not be so large.

Forecast and recommendations

We believe this year will be above average for early season *H. punctigera*. How much above average will depend on the exact direction of migration from central Australia, and the availability of local host plants for the first spring generation in cotton areas. As an indication, the distribution maps for winter breeding show that this season ranks with 1983, 1989, 1990, 1993 and 1998 as the most favourable for inland *H. punctigera* populations in the last 20 years. We cannot predict whether it will be worse than

these seasons until we see the weather patterns for the next month, but it is highly unlikely to be anything like the light season we had last year.

We believe that the cotton industry should:

1. Monitor pheromone trap catches in cotton growing areas closely during August and September. This will give a further guide to how serious early season infestations on cotton will be.

2. Be prepared to control *H. punctigera* on both grain legumes and cotton, using soft options such as Bt, NPV or trap cropping to preserve beneficials, in the early to mid spring period. This is especially important if conditions remain dry and there are few uncultivated hosts, as it would help reduce the first local generation

3. Be aware that endosulfan usage might be higher this year than last year, and take steps to ensure that the risks associated with this are minimised.

Acknowledgements

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