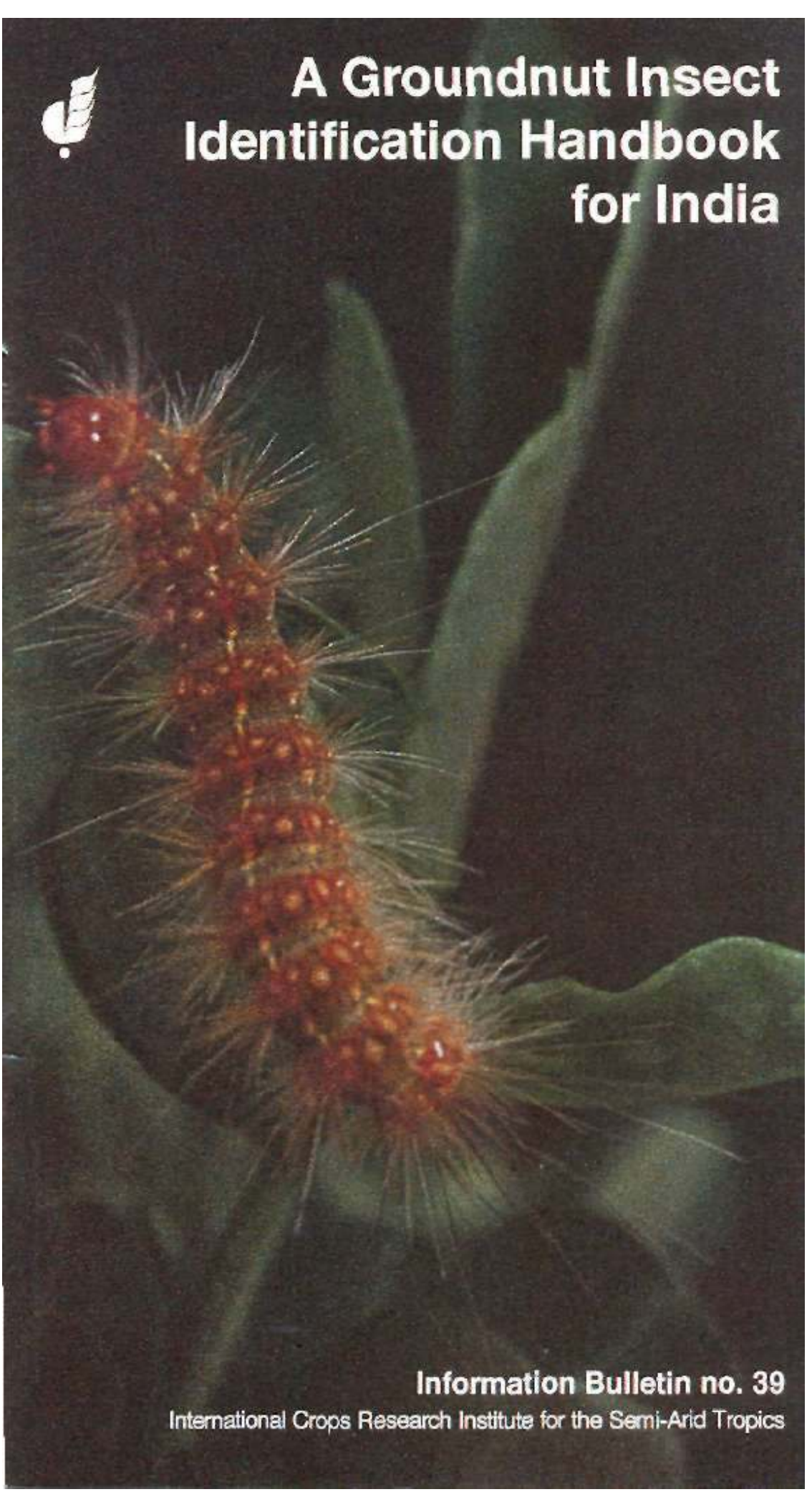
A Groundnut Insect Identification Handbook for India



Information Bulletin no. 39
International Crops Research Institute for the Semi-Arid Tropics

Abstract

Citation: Wightman, J.A. and Ranga Rao, G.V. 1993. A Groundnut Insect Identification Handbook for India. Information Bulletin no. 39. (In En. Summaries in En, Fr.) Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 64 pp. ISBN 92-9066-275-1. Order code IBE 039.

Groundnut or peanut (*Arachis hypogaea L.*) is an important oilseed crop in India. It is attacked by many insects throughout the country at different stages of plant growth, but only a few of the over 100 insects associated with this crop are economically important. This bulletin provides short descriptions of the most important species, their biology, distribution, and damage symptoms. Color photographs are provided for easy identification of the pests, and appropriate control measures are suggested.

