

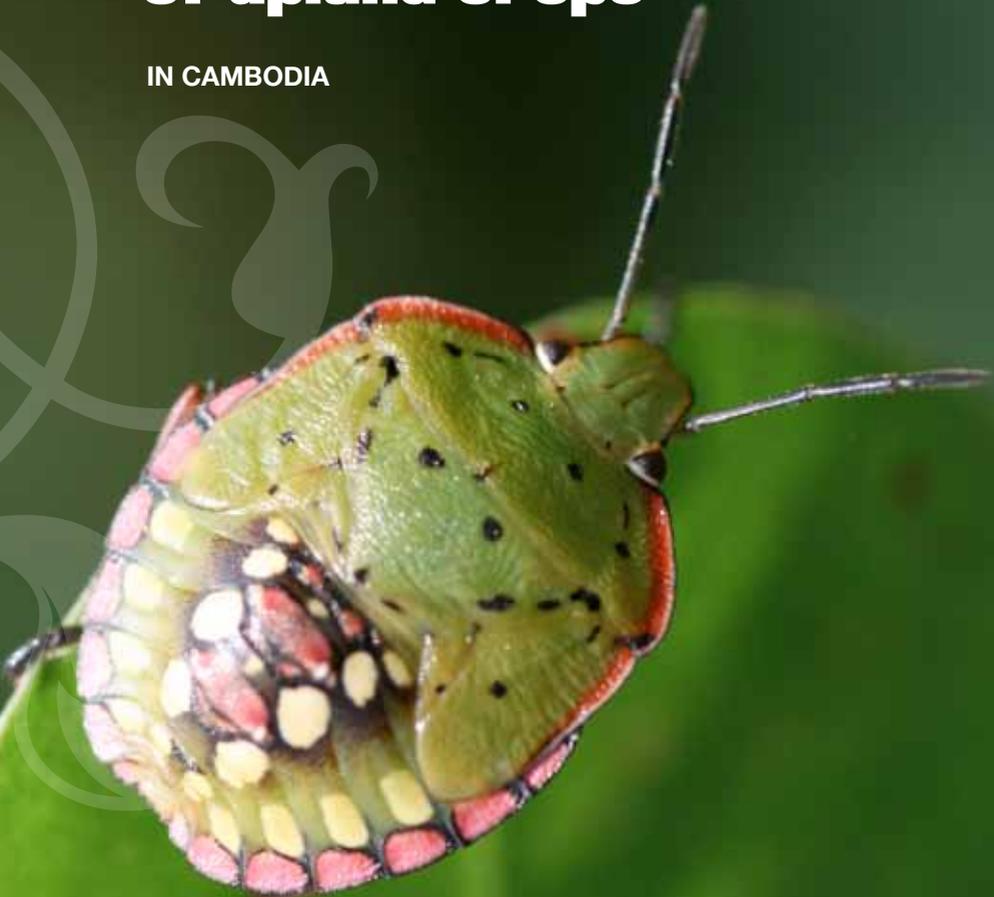


Australian Government

Australian Centre for  
International Agricultural Research

# Insects of upland crops

IN CAMBODIA



The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. ACIAR operates as part of Australia's international development cooperation program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. It commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

Where trade names are used this constitutes neither endorsement of nor discrimination against any product by the Centre.

#### ACIAR MONOGRAPH SERIES

This series contains the results of original research supported by ACIAR, or material deemed relevant to ACIAR's research and development objectives. The series is distributed internationally, with an emphasis on developing countries.

#### © Commonwealth of Australia 2010

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and inquiries concerning reproduction and rights should be addressed to the Commonwealth Copyright Administration, Attorney-General's Department, Robert Garran Offices, National Circuit, Barton ACT 2600 or posted at [www.ag.gov.au/cca](http://www.ag.gov.au/cca).

#### Published by the Australian Centre for International Agricultural Research (ACIAR)

GPO Box 1571, Canberra ACT 2601, Australia  
Telephone: 61 2 6217 0500  
[aciarc@aciarc.gov.au](mailto:aciarc@aciarc.gov.au)

Pol C., Belfield S. and Martin R. 2010. Insects of upland crops in Cambodia. ACIAR Monograph No. 143. Australian Centre for International Agricultural Research: Canberra. 132 pp.

ACIAR Monograph No. 143  
ISBN 978 1 921615 88 7 (online)

Technical editing by Biotext, Canberra  
Design by WhiteFox.com.au

Photographs by Kelly Baker, Stephanie Belfield, Rowena Eastick, Gordon Garrad, Robin Gunning, Wes Leedham, Robert Martin, Adrian Nicholas, Chanthy Pol, Fiona Scott and Tanya Smith  
Illustrations on pages 11, 13 and 14 by Robert Martin  
Insect size guides drawn by Robert Martin

Cover: Nymph of *Nezara viridula* (green vegetable bug).  
Photo by Robert Martin.

# Insects of upland crops

## IN CAMBODIA

A field guide to identifying insect pests and beneficial insects and spiders in the upland cropping systems of Cambodia

**POL CHANTHY, STEPHANIE BELFIELD  
AND ROBERT MARTIN**



**ACIAR**

[www.aciarc.gov.au](http://www.aciarc.gov.au)

2010

# Foreword

This field guide to insects was developed for farmers and extension workers in the upland cropping systems of Cambodia. It was sponsored by the Australian Centre for International Agricultural Research (ACIAR) and the Cambodian Agricultural Research and Development Institute (CARDI).

The Royal Cambodian Government's National Poverty Reduction Strategy (2003–2005) committed research centres and extension systems to focus on small-scale farmers, and place emphasis on the use of improved tools and management practices for cropping systems. Priority was given to diversification and intensification of sustainable agricultural production with few external inputs, as well as to cost-effective management practices.

ACIAR took on these challenges in 2003 with a project to develop sustainable farming systems for diversification crops (ASEM/2000/109). The focus was on maize, soybean, sesame, mung bean, peanut and cowpea in upland areas of Battambang and Kampong Cham provinces.

The aim of the project was to help reduce poverty and contribute to food security at household and national levels in Cambodia through the development of technologies and opportunities for the production of non-rice upland crops. The research process involved discussion with farmers, validation of local knowledge, documentation of case studies and identification of priorities for field experimentation.

Between 2004 and 2006 the project team held 153 on-farm experiments and demonstrations. This research provided the basis for a demonstration package of new technologies and improved practices for upland crop production. The packages included improved varieties, fertiliser recommendations, *Rhizobium* inoculation, reduced tillage and crop-residue retention. Provincial Department of Agriculture staff and non-government organisations in Battambang and Kampong Cham were trained in the implementation of on-farm demonstrations of the new technologies and improved practices in 2007.

A new ACIAR project to develop sustainable production and marketing systems for maize and soybean in north-western Cambodia (ASEM/2006/130) began in 2008. The emphasis of the project is on-farm adaptive trials to evaluate and improve the technologies and practices initially tested in 2007. The new project has also been expanded to integrate the production and marketing components of the system.

The Australian partners in this project are the University of New England, Industry and Investment NSW, the University of Canberra, the University of Melbourne, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The Cambodian partners are CARDI, the Maddox Jolie-Pitt Foundation, CARE Cambodia and the Cambodian Ministry of Commerce.

This book is part of a series of publications produced by ACIAR in support of the rollout of on-farm demonstrations for upland crops in Cambodia.



**Dr Nick Austin**  
Chief Executive Officer  
ACIAR

## Contents

FOREWORD	3
INTRODUCTION	9
ABOUT INSECTS	11
ABOUT SPIDERS	15
HOW TO USE THE GUIDE	16
PART 1 PEST INSECTS	17
PART 2 BENEFICIAL INSECTS AND SPIDERS	97
GLOSSARY	127
FURTHER READING	131

<b>PART 1 PEST INSECTS</b>	<b>17</b>
<b>Coleoptera</b>	<b>18</b>
Chrysomelidae	18
<i>Aulacophora similis</i> (pumpkin beetle)	18
<i>Monolepta signata</i> (monolepta beetle)	20
Coccinellidae	22
<i>Henosepilachna vigintiseypunctata</i> (twenty-eight spotted ladybird)	22
Curculionidae	24
<i>Hypomeces squamosus</i> (gold-dust weevil)	24
<b>Diptera</b>	<b>26</b>
Agromyzidae	26
<i>Ophiomyia phaseoli</i> (bean fly)	26
<b>Hemiptera</b>	<b>28</b>
Aleyrodidae	28
<i>Bemisia tabaci</i> (tobacco whitefly)	28
Alydidae	30
<i>Riptortus linearis</i> (brown bean bug)	30
Aphididae	32
<i>Aphis craccivora</i> (cowpea aphid)	32
<i>Aphis glycines</i> (soybean aphid)	34
<i>Rhopalosiphum maidis</i> (corn aphid)	36
Cicadellidae	38
<i>Bothrogonia ferruginea</i> (red leafhopper)	38
Coreidae	40
<i>Anoplocnemis phasiana</i> (legume pod bug)	40
<i>Cletus bipunctatus</i> (spined legume bug)	42
Pentatomidae	44
<i>Nezara viridula</i> (green vegetable bug)	44
<i>Piezodorus hybneri</i> (red-banded shield bug)	46
<i>Plautia affinis</i> (brown-winged stink bug)	48
Plataspidae	50
<i>Brachyplatys subaeneus</i> (black bean bug)	50
Pseudococcidae	52
Mealybugs	52
Pyrrhocoridae	54
<i>Dysdercus cingulatus</i> (cotton stainer)	54

