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An armyworm attacking barley.
Armyworm — a damaging pest of coarse grains on the south coast

By W. Woods, P.J. Lawrence and P. Booth*

The armyworm is a damaging pest, particularly of barley on the south coast, but recent studies are leading to more efficient control.

Armyworms are regular and damaging pests of coarse grain crops in the Esperance, Jerramungup and Albany regions of Western Australia.

Towards the end of spring, when crops are approaching maturity, armyworm larvae chew through the stem of barley just below the head. The head then falls to the ground, and although it is not eaten by the armyworms, it cannot be harvested.

Armyworm damage can occur quickly and with devastating results. A trial at Esperance, in spring 1979, illustrated clearly what can happen.

The number of armyworms and lopped heads in a Clipper barley crop were monitored from the beginning of November. On November 1, only a few larvae were found. A fortnight later around 80 larvae per square metre were present although no heads were lopped at this stage. Counts on November 20 in the heavily infested plot showed that 263 heads per square metre had been lopped in just seven days.

By November 27 in this same plot, 80 per cent of heads had been lopped, and 7 per cent were hanging ready to fall as the crop matured. Only 13 per cent of the heads were standing to harvest.

This experiment also demonstrated the patchy nature of any armyworm infestation. A similar plot had only a little more than a quarter of heads lopped. This plot had fewer heads per square metre (352) than the badly damaged plot (672 heads per square metre). It has often been observed that heavy areas of crop, such as headlands, have the heaviest infestations of armyworms.

Species

Four species of armyworms can attack barley and oat crops in agricultural areas of Western Australia. Wheat crops, although sometimes planted next to badly damaged barley, are seldom attacked.

The four species of armyworms, all of which are native to Western Australia are:

- *Pseudalaeta convecta* - common armyworm
- *Persectania elwaygii* - southern armyworm
- *Persectania dyscrita* - inland armyworm
- *Mythimna loreyimima* - sugar cane armyworm

The sugar cane armyworm is not considered a serious pest. It has only been recorded attacking barley in December 1978 at Esperance. The two species of *Persectania* can be abundant at times, with *Persectania dyscrita*, the main species collected from inland areas.

However by far the most abundant species over the last three years has been the common armyworm. It has been collected throughout the year in the Esperance and Jerramungup areas.

These areas receive good summer rains (around 150 mm from November to April) which germinate self-sown barley and stimulate grasses such as veldt grass. Armyworms survive over summer in low numbers on this green material, remain in low numbers through winter and increase rapidly to high populations in spring.

On the south coast, armyworm attack normally occurs in November. By the middle of December most barley has matured and is too dry to be attacked.

Climate therefore has considerable influence on armyworm numbers. They are not a major problem in inland areas probably because these areas do not have the summer rain and consequent green growth to ensure survival of larvae.

At Jerramungup in spring 1978 a temperature of 40°C combined with low humidity caused the death of almost all armyworms in a paddock of maturing barley being used for an insecticide trial. Farmer comments also suggested that after this hot spell armyworm numbers diminished rapidly throughout the area and little spraying was required.

Life cycle

When armyworm are reared in the laboratory, they prefer to lay eggs sandwiched between strips of tightly folded paper. Therefore in the field eggs are probably laid between the leaf sheath and the stem. Eggs are laid in clumps held together by glue manufactured by the moths.

When the larvae hatch from the eggs, they are very small and grow through a number of moults to reach full size of 3 to 4 cm. Larvae vary in colour depending on the situation. If there are many larvae in an area then they become dark in colour; some larvae are almost black. If the larval population is low then the larvae are light in colour.

Despite this range of colours, armyworms are easily distinguished from cutworm or budworm by the three prominent stripes of the “collar” behind the head. The head itself is larger in comparison to the body than these other larvae.

When the larvae have reached full size they crawl into the ground, form a pupal cell, and pupate. Pupae are reddish brown in colour about 2 cm long. Many changes occur within the pupae and a moth develops. This moth emerges by breaking open its pupal skin and forces its way to the surface.

Moths only feed on nectar and do not damage the crop. The moths generally fly at night and are attracted to lights. Armyworm moths are thick bodied, greyish brown with a wingspan of about 4 cm. They are strong fliers, and migrations of hundreds of kilometres have been recorded.

Control by spraying

Insecticide sprays give good control of armyworm, although they are expensive, and the wrong chemical may leave undesirable residues on the grain.

Farmers often fear that if they spray against armyworms when the crop is still quite green, they will need to spray again to avoid another infestation.

However research on armyworm life cycles has indicated the safety margins involved. Armyworms have been reared at different temperatures in the laboratory and average results are shown in the Figure.