Résumé

Manuel d'identification des insectes nuisibles de l'arachide en Inde: L'arachide ou cacahuète (*Arachis hypogaea* L.) est une importante culture oléagineuse de l'Inde. Partout dans ce pays, plusieurs espèces d'insectes s'attaquent à cette culture aux divers stades de développement de la plante, mais seules quelques-unes des plus de 100 espèces identifiées portent une importance économique. Ce bulletin donne de courtes descriptions des espèces-clés, leur biologie, leur répartition et les dégâts qu'elles causent. Des photos en couleurs facilitent l'identification des insectes. Des mesures de lutte appropriées sont proposées.

Cover: Red hairy caterpillar *(Amsacta albistriga)* on a groundnut leaf.

A Groundnut Insect Identification Handbook for India

J.A. Wightman and G.V. Ranga Rao

ICRISAT

Information Bulletin no. 39

International Crops Research Institute
for the Semi-Arid Tropics
Patancheru, Andhra Pradesh 502 324, India

1993

Sponsored by

राष्ट्रीय डेरी विकास बोर्ड

National Dairy Development Board
Anand 388 001, India

Contents

Authors' Note

This handbook has been published to help agricultural scientists, extension workers, and students identify the common insect pests of groundnut. A number of insects found on this crop are not pests; many are even beneficial, because they feed on pest species. Illustrations of a few of these beneficial insects are included, to emphasize that it is important to determine the role of insects found on crops rather than to assume that all insects are harmful and so must be eliminated! Brief descriptions of the distribution and biology of the pests are given, together with suggestions for control measures, where appropriate. Chemical control should be used only where essential, and preferably with the advice of a plant protection specialist. It is not easy to identify insects, particularly from photographs. Readers are therefore recommended to collect and preserve insects found on their crops, to seek help from professional entomologists to identify them, and to maintain specimen collections for future reference.

ICRISAT scientists would like to receive feedback on the impact of the recommendations made in this bulletin, particularly as insect response to control measures is likely to vary in different varieties, environments, and farming systems.

Preface

In India, insect pests are often thought to be a major constraint to groundnut production. In the past, groundnut was grown mainly as a secondary crop in subsistence farming conditions, but in recent years the crop has gained importance due to the shortage of edible oil in the country. Farmers consider groundnut to be a risky crop because of its need for high inputs and its pest and disease problems—groundnut crops are attacked by several insect species at different stages of crop growth.

Identification of a pest, and sufficient information on its biology, the extent of the damage it causes, and feasible control options are prerequisites to initiate any pest management strategy. Information on these parameters is therefore discussed in this bulletin. This information, supported by color photographs, will help scientists, students, and extension workers identify the key insect pests of groundnut. It is important to note that most groundnut pests are of localized importance, often to epidemic proportions. It is abundantly clear that most pest outbreaks are induced by poor management—excessive application of insecticides, ineffective crop rotations, etc. 'Close' monitoring and early recognition of potential pest species will be very useful in future pest management programs.

Introduction

Groundnut *(Arachis hypogaea* L., Fig. 1) is a major oilseed crop in India, occupying 8.6 million ha, of which 85% is rainfed and 15% irrigated. The crop is cultivated in 45% of India's total oilseed area and accounts for 55% of the oilseeds produced in the country. Groundnut seeds contain approximately 50% edible oil and 25% protein. The haulms remaining after pod removal are used as valuable, nutritious fodder. Groundnut oilcake is an important cattle feed and a good soil amendment. Although India ranks first in area and production (7.2 million t) in the world, average yields are low (1 t ha^{-1} in the rainy season and 2 t ha^{-1} in the postrainy season). The low yields in the rainy season are associated with the low levels of inputs characteristic of rainfed agriculture in the tropics.

Groundnut, being a leguminous plant, enriches the soil with nitrogen and is therefore valuable in crop rotations and soil improvement. It is often intercropped with a wide range of short-duration crops such as sorghum and millets (Fig. 2). Over 12% of the groundnut produced in India is utilized as seed, 6% for domestic consumption, and 81% for oil extraction; only 1% is exported.

Most groundnut insect pests are sporadic in occurrence and distribution. In general, insects cause 10-20% crop loss. However, there are instances of total crop loss caused by a single pest species. Although many insect species live and feed on the groundnut crop, only a few cause significant damage that results in large reductions in pod and haulm yields.

Although there is wide variation between genotypes, groundnut plants have considerable natural resistance to insects. This resistance is due to the production of anti-insect chemicals in the leaves and pods, the presence of long and/or dense hairs on the leaves, and the ability of established crops to recover from the removal of more than half their leaf material with minimal reduction in pod yield.

The main pests of groundnut can be more or less specific to this crop e.g., aphid and the groundnut leaf miner, or general feeders that attack a wide range of crops e.g., tobacco caterpillar (armyworm) and the other defoliators, white grubs, and termites.