<b>Isoptera</b>	<b>56</b>
Termitidae	56
<i>Macrotermes, Microtermes</i> and <i>Hypotermes</i> spp. (subterranean termites)	56
<b>Lepidoptera</b>	<b>58</b>
Gelechiidae	58
<i>Aproaerema modicella</i> (peanut leaf miner)	58
<i>Stomopteryx subsecivella</i> (soybean leaf miner)	60
Lymantriidae	62
<i>Euproctis</i> sp. (tussock moth)	62
Noctuidae	64
<i>Achaea janata</i> (castor oil looper)	64
<i>Anomis</i> sp. (semilooper)	66
<i>Helicoverpa armigera</i> (bean podborer)	68
<i>Spodoptera litura</i> (cluster caterpillar)	70
Pyralidae	72
<i>Antigastra catalaunalis</i> (sesame webworm or sesame leaf roller)	72
<i>Conogethes punctiferalis</i> (yellow peach moth)	74
<i>Diaphania indica</i> (cucumber or melon moth)	76
<i>Etiella zinckenella</i> (lima bean podborer)	78
<i>Maruca vitrata</i> (bean podborer)	80
<i>Omiodes indicata</i> (legume web spinner or soybean leaf folder)	82
<i>Ostrinia furnacalis</i> (Asian maize borer)	84
<i>Spoladea recurvalis</i> (beet webworm)	86
Sphingidae	88
<i>Acherontia styx</i> (eastern death's-head hawk moth)	88
<i>Agrius convolvuli</i> (convolvulus hawk moth)	90
<b>Orthoptera</b>	<b>92</b>
Acrididae	92
<i>Locusta migratoria</i> (migratory locust)	92
<b>Thysanoptera</b>	<b>94</b>
Thripidae	94
<i>Thrips tabaci</i> (tobacco thrip)	94

<b>PART 2 BENEFICIAL INSECTS AND SPIDERS</b>	<b>97</b>
<b>Arachnida</b>	<b>98</b>
Oxyopidae	98
Lynx spiders	98
Salticidae	98
Jumping spiders	98
<b>Coleoptera</b>	<b>100</b>
Coccinellidae	100
<i>Cheilomenes sexmaculata</i> (six-spotted ladybird)	100
<i>Coccinella transversalis</i> (transverse ladybird)	102
<b>Dermaptera</b>	<b>104</b>
Earwigs	104
<b>Diptera</b>	<b>106</b>
Syrphidae	106
Hoverflies	106
Tachinidae	108
Tachinid flies	108
<i>Trichopoda</i> spp. (feather-legged flies)	110
<b>Hemiptera</b>	<b>112</b>
Pentatomidae	112
<i>Oechalia schellenbergii</i> (spined predatory shield bug)	112
Reduviidae	114
Assassin bugs	114
<b>Hymenoptera</b>	<b>116</b>
Parasitic wasps	116
Predatory wasps	116
Formicidae	118
Predatory ants	118
Scelionidae	120
<i>Trissolcus basalus</i> (pentatomid egg parasitoid)	120
<b>Mantodea</b>	<b>122</b>
Mantidae	122
Praying mantises	122
<b>Neuroptera</b>	<b>124</b>
Lacewings	124

# Introduction

Crops are subject to attack from a wide range of insect species in the wet tropical environment of Cambodia, resulting in extensive damage and economic losses.

This illustrated field guide will assist with the identification of the major insect pests of the main upland crops in Cambodia—cowpea, maize, mung bean, peanut, sesame and soybean. However, not all insects found in the crops are pests; some insects and spiders play a significant role in keeping the insect pests under control.

The guide provides a brief description of insect pests and the damage they cause, as well as information on a range of beneficial insects and spiders that can be found in upland crops in Cambodia. The impact of beneficial insects can be increased by integrated pest management and careful use of pesticides.



Mr Pol Chanthy (CARDI) demonstrates the use of the sweep net at a workshop on integrated pest management in Kampong Cham.

# About insects

Insects are small animals without backbones. They have an external skeleton, which is mainly hard but with membranous areas at the joints. The body is segmented and has three pairs of jointed legs (six legs in total) and one or two pairs of wings (Figure 1).

The body is divided into three segments: head, thorax and abdomen.

The head is the feeding and sensory centre; it bears the antennae, eyes and mouthparts. The antennae are highly sensitive to odours and touch. The feet and ovipositors are also important sensory detectors for odours and touch. The eyes are either compound eyes (as in in adult flies and moths) or simple eyes called ocelli or stemma (as in caterpillars). Compound eyes are made up of a large number of individual lenses (for example, there are about 4,000 lenses to each compound eye in the housefly). The mouthparts include a labrum, or upper lip; a pair of main jaws, or mandibles; a pair of secondary jaws, or maxillae; and a labium, or lower lip. These mouthparts are modified in the various insect groups, depending

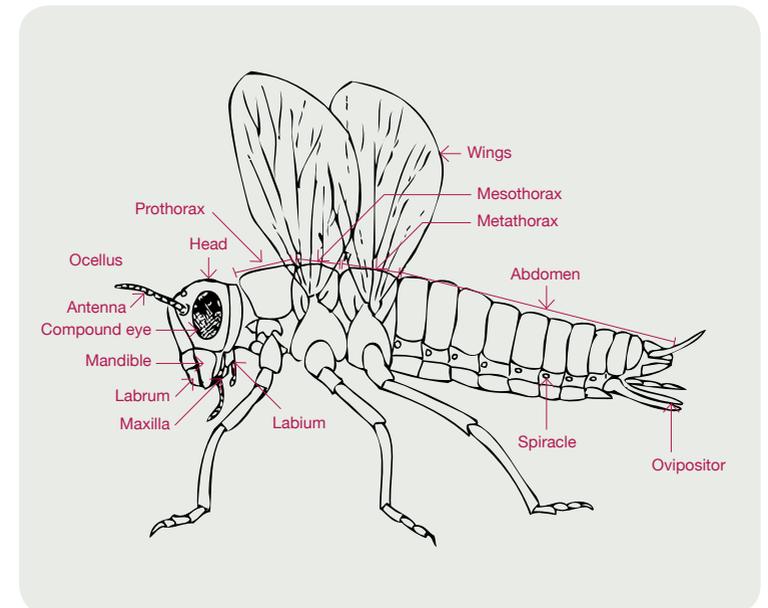


FIGURE 1 Insect parts

on their diet. Mouthparts are one of the major ways to distinguish between insect orders—all beetles have chewing mouthparts whereas bugs have a piercing, sucking tube.

The thorax, or middle segment of the body, is the movement centre, and is made up of three segments: the prothorax, mesothorax and metathorax. Each segment bears a pair of legs and, in flying insects, the second and third of these segments also each bear a pair of wings. The wings have an upper and a lower membrane, and between these two layers they are strengthened by a framework of chitinous tubes known as veins. One pair of wings may be modified, and in beetles form a hard outer case.

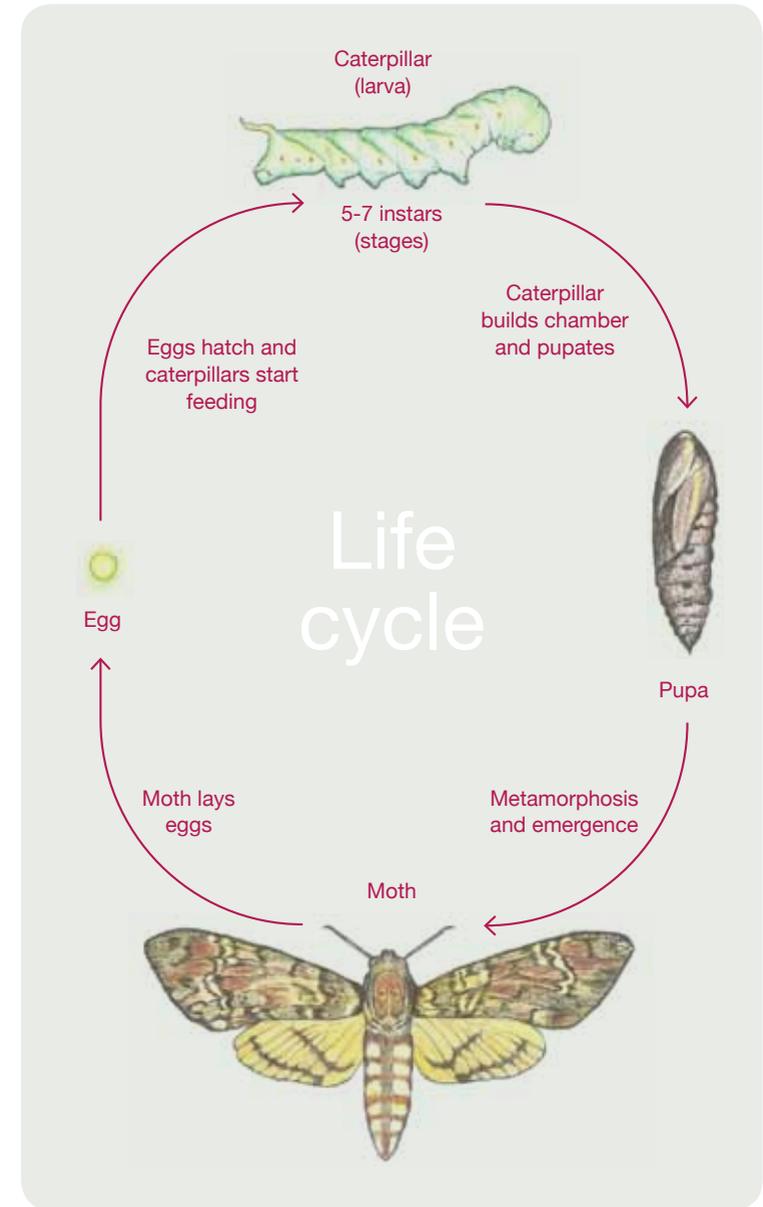
The abdomen, or end segment of the body, is the metabolic and reproductive centre, where food is digested and excreted, and where the reproductive organs are located. In the female there is very commonly an egg-laying instrument, or ovipositor, and many insects have a pair of tail feelers.

Most insects breathe by means of fine air tubes called tracheae that open to the exterior by a pair of breathing pores (or spiracles) on the abdomen.

Reproduction is variable, but most insects hatch from eggs. Mating usually occurs once only, and death soon follows. Reproduction usually requires a male and female to mate, but there are many variations on this theme; for example, some aphids can reproduce without males.

Insect orders such as Coleoptera (beetles), Diptera (flies) and Lepidoptera (moths) go through morphologically different stages in their life cycle (Figure 2). Immature insects (larvae) hatch from eggs, usually in the form of a caterpillar, grub or maggot, and pass through major physical changes (metamorphosis) before the adult stage. Each stage is called an instar. An insect about to metamorphose usually goes through a resting stage called the pupa. When the changes are complete, the adult insect emerges.