At the warmer temperature, the larvae develop faster. Average
Effect of temperature on the development of armyworm.

Temperatures for the Esperance and Albany regions indicate that in spring armyworm would probably develop at a slightly slower rate than that indicated by the constant temperature of 25°C.

It appears that most heads are lopped by large armyworm. Therefore it will be at least two weeks and probably three weeks after spraying before head lopping can occur, assuming immediate egg lay. However, immediate egg laying is unlikely, so there is probably a safety margin of three or four weeks before serious damage would occur.

Aerial application of the spray is preferable, as ground application causes crop damage. This means that contractors have to be employed and this requires as much advance notice of a potential problem as possible. Frequent inspection of the crop is therefore essential.

Biological control

Several native insects help to control armyworm populations and one species has been imported. Any control programme should recognise the value of these predators and parasites, and indiscriminate spraying with insecticides should be avoided.

The green carabid *Calosoma* sp. is a predator of armyworm. It is a large green beetle (3 cm long) which ferociously devours any armyworms it catches. It is often observed moving quickly along the ground in barley crops, and if caught, it gives off a pungent smell.

The encyrtid wasp *Litomastix* sp. is a small native wasp which has often been found parasitising armyworm larvae collected from southern areas. In a sample of larvae collected in November 1978 at Esperance, 50 per cent were parasitised. In larvae samples from Jerramungup in 1977, the percentages of armyworm affected by the encyrtid wasp was 60 per cent in September and in October.

This wasp has an interesting life history. The adult wasp lays its eggs in the eggs of armyworms. In the laboratory eggs of common, sugar cane and inland armyworms have been exposed to these parasites and all have been attacked.

As the armyworm grows, the encyrtid egg inside it divides many times forming hundreds of encyrtid larvae. These larvae live and grow within the armyworm until it reaches full size when they pupate and the host dies. The dead armyworm remains in a characteristic mumified shape with the wasp pupae visible under the skin. Finally the small black wasps emerge. On average 1000 wasps develop in each host larva, and at 25°C it takes about two months from egg laying until the adult wasp emerges.

The tachinid fly *Palexorista* sp. parasites inland armyworms in northern areas, although armyworms are an infrequent pest in these regions. Two samples have yielded high levels of parasitism. A sample collected in September 1977 at Watheroo contained 73 per cent parasitised armyworm. In September 1979 at Lancelin, 81 per cent of armyworm were parasitised.

Parasitic or predatory insects are sometimes successful overseas at controlling an insect pest such as armyworm. However before such an insect can be introduced into Western Australia, the Department of Agriculture has to satisfy itself that the insect will not become a pest itself. Usually this is not a problem;
Armyworm parasitised by the native encyrid wasp. The distortion is characteristic.

Larvae of the apanteles wasp emerged from an armyworm. Some have begun to spin cocoons.

in fact it is often difficult to ensure the predator or parasite will survive.
To attempt to improve control of armyworm, a parasitic wasp was introduced from New Zealand (DSIR, Auckland) in January 1979. Known as the apanteles ("a-pant-e-l-e-es") wasp, Apanteles ruficrus, it originated in central Asia, and has caused no problems when introduced to New Zealand.

In New Zealand, apanteles wasp has given outstanding control of the armyworm species Pseudaela separata. This armyworm does not occur in southern Western Australia, although it is a major pest of rice and maize at Kununurra.

Apanteles wasps have been reared in Department of Agriculture laboratories since January 1979 and large numbers have been released at Esperance, Jerramungup, Albany and Kununurra.

In the laboratory, larvae of all armyworm species have been parasitised by the wasp. Larvae of Agrotis ypsilon and Agrotis porphyricollis, both cutworms, have also been attacked. The common armyworm is readily attacked and 100 per cent parasitism has regularly been recorded.

The apanteles wasp stings a host larva, inserting its eggs into the body cavity. These eggs hatch and develop into wasp larvae. The apanteles larvae live inside the host eating the body contents but not killing it. The armyworm larva still grows until it is finally killed when the wasp larvae chew their way out of the host and spin a cluster of small white cocoons. On average, 40 wasps issue from each larva and at 25°C it takes about two weeks from stinging until emergence and pupation of wasp larvae. The adult wasps are very small (about 2 mm long), black, and will live one to two weeks if fed on honey.

Apanteles wasps have emerged from two armyworms collected at Esperance in November 1979. However at this stage it would be unwise to claim this is a definite recovery until positive identification is made. Because the wasp is tiny, it is very difficult to identify positively.

Also the success of the release will depend on how the wasps survive the hot summer period. It would be impossible to release enough apanteles wasps every year to control armyworm populations.