Summary

The project DAN 33L involved studies of insecticide resistance in the major cotton pests *Helicoverpa armigera* and *Helicoverpa punctigera*. The aims of the project were : to investigate the mechanisms of pyrethroid insecticide resistance in *H.armigera*; to develop *Helicoverpa* bioassay techniques against ovicides, stomach poisons and first instar larvae; to monitor *H.armigera* resistance to endosulfan, carbamates and organophosphates and to monitor the response of *H.punctigera* to insecticides. The findings of these studies are summarised below.

In 1983, at the onset of pyrethroid resistance in Australian *H.armigera,* three resistance mechanisms were identified. They were : a strong nerve insensitivity (*Super - Kdr*) , penetration resistance (*Pen*), and a factor which was overcome by piperonyl butoxide (*Pbo*). Nerve insensitivity was the major cause of pyrethroid resistance and conferred high order resistance ~100 times. From 1987 to 1990, to monitor accurately the effectivness of the Australian *Helicoverpa* insecticide resistance management strategy, we conducted a survey of resistance mechanism frequencies in field collected resistant *H. armigera.* The relative importance of the *Pen* and *Pbo* mechanisms in resistant *H. armigera* have increased, as *Kdr* has decreased in gene frequency and potency. *Pen* and *Pbo* confer only low order resistance. The impact of the *Helicoverpa* insecticide resistance management strategy on pyrethroid resistance in *H.armigera* is discussed.

A method for the bioassay of contact insecticides against larval first instar *Helicoverpa* spp. is described. "Brown eggs" were sprayed with formulated larvicides, just prior to hatch. The neonate larvae received insecticide dosage from the exterior of the shell and sprayed surrounds. Trials pyrethroids and organophosphorous insecticdes, showed a close relationship between the concentration of active ingredients and mortality in first instar larvae. The method sucessfully distinguished between pyrethroid resistant and susceptible *H. armigera.* The results were compared with bioassay of third instar larvae by topical application. The importance and advantages to the Australian *Helicoverpa* insecticide resistance management strategy of resistance monitoring in first instar larvae are discussed.

H. armigera larvae were collected from NSW and Queensland from 1983 to 1990 and bioassayed with methomyl and thiodicarb. Methomyl was tested by topical application on 3rd instar larvae. New bioassay techniques for thiodicarb, a stomach poison and methomyl as an ovicide were developed and are described. Baseline susceptibility data for thiodicarb are presented, as is evidence of widespread resistance to methomyl in *H. armigera* larvae. Resistance to methomyl in a selected strain was estimated as approximately 23 fold, while in field strains, resistance did not exceed 11 fold. Resistance was not expressed by the egg stage. These data are discussed with reference to possible resistance mechanisms and the Australian *Helicoverpa* resistance management strategy.

Organophosphate were bioassayed against Australian *Helicoverpa armigera* collected from NSW and Queensland. Methyl parathion, sulprofos and profenofos were tested against 3rd instar larvae. Baseline susceptibility data for methyl parathion are presented, as well as evidence for

incipient organophosphorous resistance. These data are discussed with reference to the Australian *Helicoverpa* resistance management strategy.

*H. armigera*_ larvae were collected from New South Wales and Queensland from 1974 to 1990 and laboratory cultures were established. Endosulfan was topically applied to 3rd instar larvae of the F1 generation of these strains, and a susceptible reference strain. The highest levels of endosulfan resistance (>50-fold) were recorded in 1974. Resistance was barely detectable from 1977 to 1983 but since then resistance has become widespread. However, resistance levels have remained generally low with only 2 of the 106 strains tested showing levels of resistance above 10-fold. The highest level of resistance recorded after 1975 was 23 fold and laboratory selection with endosulfan increased resistance in this strain to 163-fold. These data are discussed in terms of cyclodiene use on cotton and the resistance management strategy *H. armigera* which was implemented in NSW and Queensland during 1983.

Helicoverpa punctigera were collected from field locations in Australia, principally from New South Wales and Queensland, between 1974 and 1989. *H.punctigera* were bioassayed with deltamethrin, fenvalerate, DDT, endosulfan, carbaryl, methomyl and methyl parathion. Bioassay was by topical application on third instar larvae. Baseline susceptibility data are presented for DDT, endosulfan, carbaryl, methomyl and methyl parathion. There was evidence of heterogeneity of response to pyrethroids, in particular to deltamethrin. These data are discussed with reference to the ecology of *Helicoverpa* spp and the Australian *Helicoverpa* resistance management strategy.