Other insects such as Blattodea (cockroaches), Hemiptera (bugs), and crickets and grasshoppers (Orthoptera) go through nymphal stages (instars), which look like tiny versions of the adults (Figure 3). Usually the main difference is that the adult has fully functional wings, although some do not have wings at all.



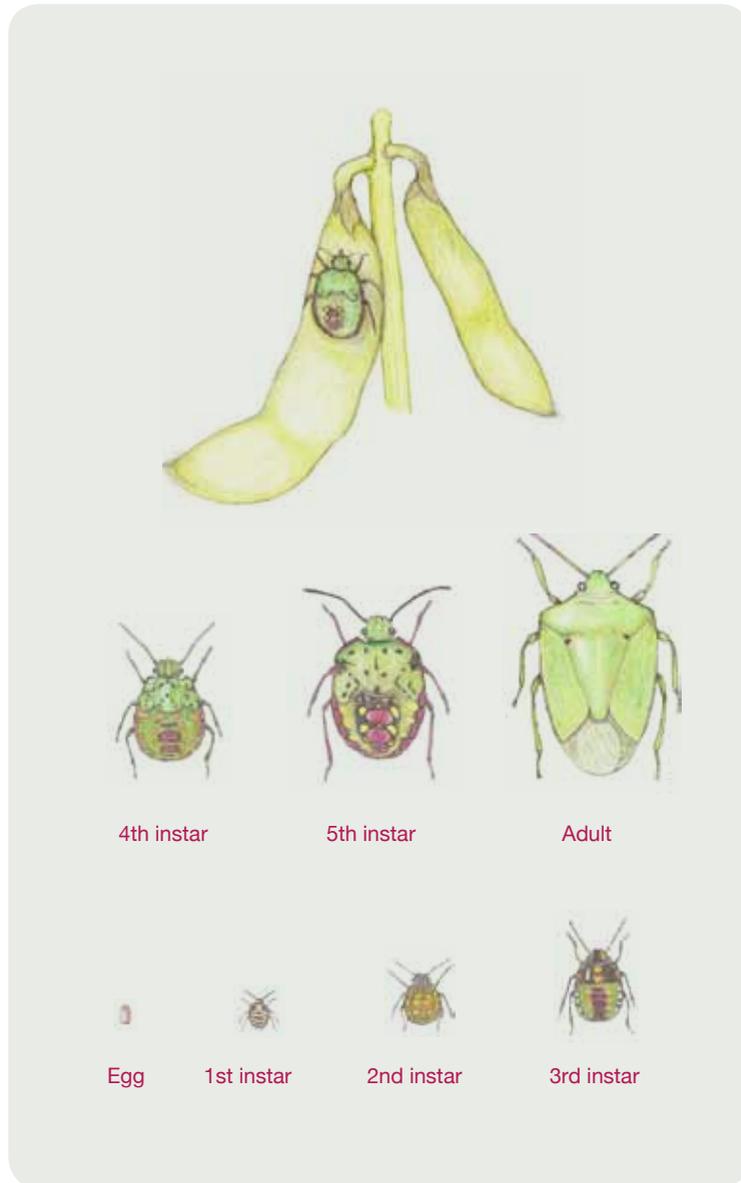
**FIGURE 2** Life cycle of *Acherontia styx*, an insect with morphologically different stages

## About spiders

Spiders differ from insects in having eight rather than six legs. Unlike insects, spiders do not have antennae and their mouthparts are modified into fangs that inject venom. Spiders also have only two body segments. The head and thorax are combined to form the cephalothorax, which is joined to the abdomen by a cylindrical pedicel.

The spider's abdomen has appendages modified into spinnerets that extrude silk from up to six types of silk glands within their abdomen. Spider webs vary widely in size, shape and the amount of sticky thread used.

All spiders are predators, and most feed on insects caught in a web. Others, such as jumping spiders and wolf spiders, are active hunters, relying on excellent vision to stalk and kill their prey. Jumping spiders are most likely to be found in upland field crops.



**FIGURE 3** Life cycle of *Nezara viridula*, an insect with stages that look similar to the adult

# How to use the guide

The guide is in two parts. Part 1 describes pest insects and Part 2 describes beneficial insects and spiders. In each part the insects are presented alphabetically according to order, family, genus and species.

An order such as Coleoptera (beetles) is a group of insects that have many main features in common. The order is split into a number of families, for example Chrysomelidae (small beetles) and Coccinellidae (ladybirds), with the insects in these family groups having further common characteristics.

Each genus comprises one or more species, each with its own unique name (for example, *Aulacophora similis*, *Aulacophora flavomarginata*).

Where known, the scientific name of each insect is given, followed by its most widely used English common name. A diagram of the actual size of each insect, inset in a 2-cm box, is included alongside the name.

For the pest insects, a brief description is followed by notes on the damage the insect causes, the crops it attacks, at which stage of the plant's development to look for the insect and any similarities to other species found in the region.

For the beneficial insects and spiders, a brief description is followed by the pest insects they attack and the impact they have on the pest insect.

All descriptions are illustrated with photographs. Photographs depict the adult unless otherwise stated.

# Part 1 Pest insects

Many different species of insect might be present in a crop but not all of them are pests.

Insect pests have natural enemies such as other insects and spiders, and it is therefore very important to correctly identify insect species before attempting any control measures in a crop. Identification will enable the pest status of the insect to be established and the type of damage it might cause to the crop to be assessed. It is important to know the extent of damage likely to be caused by the insect and whether or not it would be profitable to attempt control.

An insect is considered to be a pest of economic importance if the damage caused leads to a loss in yield or quality of the crop, resulting in a loss of profit by the farmer. Most species reach economic pest status when there is a 5–10% loss in yield. However, a 10% loss of plants or leaf area in a crop does not necessarily mean a 10% loss in yield.

Some crop species can compensate for loss of plants or leaf area if the loss occurs in the early stages of growth. For example, soybeans can tolerate a loss of up to 35% of leaf area in the vegetative stage until the start of flowering. However, after flowering and during pod fill, the threshold for economic damage is considered to be a 15% loss of leaf area.

Pest and damage thresholds are a core component of integrated pest management. They provide a rational basis on which to make pest control decisions. Thresholds can be based on the abundance of the pest, the damage they cause, or a combination of both. Farmers should not apply insecticide when the pests are below the economic threshold because this may result in an increase in the number of pests if beneficial insects are also killed.

# Coleoptera

## Chrysomelidae

### *Aulacophora similis*

#### Pumpkin beetle



#### Description

Adults are about 7 mm long and have a yellow–brown back with a blackish mesothorax and metathorax. The abdomen has a brown tip. Adults lay clusters of eggs in the soil. The eggs hatch into small larvae that burrow into the soil and feed on the roots.

#### Damage caused

When feeding, these beetles make large holes in the leaves and may cause total defoliation. Larvae feed on the roots of cucurbits.

#### Crops attacked

Cucumber, melon, mung bean, soybean and sesame.

#### When to look

Seedling to fruiting stages.

#### Similar to

*Aulacophora foveicollis* and several other *Aulacophora* species.



# Coleoptera

## Chrysomelidae

### *Monolepta signata*

#### Monolepta beetle



#### Description

Adults are about 3 mm long. Their hard wings are reddish-yellow or reddish-brown and each has two white spots.

#### Damage caused

Adults eat large holes in the leaves.

#### Crops attacked

Peanut, mung bean, soybean, potato and sunflower.

#### When to look

Seedling to fruiting stages.

#### Similar to

Several other *Monolepta* species.



# Coleoptera

## Coccinellidae

### *Henosepilachna vigintiseipunctata*

#### Twenty-eight spotted ladybird



#### Description

Adults are 5–8 mm long and are yellow with black spots. The eggs are yellow, elongate and oval, and are usually laid on the undersurface of a leaf in batches of 5–40. Larvae are elongate and elliptical with moderately long legs and a well-developed head and mandibles. The body is covered with long, branched processes (scoli) bearing spines.

#### Damage caused

Adults and larvae scrape away leaf surface cells between the veins to leave irregularly shaped holes or strips. Heavy feeding skeletonises the leaves.

#### Crops attacked

Beans and tomato.

#### When to look

Vegetative, flowering and fruiting stages.

#### Similar to

Other ladybirds; however, almost all other ladybirds eat other insects.



# Coleoptera

## Curculionidae

### *Hypomeces squamosus*

#### Gold-dust weevil



#### Description

Adults are 13 mm long and elongate to oval, with a dense covering of glittering, metallic green or blue-green scales that give a dusted appearance. Larvae are greyish-white and 15–20 mm long when fully grown.

#### Damage caused

Adults damage the growing points and young, tender leaves of host plants. Larvae feed by gnawing the roots just below the soil surface, and may cause lodging (collapse) or death of host plants.

#### Crops attacked

Maize, cotton, tobacco, rice, sugarcane and mango.

#### When to look

Seedling and vegetative growing stage.

#### Similar to

Other weevils.



# Diptera

## Agromyzidae

### *Ophiomyia phaseoli*

#### Bean fly



#### Description

Adults are tiny black flies 3 mm long, about one-quarter the size of a common housefly, with one pair of transparent wings. Larvae are small, white maggots with brown heads. Pupae are pale yellow, straw-coloured or light brown, and can be seen sticking under the membranous epidermis, usually at the root–shoot junction.

#### Damage caused

Attacked seedlings may be wilted or dead, and leaves of older plants may be yellow and stunted. Damaged stems are thicker than normal and cracked lengthwise just above the soil.

#### Crops attacked

Mung bean, cowpea, soybean and other legumes.

#### When to look

Seedling and vegetative growing stages.

#### Similar to

Other small flies.



# Hemiptera

## Aleyrodidae

### *Bemisia tabaci*

#### Tobacco whitefly



#### Description

Adult *Bemisia* are soft and whitish-yellow when they first emerge from the nymph. Within a few hours the wings become iridescent white due to a powdery wax. The body remains light yellow with a light dusting of wax. The female is 0.96 mm long and the male is slightly smaller (0.82 mm).

