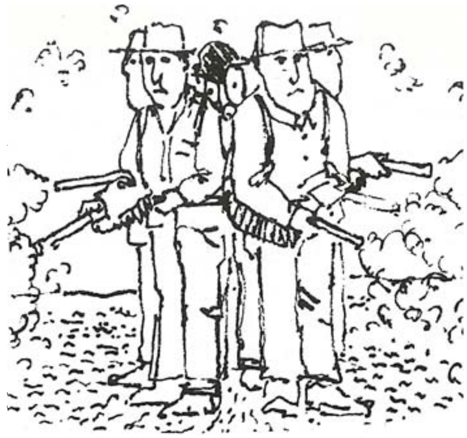
***Heliothis* caterpillar beside its hole in a developing cotton boll.**



The spraying's to stop boll damage like this.

well. This area is about as far south as the crop can grow; further south the growing season becomes too short. As it happens the climate is getting a bit cool for the cotton bollworm too. The pest has to survive the winter as dormant pupae in the soil beneath the dead plant trash remaining from the previous season. Mr Wilson has found that the adults do not emerge until the soil temperature rises above 18°C.

In years with a cool spring (1974 for example) this may not happen until early December, so the population cannot start to build up till then.

The fact that the pupae remain dormant in the ground for 5–6 months makes them vulnerable to attack. Cultivating the cotton residues into the soil in autumn should kill the great majority of the pupae—thus greatly slowing down the speed of build-up of large and damaging populations the following season.

In the short term it should be possible to hold the cotton bollworm at bay by doing this. Small amounts of insecticide may have to be applied too. And deft management, particularly of irrigation and nitrogen fertilizer, can make sure that the cotton crop sets as soon as possible, hopefully before the bollworm population gets too large.

This approach should give the grower a breathing space, and research workers time to find other ways of keeping bollworm populations down. Finding a cotton variety that matured earlier would obviously help.

Early in 1974, Mr Wilson joined other research workers at the CSIRO Cotton Research Unit at the New South Wales Agricultural Research Station near Narrabri. In cooperation with officers of the State Department of Agriculture, these researchers are now trying to develop an effective system of integrated pest control for the crop.

One approach has been straight biological control with an American wasp called *Trichogramma*, which preys on all *Heliothis* species. The wasp hasn't been tried in the Namoi Valley, but releases on the Ord and at St. George in Queensland failed. The wasp could not keep bollworm and budworm numbers low enough —even two larvae per metre in a cotton row can cause serious economic damage.

Another idea was to bring in a commercial virus spray already available in America, but this proved to be too unstable and expensive—it had to be flown from the United States in dry ice. Nevertheless, Mr Bob Teakle of the Queensland Department of Primary Industries is looking at the use of local virus diseases.

Strangely enough the most hopeful agent has been around for some time. This is a bacterium—*Bacillus thuringiensis* —which by itself could not do the job. However, a research worker in America tried mixing it with the chemical chlorphenamidine and found that, astonishingly, the two had a synergistic effect— that is, the two together proved much more effective than either separately. Effective control of *Heliothis* has been claimed following applications of the mixture at as low a rate as 280 grams per hectare. (Compare that with 125 kg of DDT on the Ord.)

When DDT resistance appeared in *Heliothis*

Peru	1952
Louisiana, U.S.A.	1956
Arkansas, U.S.A.	1961
Lower Rio Grande, U.S.A.	1963
Mexico	early 1960s
Nicaragua	1965–66
Ord River, Australia	1970–71
Namoi Valley, Australia	1972–73

Mr Wilson and his colleagues are following this up, since it should mean that control is possible using very little insecticide indeed, so resistance should take a very long time to appear.

Further north, especially on the Ord, prospects for bollworm and budworm control don't look so good. In a tropical climate the bollworms can breed all the year round, so they don't have a vulnerable phase in the ground. It may be possible to reduce the numbers of bollworms by introducing a crop-free period, and then cultivating in the crop residues and ruthlessly keeping down any weeds on which the cotton bollworm can feed. Growing sorghum and maize nearby would also have to be forbidden, since these act as reservoirs. Even so, the native budworm and the host of other potential pests that live naturally in the bush nearby would still be there.

More about the topic

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