#### Damage caused

Tobacco whitefly transmits *mung bean yellow mosaic virus*, which is a serious disease in mung beans.

#### Crops attacked

Whitefly can be found on tobacco, cotton, okra, peanut, pigeon pea, chilli, cucumber, soybean, mung bean, sweetpotato, tomato and cassava.

#### When to look

All stages of crop growth.

#### Similar to

Other whiteflies.

# Hemiptera

## Alydidae

### *Riptortus linearis*

#### Brown bean bug



#### Description

Adults are 16–18 mm long and have yellow stripes along each side. The nymphs look like ants but have the sucking mouthparts of bugs. The eggs are shiny brown.

#### Damage caused

Adults and nymphs pierce and suck contents from developing seeds and pods, resulting in deformed or discoloured seeds.

#### Crops attacked

Mung bean, soybean, cowpea and sesame.

#### When to look

Flowering to late pod fill. Check early morning before bugs become too active.

#### Similar to

*Riptortus serripes* (large brown bean bug) and *Melanacanthus scutellaris* (small brown bean bug).



# Hemiptera

## Aphididae

### *Aphis craccivora*

#### Cowpea aphid



#### Description

Adults are 2 mm long, soft-bodied, pear-shaped and shiny black. Both winged and wingless forms occur. Two sharp points protrude from the sides at the rear of the body.

#### Damage caused

Aphids amass on growing points where they suck sap from flowers, pods and stems. Plants can be stunted and deformed. Leaves become very sticky from aphid excretion.

#### Crops attacked

Mung bean, cowpea, peanut and sweetpotato.

#### When to look

Flowering to maturity. Look for beneficial insects eating aphids. Also look for virus symptoms, as aphids may transmit viruses to other plants in the crop.

#### Similar to

Other aphids.



# Hemiptera

## Aphididae

### *Aphis glycines*

#### Soybean aphid



#### Description

Adults are less than 2 mm long and has a yellow, pear-shaped body and a black tube protruding from each side of the rear of the body. Some have clear wings. All stages and sizes of the insect may be living together.

#### Damage caused

Soybean aphids feed on tender parts of young plants, and may cause stunting and poor development of the growing tips. In severe infestations, the entire stem dries up and dies.

#### Crops attacked

Soybean.

#### When to look

From flowering to maturity.

#### Similar to

Other aphids.



# Hemiptera

## Aphididae

### *Rhopalosiphum maidis*

#### Corn aphid



#### Description

Adults are up to 2 mm long and light to dark olive-green in colour, with a purple area at the base of small, tube-like projections at the rear end. They are usually wingless. Antennae extend to about one-third of the body length. Nymphs are similar but smaller in size.

#### Damage caused

Adults and nymphs suck sap and produce honeydew. Very high numbers may turn plants yellow. High populations on the fruit heads produce sticky grain. A combination of aphid attack and water stress can cause reduced crop yield.

#### Crops attacked

Maize.

#### When to look

All stages of the crop are attacked, but the most serious damage is when high numbers infest cobs.

#### Similar to

Other aphids.



# Hemiptera

## Cicadellidae

### *Bothrogonia ferruginea*

#### Red leafhopper



#### Description

Adults are about 12 mm long and are red with black spots on the head and thorax.

#### Damage caused

The extent of damage caused to crops in Cambodia is unknown. However, leafhoppers can be serious economic pests. Their feeding may remove sap, destroy chlorophyll, transmit disease or curl leaves; they also puncture the plant while laying eggs.

#### Crops attacked

Mung bean and soybean.

#### When to look

Vegetative stages.

#### Similar to

Other leafhoppers.



# Hemiptera

## Coreidae

### *Anoplocnemis phasiana*

#### Legume pod bug



#### Description

Adults are 22–28 mm long and dark brown–black. The males have larger, stronger back legs than the females.

#### Damage caused

Adults and nymphs pierce and suck contents from leaves, developing seeds and pods.

#### Crops attacked

Mung bean, soybean, cowpea and other crop species.

#### When to look

Flowering to late pod fill. Check early morning before bugs become too active.

#### Similar to

Other pest and beneficial bugs.



# Hemiptera

## Coreidae

### *Cletus bipunctatus*

#### Spined legume bug



#### Description

Adults are similar in length to the brown bean bug and 9–11 mm long. They are reddish-brown in colour with three white dots on the back.

#### Damage caused

Adults and nymphs pierce and suck contents from developing seeds and pods, resulting in deformed or discoloured seeds.

#### Crops attacked

Mung bean, soybean and cowpea.

#### When to look

Flowering to late pod fill. Check early morning before bugs become too active.

#### Similar to

Other pest and beneficial bugs.



# Hemiptera

## Pentatomidae

### *Nezara viridula*

#### Green vegetable bug



#### Description

Adults are 11–13 mm long and bright green. Nymphs change colour as they grow: 1st instar orange or brown; 2nd instar black with orange and white spots; 3rd instar black with orange and white spots; 4th and 5th instars mostly green or mostly black with white, yellow and red markings. Hexagonal masses of 30–130 barrel-shaped eggs are laid on the underside of leaves.

#### Damage caused

Adults and nymphs pierce and suck developing seeds and pods, which are then lost, deformed or develop dark marks.

#### Crops attacked

Mung bean, soybean, cowpea, sesame, peanut and maize.

#### When to look

Budding to late pod fill. Check early morning.

#### Similar to

*Piezodorus hybneri* (red-banded shield bug).



Adult



Eggs and nymphs (1st instar)



Nymphs (3rd instar)



Nymph (5th instar)

# Hemiptera

## Pentatomidae

### *Piezodorus hybneri*

#### Red-banded shield bug



#### Description

Adults are 9 mm long and light green or yellow in colour, with a red or yellow band across the 'shoulders' and around the edge of the body. Nymphs are initially orange-brown. Older nymphs are mainly green with red-brown marks in the centre of the back. The eggs are laid in two rows on the underside of leaves in groups of 15–40.

#### Damage caused

Adults and nymphs pierce and suck developing seeds and pods, which are then lost, deformed or develop dark marks.

#### Crops attacked

Mung bean, soybean, cowpea, sesame and peanut.

#### When to look

Budding to late pod fill. Check early morning.

#### Similar to

*Nezara viridula* (green vegetable bug).



# Hemiptera

## Pentatomidae

### *Plautia affinis*

#### Brown-winged stink bug



#### Description

Adults are 7–8 mm long and green or yellow in colour, with dark brown markings on the forewings. The legs and antennae are banded green and pale brown.

#### Damage caused

Adults and nymphs pierce and suck developing fruit and pods of a range of crop species, but *P. affinis* is likely to be a minor pest of upland crops.

#### Crops attacked

Mung bean and soybean.

#### When to look

Budding to late pod fill. Check early morning.

#### Similar to

*Nezara viridula* (green vegetable bug).



# Hemiptera

## Plataspidae

### *Brachyplatys subaeneus*

#### Black bean bug



#### Description

Adults are 4–6 mm long, oval in shape and iridescent black in colour. The head is flattened and the eyes are prominent.

#### Damage caused

Black bean bugs are sucking pests and cause similar damage to pods and fruit as do other pod suckers, such as the green vegetable bug.

#### Crops attacked

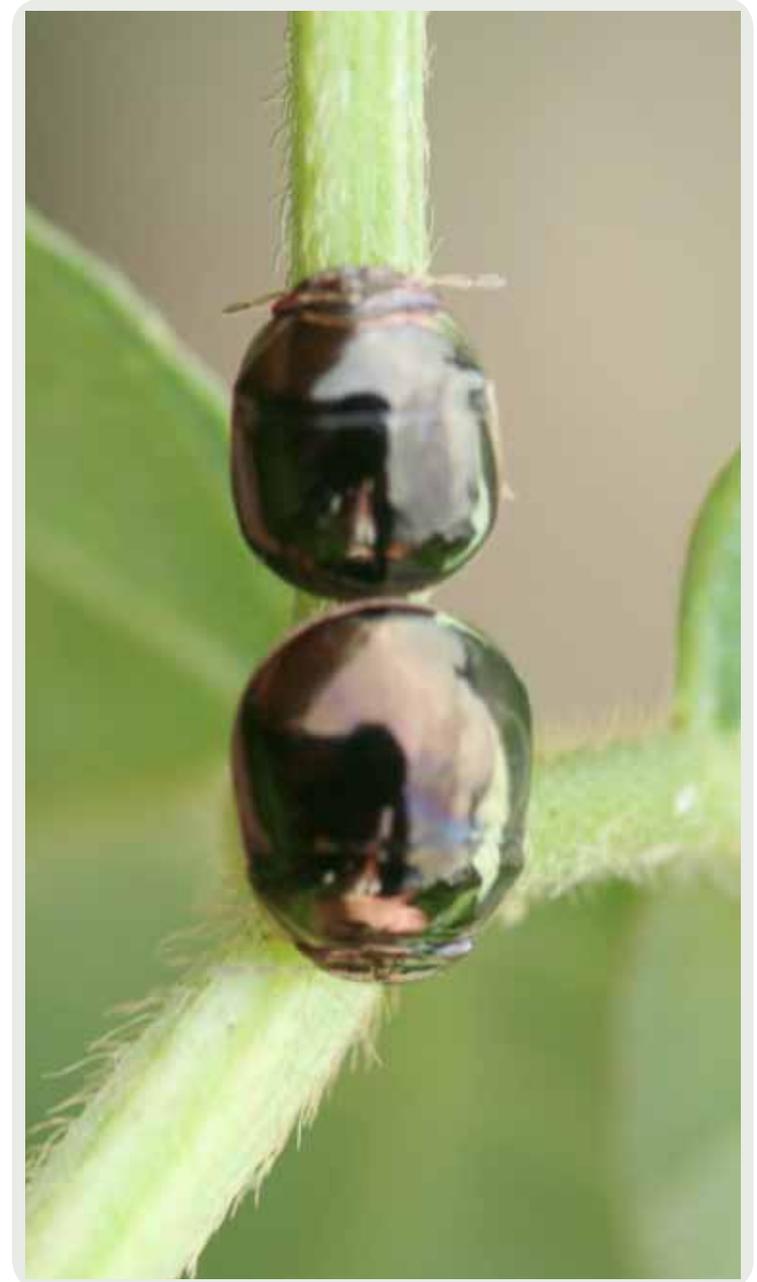
Mainly legumes such as mung bean and soybean, but they also feed on sugarcane, rice and sweetpotato.

#### When to look

Budding to late pod fill. Check early morning.

#### Similar to

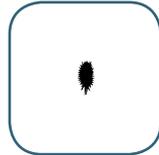
Other Plataspidae spp.



# Hemiptera

## Pseudococcidae

### *Mealybugs*



#### Description

Male and female mealybugs have distinct morphological differences. Female adults are about 3 mm long. Female adults and nymphs are oval and covered by a white, waxy coating. Males are small, aphid-like, winged insects.

#### Damage caused

Female mealybugs colonise shoots, stems and leaves, forming a white mass. They are piercing and sucking insects that can stunt plant growth. If peanut kernels are attacked, they turn black and fall apart. Male mealybugs are short-lived and do not feed as adults.

#### Crops attacked

Sesame, peanut, soybean and mung bean.

#### When to look

All crop stages.

#### Similar to

Other mealybugs.

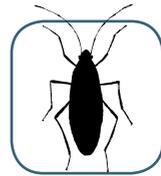


# Hemiptera

## Pyrrhocoridae

### *Dysdercus cingulatus*

#### Cotton stainer



#### Description

Adults are 15 mm long. The prothorax has a white collar (neck), rarely extending on to the lateral angles. The posterior margin of the thorax is usually orange. Half of the forewings are yellow with two black spots, and the other half are membranous and black. There are 1–6 variably sized white bands on the abdominal segments.

#### Damage caused

Cotton stainers are occasional pests of cotton that feed on developing and mature cotton seed. Adults can be found in other crops such as mung bean but damage is expected to be minimal.

#### Crops attacked

Cotton flower buds and seeds, soybean and mung bean.

#### When to look

Flowering to maturity stages.

#### Similar to

*Dysdercus sidae* (pale cotton stainers).



# Isoptera

## Termitidae

*Macrotermes, Microtermes*  
and *Hypotermes* spp.

Subterranean termites



### Description

Termites are social insects with a strict caste system, which consists of workers, soldiers, winged reproductive termites and a queen. The workers are white, soft-bodied and 4–5 mm long. The soldiers are larger with large mandibles and can be up to 9 mm long.

### Damage caused

Termites can attack plants at any stage of development from the seed to the mature plant. Seedlings can be cut just below or above the soil surface. They can kill the plant or lower yield through decreased uptake of water and nutrients. Damage to the root system can also lead to attack by pathogens, or lodging of mature plants.

### Crops attacked

Maize.

### When to look

Check residues of the previous crop or weeds before sowing, and throughout crop growth.

### Similar to

Other termites.



# Lepidoptera

## Gelechiidae

### *Aproaerema modicella*

#### Peanut leaf miner



#### Description

Moths are grey and mottled, with a wing span up to 18 mm. The eggs are white when laid and darken to yellow-brown. Larvae are 15 mm long, grey-green, and with a shiny black head.

#### Damage caused

Leaf miners extend outwards from an initial serpentine shape to become blotches (mines). Leaves become distorted within a few days. Larger larvae leave the mine and web together two halves of a leaflet. The leaves in a heavily damaged field turn light brown and drop off the plants.

#### Crops attacked

Peanut, soybean, mung bean and pigeon pea.

#### When to look

All crop stages.

#### Similar to

*Stomopteryx subsecivella* (soybean leaf miner).



# Lepidoptera

## Gelechiidae

### *Stomopteryx subsecivella*

#### Soybean leaf miner



#### Description

Moths are grey and mottled, with a full wing span of up to 18 mm, but they are weak fliers. The eggs are white when laid and darken to yellow-brown. Larvae are grey-green with a shiny black head.

#### Damage caused

Young larvae feed within the leaf (mining), but after 3–4 days emerge and fold individual leaves or web leaves together, remaining inside each fold.

#### Crops attacked

Soybean and peanut.

#### When to look

All crop stages.

#### Similar to

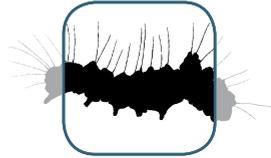
*Aproaerema modicella* (peanut leaf miner).



Larva

# Lepidoptera

## Lymantriidae *Euproctis* sp. Tussock moth



### Description

Larvae are 20–25 mm long.

### Damage caused

Larvae are occasionally found feeding in small clusters, although the damage done is probably minor except for the individual plant.

### Crops attacked

Soybean and peanut.

### When to look

All crop stages.

### Similar to

*Orgyia* spp. and *Dasychira* spp. (other tussock moths).



# Lepidoptera

## Noctuidae

### *Achaea janata*

#### Castor oil looper



#### Description

Moths are 25 mm long. Their hindwings have a white band and three evenly spaced white blotches along the outer wing margin. Mature larvae are up to 60 mm long and have two black spots behind the front legs. Larvae are purple-brown and can be light or dark. They have a group of four pairs of legs toward their rear and move in a looping motion.

#### Damage caused

Larvae mainly feed on leaves but occasionally eat seeds.

#### Crops attacked

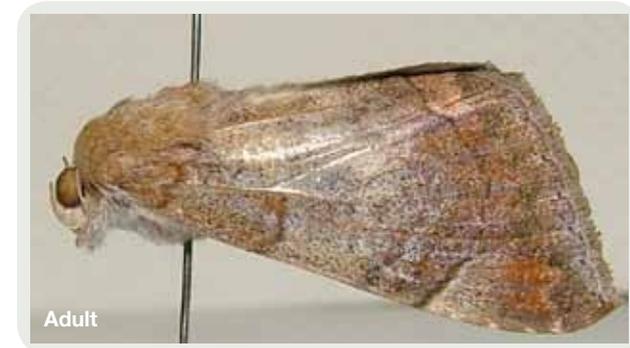
Soybean and peanut.

#### When to look

Check all crop stages.

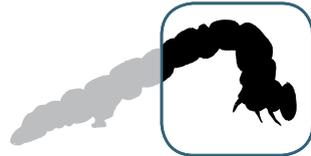
#### Similar to

*Mocis alterna* (bean looper) and other loopers.



# Lepidoptera

Noctuidae  
*Anomis* sp.  
Semilooper



## Description

Moths have a wingspan of 28 mm. The eggs are laid on the undersurface of leaves. Young larvae are green, and those of the last instar measure up to 35 mm in length and bear short, lighter green longitudinal lines and spots.

## Damage caused

Young larvae skeletonise leaves, while older larvae eat irregular holes in leaves. Buds and fruit are also damaged.

## Crops attacked

Peanut, as well as a wide range of crop and weed species.

## When to look

Can be present at any stage.

## Similar to

Other semiloopers and loopers.



Adult



Larva

# Lepidoptera

## Noctuidae

### *Helicoverpa armigera*

#### Bean podborer



#### Description

Moths are 35 mm long. Newly hatched larvae are white in colour with dark heads. Larvae go through up to six stages (instars). As they grow, larvae become darker with dark spots on their segments, but vary widely in colour. Medium larvae (10 mm long) have lines along the side of their body and a saddle of darker colour on the 4th segment back from the head. Large larvae are 35–40 mm long and have white hairs around the head and on the body.

#### Damage caused

Most damage is from feeding on tips, buds, flowers and pods. Larvae will also feed on leaves, but this is not usually significant.

#### Crops attacked

All field crops.

#### When to look

All stages of growth. Most crops need to be checked from budding and flowering to maturity.

#### Similar to

*Spodoptera* spp. (cluster caterpillar).



Adult



Larva



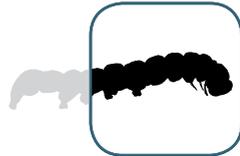
Pupa

# Lepidoptera

## Noctuidae

### *Spodoptera litura*

#### Cluster caterpillar



#### Description

Moths are up to 25 mm long. The eggs are laid in clusters of up to 300 and are covered with a mat of grey-brown hairs. Mature larvae grow up to 30 mm long and have black triangles in a line on both sides of the back; the body narrows towards the head.

#### Damage caused

Larvae skeletonise leaves, and heavy infestations destroy buds and flowers.

#### Crops attacked

Mung bean, soybean, peanut and sunflower.

#### When to look

All crop stages.

#### Similar to

Other *Spodoptera* spp. and *Helicoverpa* spp. (bean podborer).



# Lepidoptera

## Pyralidae

### *Antigastra catalaunalis*

#### Sesame webworm or sesame leaf roller



#### Description

Moths are 20 mm long with the head and prothoracic shield dark brown. The wing pattern is not distinctive. The forewings are triangular with a clear, pointed apex; the base is light orange–brown. The postmedian band on the hindwings is slightly darker than the rest of the forewings. Larvae are light brown–green with thin, longitudinal, pale-red lines.

#### Damage caused

Larvae feed externally by making a loose web that sticks several leaves together. They feed on leaves and young shoots, and their excreta remain between the leaves and the loose web.

#### Crops attacked

Sesame.

#### When to look

Seedling to fruiting stage.

#### Similar to

Larvae are similar to the larvae of *Maruca vitrata*. The webbing and damage are similar to that caused by *Omiodes indicata* (legume web spinner).



# Lepidoptera

## Pyralidae

### *Conogethes punctiferalis*

#### Yellow peach moth



#### Description

Moths are 13 mm long and bright yellow or orange with black markings. Larvae are up to 20 mm long with a dark head and are grey-pink with darker oval spots on the body.

#### Damage caused

Larvae tunnel into stems and cobs and produce a lot of webbing and excreta at the tunnel entrance.

#### Crops attacked

Maize.

#### When to look

After silking or flowering.

#### Similar to

Not similar to other insects in the region.

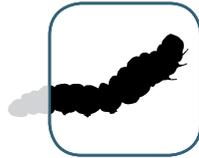


# Lepidoptera

## Pyralidae

### *Diaphania indica*

#### Cucumber or melon moth



#### Description

Moths are pearly white with a brown band around the edge of the wings; the extended wingspan is 25 mm. The tip of the abdomen bears a tuft of long, orange-brown scales. The eggs are oval in shape, 0.7–0.8 mm long and 0.4–0.5 mm wide. Young larvae are transparent but turn green as they grow. Fully grown larvae are 18–25 mm long.

#### Damage caused

Young larvae cluster around the main vein, folding or binding the leaf together.

#### Crops attacked

Cucurbits, beans and pigeon pea.

#### When to look

Flowering to fruiting stages.

#### Similar to

Not similar to other insects in the region.

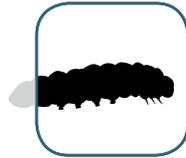


# Lepidoptera

## Pyralidae

### *Etiella zinckenella*

#### Lima bean podborer



#### Description

The forewings of adults are brownish-grey with a white stripe on the edge. The hindwings are transparent to opaque with darker outer edges. The oval eggs are white and turn pink. Young larvae have yellowish bodies and black heads, and become green with dark pink stripes before pupation. Fully grown larvae are 15–22 mm long.

#### Damage caused

Pods are marked with a brown spot where the larvae have entered. As the larva develops within the pod, excreta accumulates, causing soft, rotten patches on the pod. A large hole in the pod is evident at the point where the larva leaves to pupate in the soil.

#### Crops attacked

Soybean, cowpea, mung bean and other legumes.

#### When to look

Fruiting stage.

#### Similar to

Other *Etiella* spp.



# Lepidoptera

## Pyralidae

### *Maruca vitrata*

#### Bean podborer



#### Description

Young larvae are a yellow–green colour with many rows of dark marks on the body, and a dark head. Older larvae may lose the dark spots and grow up to 18 mm long; the head is light to dark brown.

#### Damage caused

Young larvae may be found together among the flowers. Flowers may be damaged and discoloured; flower-bud shedding may occur and pod production may be reduced. Pods have small, darkened entry holes on the surface. Leaves and pods are stuck together by webbing and show signs of surface feeding.

#### Crops attacked

Mung bean and cowpea.

#### When to look

Budding to end of grain fill.

#### Similar to

Other podborers.



# Lepidoptera

## Pyralidae

### *Omiodes indicata*

Legume web spinner  
or soybean leaf folder



### Description

Adult moths have a wingspan of 20–28 mm. Their colour ranges from reddish-yellow or orange–brown to dark grey with some lighter grey markings. Larvae are 15 mm long, light to dark green on top and yellowish-green underneath; a single, thin, greenish stripe runs lengthwise down the middle of the back. The head is light brown.

### Damage caused

Larvae live between two leaves spun together. In later stages they may spin several leaves together, forming a mass of partially eaten leaves.

### Crops attacked

Soybean, cowpea, peanut, bean and tobacco.

### When to look

Vegetative stage to pod filling.

### Similar to

*Omiodes indicata* and *O. diemenalis* (bean leaf roller) are similar and occur together on soybean.

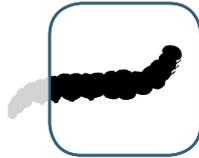


# Lepidoptera

## Pyralidae

### *Ostrinia furnacalis*

#### Asian maize borer



#### Description

Adult moths are 20 mm long and brown or yellow in colour. They lay oval, light yellow eggs on top of leaves or on the husk. The eggs turn black before hatching. Young larvae are pink to yellow–grey with black heads. Older larvae are whitish with two spots per segment.

#### Damage caused

Older larvae bore into the stalk at the node and into developing maize tassels and ears, and mung bean midribs and pods.

#### Crops attacked

Maize and mung bean.

#### When to look

Crop vegetative stage.

#### Similar to

*Maruca vitrata* (bean podborer).

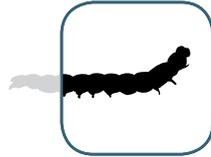


# Lepidoptera

## Pyralidae

### *Spoladea recurvalis*

#### Beet webworm



#### Description

Moths are 10 mm long. Larvae are initially creamy-white but develop grey-green and black marks. Older larvae are 20–25 mm long and have a black line down the middle of the back.

#### Damage caused

Larvae feed mainly on leaves but can affect flowers and pods. They web plant parts together and feed inside the web.

#### Crops attacked

Mung bean.

#### When to look

Can be present at any stage; very common on pigweed.

#### Similar to

*Maruca vitrata* (bean podborer).

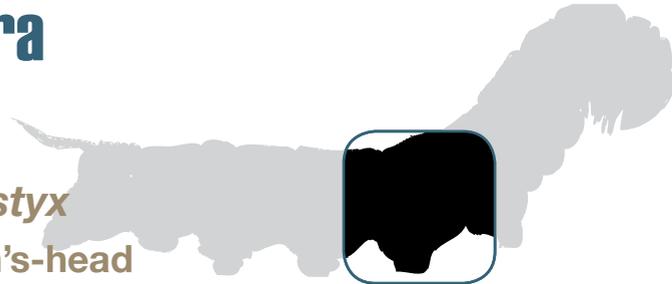


# Lepidoptera

## Sphingidae

### *Acherontia styx*

#### Eastern death's-head hawk moth



#### Description

Moths and larvae are very large. Larvae are 90–100 mm long, green with yellow stripes and black dots along the sides, and have a large, upwardly curved posterior horn.

#### Damage caused

Larvae feed mainly at night on young leaves and growing points, and leave a lot of black droppings on the ground. Entire crops can be defoliated when larvae are present in large numbers.

#### Crops attacked

Sesame, mung bean and soybean.

#### When to look

All crop stages.

#### Similar to

Other Sphingidae spp.

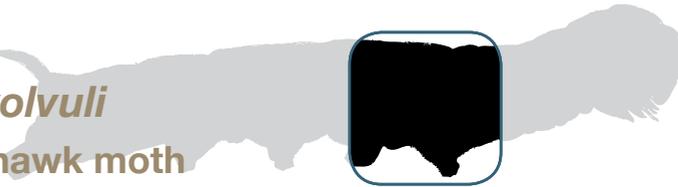


# Lepidoptera

## Sphingidae

### *Agrius convolvuli*

#### Convolvulus hawk moth



#### Description

Moths and larvae are very large. Larvae are 85–100 mm long, range in colour from green to brown, and have a large, upwardly curved posterior horn.

#### Damage caused

Larvae feed mainly at night on young leaves and growing points, and leave a lot of black droppings on the ground. Entire crops can be defoliated when present in large numbers.

#### Crops attacked

Mung bean, soybean and sesame.

#### When to look

All crop stages.

#### Similar to

Other Sphingidae spp.



Larvae



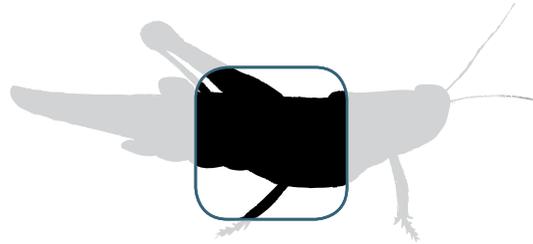
Pupa

# Orthoptera

## Acrididae

### *Locusta migratoria*

#### Migratory locust



#### Description

Adults are 40–65 mm long, with males smaller than females. Their body colour varies according to population density from green to brown in the solitary form and straw in the gregarious form. Locusts can become highly abundant and can migrate in swarms; outbreaks often follow droughts.

#### Damage caused

Adults and nymphs feed on leaves and stems. Leaves are generally the first plant parts to be attacked. In cereals, varying proportions of ripening grains are eaten, and seed pods and fruits may also be attacked on legumes.

#### Crops attacked

Maize, mung bean, soybean and peanut.

#### When to look

All crop stages.

#### Similar to

Other locusts.

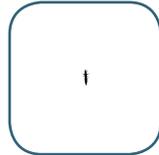


# Thysanoptera

## Thripidae

### *Thrips tabaci*

#### Tobacco thrip



#### Description

Thrips are very small, about 1 mm long, and barely visible to the naked eye. Larvae are either yellow or white. Older individuals are yellowish-brown and move quickly.

#### Damage caused

Thrips feed by sucking plant cell contents. Affected leaves are silvery or have tiny brownish marks or spots; the leaves may be wilted or distorted during growth and have reduced photosynthetic capacity.

#### Crops attacked

Peanut.

#### When to look

Seedling to flowering stages.

#### Similar to

Other thrips.



# Part 2

## Beneficial insects and spiders

There is a broad range of insects as well as spiders that consume other insects or parasitise them, reducing the number of pest insects. These predators and parasites are called beneficial insects or 'good bugs' because they do more good than harm to the crop. They seek out and destroy other insects in a wide range of crops, and are an important component of natural pest control.

Parasitic insects need other insects to complete their life cycle. Parasitising a pest insect interferes with the pest by slowing down the build-up of pest numbers, and can prevent major outbreaks. The number of beneficial insects in a crop will depend on the food resources available, shelter, climatic conditions and use of insecticides.

The farmer needs to check to see if a healthy and viable population of predators and parasites exists within the crop by examining the life cycle stage and numbers present. A healthy predator population may be effective in controlling pest insects. It may save the farmer time and money by reducing the need to apply insecticides, and can help the farmer determine if insecticides are necessary to control a pest problem.

Many insecticides will kill both pest and beneficial insects, although there are a few that only kill target pests. For sustainable pest management, pest control should not rely solely on chemical insecticides, but try to retain beneficial insects.

Knowing which arthropods are beneficial can help decide on pest-control options. A few of the many major groups of beneficial insects and spiders are included in the following section.

# Arachnida

## Oxyopidae

### Lynx spiders



## Salticidae

### Jumping spiders



The class Arachnida includes spiders, scorpions, ticks and mites. Spiders belong to the order Araneae. There are a number of groups of spider that could occur in upland crops, including flower or crab spiders, wolf spiders, nightstalking spiders, orbweavers, lynx spiders and jumping spiders. Lynx and jumping spiders are commonly found in upland crops.

### Description

Lynx and jumping spiders are active hunters, stalking their prey instead of relying on a web to catch it. They have highly developed eyesight that they use to distinguish and track their prey over short distances before pouncing and injecting their venom.

### Pests attacked

Lynx and jumping spiders can attack all types of insects, including predatory insects in crops, as long as the spider is large or venomous enough to overcome its prey. They also prey on larvae and eggs. They usually arrive in crops by 'ballooning', where they float on air currents when young.

### Impact

The impact of a spider species on pests depends on its diet, abundance, and whether or not it coincides with the pests. They can be effective predators of leafhoppers, caterpillars and other pests. However, spiders might also eat beneficial insects and other spiders.



Lynx spider, *Oxyopes javanus*



Jumping spider

# Coleoptera

## Coccinellidae

### *Cheilomenes sexmaculata*

#### Six-spotted ladybird



#### Description

Adults are 3–6 mm long and 3–5 mm wide. The body outline is oval and shiny, and the ground colour is orange, light red, yellow or pinkish. There are six black spots on the wing covers including two zigzag lines and a rear black spot. Larvae are dark slaty-grey to brown with yellowish patches. Pupae are yellow with black spots.

#### Pests attacked

Ladybirds are important predators of aphids and other insect eggs and larvae.

#### Impact

Ladybirds are good predators, consuming a lot of small prey. They can reach large numbers and can successfully control pests in combination with other predators.

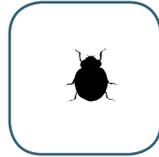


# Coleoptera

## Coccinellidae

### *Coccinella transversalis*

#### Transverse ladybird



#### Description

Adults are 5 mm long and bright orange-red in colour, with black markings on the back. There is a dark strip down the centre of the back where the wings meet, and prominent V-shaped markings on each side. They are active during the day and adults and larvae can be found living on the same food plants.

#### Pests attacked

Ladybirds are important predators of aphids and other insect eggs and larvae.

#### Impact

Ladybirds are good predators, consuming a lot of small prey. They can reach large numbers and can successfully control pests in combination with other predators.



The pupae are the two 'bugs' on the left; the larva is on the right.

# Dermaptera

## Earwigs

There are 12 families of earwigs in the insect order Dermaptera.



### Description

Earwigs are elongated, flattened and brown in colour. The abdomen is flexible and muscular, and is capable of manoeuvring as well as opening and closing the 'forceps' that occur at the rear end. The forceps are used for a variety of purposes including holding prey and copulation; they tend to be more curved in males than in females.

### Pests attacked

Earwigs prey on other insects, but they can also feed on soft plant tissues.

### Impact

It is debatable whether earwigs are harmful or beneficial to crops as they eat insect pests as well as eating the leaves.



# Diptera

## Syrphidae Hoverflies



### Description

Hoverflies look like bees and wasps, and 'hover' like a helicopter. Adults feed on nectar and pollen, and have black and yellow striped bands across a flattened body that is 4–7 mm long. Larvae can be up to 8 mm long, are green, and are grub-like with no eyes. The brown tear-shaped eggs are often found in leaf litter.

### Pests attacked

Hoverflies spear aphids with their jaws, hold them upright and suck out the fluids.

### Impact

Hoverflies eat large numbers of aphids.



# Diptera

## Tachinidae Tachinid flies



### Description

Adults are 10 mm long and have large (sometimes red) eyes, thick bodies (sometimes with a metallic appearance), bristles on the back and short antennae. Larvae are white and carrot-shaped. The eggs are white and elongate.

### Pests attacked

Tachinid flies parasitise the larvae and eggs of a wide range of insect pests. They usually lay their eggs close to the head of the pest larva, and sometimes in the egg chamber of the host.

### Impact

Tachinid flies can reach large numbers and attack important pests such as *Helicoverpa*. They do not kill the host until after the caterpillar has finished feeding, and therefore do not prevent crop damage by that generation of the pest. However, tachinid flies can help reduce the size of following *Helicoverpa* generations and thus reduce future damage.



# Diptera

## Tachinidae

### *Trichopoda* spp.

### Feather-legged flies



### Description

*Trichopoda* is a genus of small, brightly coloured flies that range in size from 5 to 13 mm. The flies have a distinctive fringe on the hind legs. The eggs are laid on adult or late nymphal stages of *Nezara viridula* (green vegetable bug). On hatching, the maggot bores into the body of the host and feeds on the host's fluids for about 2 weeks. When fully grown, the maggot emerges, killing the host, and pupates in soil. The adult fly emerges after about 2 weeks.

### Pests attacked

*Trichopoda* species have been released as a biological control for *N. viridula* in various parts of the world.

### Impact

Parasitism rates can be as high as 50%, but there is conflicting evidence of the effectiveness of biological control by this parasite.



# Hemiptera

## Pentatomidae

### *Oechalia schellenbergii*

#### Spined predatory shield bug



#### Description

Adults are 12 mm long and have a grey–brown, shield-shaped body with a light marking in the middle of the back and a pair of prominent spines on either side of the shoulder. Nymphs are dark grey with a characteristic red ring on the back. The eggs are laid in an irregularly shaped ‘raft’ and are black with short white spines around the rim.

#### Pests attacked

Hemipteran predators such as *O. schellenbergii* are important biological control agents of a range of agricultural pests, including larvae of *Helicoverpa*. Adults and older nymphs use piercing, sucking mouthparts to feed on insect larvae. Young nymphs feed on plant sap.

#### Impact

*Oechalia schellenbergii* has also been used effectively as a control agent in conjunction with DiPel, a biological insecticide.



# Hemiptera

## Reduviidae Assassin bugs



### Description

Assassin bugs are closely related to plant-sucking bugs. However, unlike their plant-feeding relatives, assassin bugs have an elongated body with grasping forelegs and a pronounced head equipped with a powerful proboscis for stabbing their prey. Adults are 12–15 mm long.

### Pests attacked

Assassin bugs tend to prefer softer-bodied prey such as caterpillars and small bugs such as green mirids. The assassin bug injects an enzyme that dissolves the inner organs of the prey, and sucks out the contents, leaving behind an empty shell.

### Impact

The nymphs have large appetites and can consume up to 160 small- to medium-sized heliothis larvae over a 9–12-week period.



# Hymenoptera

## Parasitic wasps



## Predatory wasps



### Description

There are many different and varied forms of wasps. Wasps typically have a constricted region joining the first and second segments of the abdomen known as the petiole. Like all insects, wasps have three sets of two legs. In addition to their compound eyes, wasps also have simple eyes known as ocelli, which are usually arranged in a triangular formation just forward of an area of the head known as the vertex.

### Pests attacked

Wasps are often important predators of various insect larvae such as *Helicoverpa*, *Spodoptera* and other moth genera. The female parasitic wasp may lay eggs on the larvae or pupae of lepidopterous pests. The wasp larvae feed inside the host larvae, which usually do not die before pupation. Many predatory wasps build mud cell nests. They paralyse the insect larva and lay an egg in it before sealing the cell to allow their young to devour the prey under the protection of the mud cell. The social paper wasps harvest larvae, which are masticated and then fed to developing wasp larvae at the nest.

### Impact

The impact is a reduction in the size of following caterpillar generations and a reduction of further damage.



# Hymenoptera

## Formicidae Predatory ants



### Description

Ants are social insects. Ants have elbowed antennae and a distinctive node-like structure that forms a slender waist between the abdomen and thorax.

### Pests attacked

Ants are important generalist predators in agricultural systems.

### Impact

The extent of their impact on pests is not well known. The edges of fields are often protected by ants if the surrounding verges are left undisturbed to allow ant nests to form.

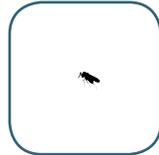


# Hymenoptera

## Scelionidae

### *Trissolcus basal*

#### Pentatomid egg parasitoid



#### Description

*Trissolcus basal* is a very small black wasp (about 2 mm long) with downward elbowed antennae and a flattened abdomen. Wing veins are not obvious.

#### Pests attacked

In parts of the world where it has been released, *T. basal* usually occurs in all crops attacked by *Nezara viridula* (green vegetable bug), including cotton, maize, soybean and other legumes. *Trissolcus basal* lays eggs inside pentatomid eggs, where they develop to adulthood. The primary host is *N. viridula*, but *Trissolcus* parasitises eggs of other pentatomids, including beneficial ones.

#### Impact

*Trissolcus basal* can reduce *N. viridula* numbers by more than 50%. Planting trap crops of early maturing soybeans could be an integrated pest management strategy to reduce *N. viridula* numbers in the main crop.



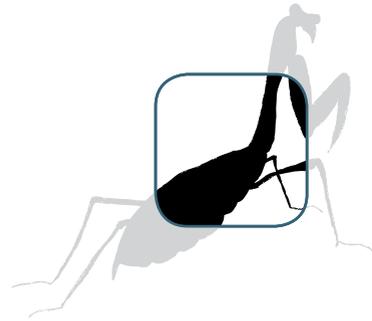
Adult wasp laying eggs inside eggs of a pentatomid insect.



# Mantodea

## Mantidae

### Praying mantises



#### Description

Praying mantises are similar to stick insects. They are distinguished by their large size, up to 120 mm long, and raptorial (hooked) front arms to capture prey.

#### Pests attacked

They feed on a range of other insects and sometimes chew leaves.

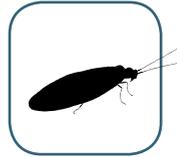
#### Impact

It is uncertain if praying mantises have a beneficial impact in crops. They feed on beneficial as well as harmful insects and will even eat each other.



# Neuroptera

## Lacewings



### Description

Adults of this order possess four membranous wings. The forewings and hindwings are about the same size and have many veins. Lacewings have chewing mouthparts, and undergo complete metamorphosis (see Figure 2).

### Pests attacked

The larvae of most lacewing families are predators; many eat aphids and other pest insects.

### Impact

Lacewings are abundant and widespread in nature, and have been used for biological control through commercial distributors. The most common predators in field crops are the brown and green lacewings.



Adult



Larva

# Glossary

**Abdomen:** The rear section of the three major body divisions, located at the end of the thorax.

**Antennae (antenna):** Paired appendages on the head of arthropods used for sensing. The typical insect antennae have three segments—the scape (base), the pedicel (stem) and the flagellum, which often consists of many units.

**Arthropod:** An invertebrate that has an exoskeleton (external skeleton), a segmented body and jointed attachments called appendages.

**Caterpillar:** A soft-bodied larva with a number of prolegs or false legs on the abdomen in addition to the six true thoracic legs. Usually refers to the larvae of moths and butterflies.

**Cerci:** A pair of jointed appendages on the tip of the abdomen of insects and other arthropods.

**Chitin (chitinous):** A long-chain polymer derived from glucose and the main component of the exoskeleton of insects.

**Compound eye:** An eye which consists of many light-sensitive lenses, each with its own refractive system and each forming a portion of an image.

**Exoskeleton:** An external skeleton largely made of chitin that supports and protects the insect's body. See chitin.

**Forceps:** Enlarged cerci on the tip of the abdomen of earwigs. See cerci.

**Honeydew:** A sugar-rich, sticky substance secreted by aphids and some scale insects as they feed on plant cell contents.

**Instar:** One stage of growth between moults, for example 3 larval instars (or growth stages) before an insect pupates. The number of larval instars varies between insects and may range from 3 to 30.

**Integrated pest management:** Uses a combination of methods (such as timing of sowing and retention of beneficial insects) to control pest insects and reduce the use of pesticides.

**Iridescent (iridescence):** The property of certain surfaces that appear to change colour as the angle of view changes. Iridescence may be seen commonly in fly, beetle and butterfly wings.

**Labium:** Lower lip.

**Labrum:** A small, hardened body part concealing some or most of the mandibles. It serves to hold food in place during chewing by the mandibles, and thus can simply be described as an upper lip.

**Larva (larvae):** The immature stage of most insects. Usually grub-like in appearance.

**Maggot:** The common name of the larval phase of development in insects of the order Diptera. See larva.

**Mandible:** The jaws of an insect consisting of the upper chewing pair of mouthparts, sometimes modified into other shapes.

**Maxilla:** Insect mouthpart situated beneath the mandibles; paired maxillae manipulate food during chewing.

**Membranous:** Transparent, usually referring to the flying wings of insects.

**Mesothorax:** The middle of the three segments in the thorax of an insect, bearing the second pair of legs.

**Metamorphosis:** A change in the appearance or function of a living organism by a natural process of growth or development.

**Metathorax:** The hindmost of the three segments in the thorax of an insect, bearing the third pair of legs.

**Moult:** To shed the hard outer skin of an invertebrate during growth.

**Nymph:** The immature stage of certain species of insects. Nymphs usually resemble their parents but are mostly smaller and lack wings.

**Ocellus (ocelli):** A simple eye consisting of a single lens, often occurring in patterns of three in many insects.

**Ovipositor:** A tube, usually concealed but sometimes extending some length outside the end of the abdomen, with which many female insects deposit eggs.

**Parasite (parasitise):** An organism that feeds on or in a different organism while contributing nothing to the survival of its host.

**Parasitoid:** A term applied to insects whose larvae are parasites of other insects and eventually kill the host.

**Predator:** An organism that exists by preying on other living organisms.

**Proboscis:** The lengthened mouthparts that are modified to form a tube for piercing and sucking, or other specialised ways of feeding. This term may also refer to the coiled feeding tube of moths and butterflies. See rostrum.

**Prolegs:** Fleshy, stubby structures found on the undersurface of the abdomen of most larval forms of insects of the order Lepidoptera.

**Prothorax:** The foremost of the three segments in the thorax of an insect, bearing the first pair of legs.

**Pupa (pupae):** A non-feeding and relatively inactive stage between the larval and adult stages of insects with a complete life cycle. Often referred to as a chrysalis in butterflies and moths.

**Pupating (pupate):** To go through the pupal stage. See pupa.

**Rostrum:** The elongated piercing and sucking mouthparts of all insects of the order Hemiptera. Also applied to the snout of weevils (Curculionidae). See proboscis.

**Spiracles:** Small openings on the abdomen that allow air to enter an insect's respiratory system via the trachea. See trachea.

**Thorax:** The middle section of the three major body divisions, located between the head and the abdomen. The wings and legs are all appendages of the thorax.

**Tracheae:** Tubes that allow air to move into and out of insect tissue.

**Transparent:** Clear—can be seen through.

## Further reading

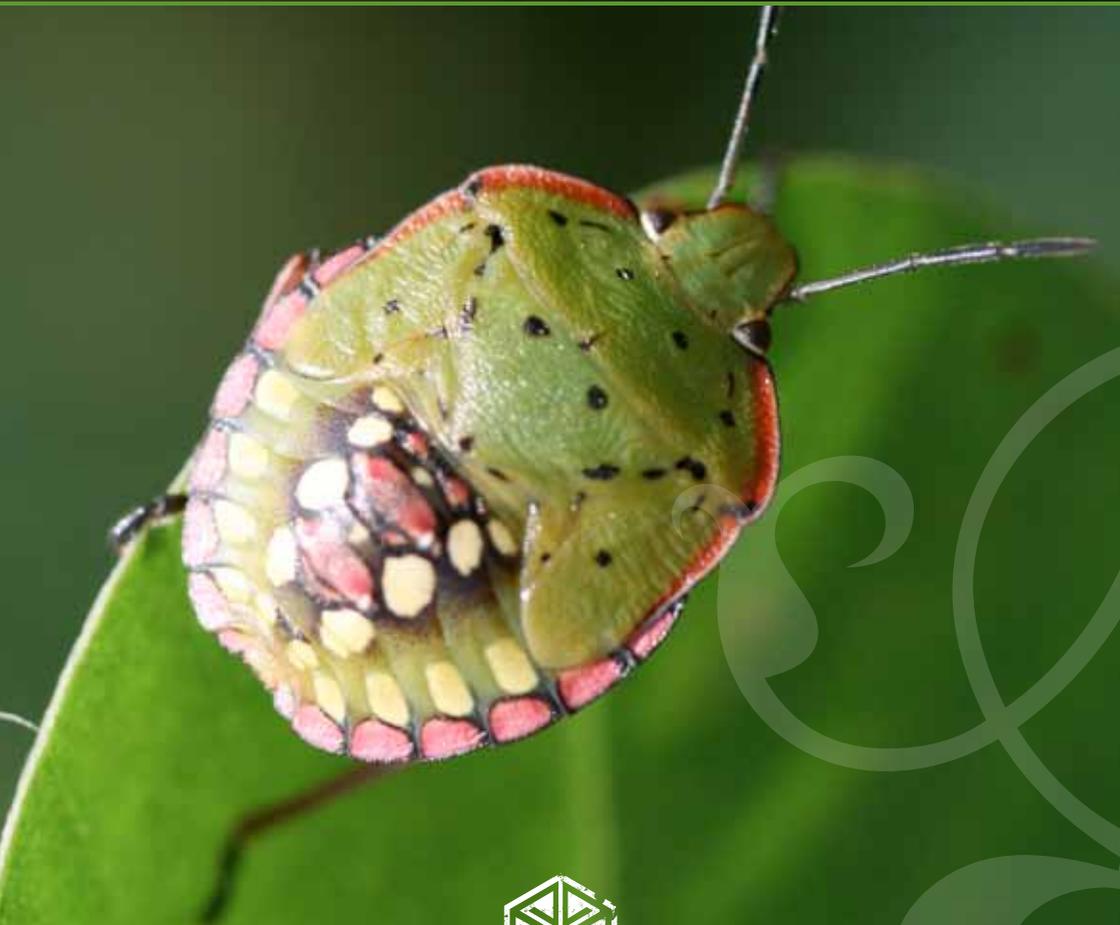
- Alejandro Ortega C. 1987. Insect pests of maize: a guide for field identification. International Maize and Wheat Improvement Center (CIMMYT): Mexico.
- AVRDC 1992. Vegetable production training manual. Asian Vegetable Research and Development Center: Taiwan.
- Brier H., Mills G., McLennan A., Lucy M. and Wessels J. 2004. Insects: what soybean insect is that? Department of Primary Industries: Queensland.
- CABI 2001. Crop protection compendium. Global module, 3rd edition. CAB International Publishing: Wallingford, UK.
- CSIRO. Insects and their allies: glossary of terms. <<http://www.ento.csiro.au/education/glossary.html>>
- Fenmore P.G. 1982. Plant pests and their control. Butterworths: Wellington, New Zealand.
- Field Crop Research Institute 2001. A guide book for field crops production in Thailand.
- Holland J., Lucy M., Brier H., Ryley M. and Moore K. 1998. Agfact P4.2.19 Mungbean. NSW Agriculture: Tamworth; Queensland Department of Primary Industries: Queensland.
- Jessop L. 1983. A review of the genera of Platyspidae (Hemiptera) related to *Libyaspis*, with a revision of *Cantharodes*. Journal of Natural History 17, 31–62.
- Parker B.L., Talekar N.S. and Skinner M. 1995. Field guide: insect pests of selected vegetables in tropical and subtropical Asia. Publication No. 94–427, Asian Vegetable Research and Development Center: Taiwan.
- Shepard B.M., Carner G.R., Barrion A.T., Ooi P.A.C. and van den Berg H. 1999. Insects and their natural enemies associated with vegetables and soybean in Southeast Asia. Quality Printing Company: Orangeburg, USA.

Tickoo J.L. and Satyanarayana A. 1998. Progress in mungbean breeding research with special emphasis on disease and insect resistance, constraints, and future directions. In 'International Consultation Workshop on Mungbean'. Proceedings of Mungbean Workshop, New Delhi, 7–11 September 1997. Asian Vegetable Research and Development Center: Taiwan.

Wise D.H. 1993. Spiders in ecological webs. Cambridge University Press.

Wood P., Ferguson J., Brown E., Cahill M., English M., Brennan L. and Elder R. 2000. Crop insects: the ute guide, northern grain belt edition. Department of Primary Industries: Queensland.





**ACIAR**

Research that works for developing  
countries and Australia

[www.aciar.gov.au](http://www.aciar.gov.au)