On the basis of currently available information, it is unwise to rate such insects as the ash weevil and non-viruliferous thrips as being economically important. Data on yield loss caused by jassids (leaf hoppers) are not always convincing, although these little insects can undoubtedly reduce productivity when they are present in large numbers. Virus vectors and soil insects pose different and difficult problems. The former can cause significant losses in yield if a virus-carrying population invades a field, even at low densities. Soil insects can also cause considerable damage at low population densities, and in addition are difficult to detect before the damage occurs.

In this bulletin, defoliators (all but one of them caterpillars), sucking insects (including virus vectors), soil insects, and storage insects are discussed under separate headings.

Figure 1. A healthy groundnut crop.

Figure 2. Groundnut intercropped with pearl millet.

1

2

Defoliators

Many species of leaf-eating caterpillars are found on groundnut plants, but few are of economic importance. Most defoliators are polyphagous and sporadic in occurrence. It is evident from past experience that groundnut crops can tolerate considerable defoliation. Natural control processes usually keep defoliators at densities well below their economic threshold levels. However, the indiscriminate use of insecticides can cause pest outbreaks that have the potential to inflict total crop loss.

Tobacco caterpillar/tobacco armyworm

Spodoptera litura (Fab.)

(Lepidoptera: Noctuidae)

Groundnut fields in parts of Karnataka and the coastal areas of Andhra Pradesh and Tamil Nadu are often attacked by this pest in the postrainy season.

The adults are light brown moths with a wing span of about 30 mm, and mottled forewings (Fig. 3). Eggs are laid in clusters of several hundreds, usually on the upper surface of leaves. These egg masses, which measure about 4x7 mm, appear golden brown because they are covered with the body scales of the female (Fig. 4). The eggs take 2-3 days to hatch; the larvae disperse quickly from the egg batch. Young larvae are light green. The later instars are dark green to brown on their backs, lighter underneath, and have prominent black spots on the thorax. There are often thin, light-colored lines along the body (Fig. 5). Larvae can be

Figure 3. *Spodoptera litura* adult.
Figure 4. S. *litura* egg masses.
Figure 5. S. *litura* larva.

3

4

5

50 mm long before they pupate. The pupae are reddish brown and are found in the soil close to the plants.

The presence of newly hatched larvae can be detected by the 'scratch' marks they make on the leaf surface (Fig. 6). The older larvae are night-feeders and are usually found in the soil around the base of plants during the day. They chew large areas of the leaf, and can, at high population densities, strip a crop of its leaves (Fig. 7a,b). In such cases, larvae migrate in large groups from one field to another in search of food. In areas where groundnut is grown on light soils the caterpillars have been seen boring into the pods (Fig. 8).

In Andhra Pradesh, the insect has 12 generations a year, each lasting slightly more than a month in winter and less than a month in the hot season. In Andhra Pradesh this pest was once limited to tobacco crops, but outbreaks are now spreading. It is presumed to have adapted to groundnut as a result of the continuous (relay) cropping that became possible following the development of irrigation schemes.

Figure 6. Damage caused by young S. *litura* larvae.
Figure 7a,b. Damage caused by later instar *S. litura* larvae.
Figure 8. Pods damaged by S. *litura* larvae.

6

7a

7b

8

Hairy caterpillars

Amsacta albistriga Walk.

Amsacta moori Butler

(Lepidoptera: Arctiidae)

Several species of hairy caterpillars attack groundnut. Two important ones are the red hairy caterpillars: *Amsacta albistriga,* found in southern India, and *A. moori* in the northern states. Both can be devastating, but are highly sporadic. About a decade ago they were considered to be the key pests of groundnut, but their status has now changed to the extent that they are unpredictably important in isolated pockets.

Both species have one generation a year. The adults emerge from the soil at the onset of the southwest monsoon (usually in June). They are brownish-white moths with a 40-50 mm wing span (Fig. 9). The forewings are completely white in *A. moori* and brown in *A. albistriga.* Females lay 800-1000 eggs in clusters of 50-100 on the host plants. The larvae are initially light brown, but turn reddish as they grow (Fig. 10). Their 'hairiness' makes them conspicuous, especially the larger ones, which are up to 5 cm long. They are gregarious and often migrate from field to field in search of food after devastating the foliage in the field where they hatched.

The larval period lasts for about a month and pupation takes place in the soil. The adults from these pupae do not emerge until the next rainy season.

Figure 9. ***Amsacta albistriga*** **adult.**

Figure 10. ***A. albistriga*** **larva.**

9

10

Bihar hairy caterpillar

Spilosoma (Diacrisia) obliqua (Walk.)

(Lepidoptera: Arctiidae)

This species is widely distributed in Andhra Pradesh, Assam, Bengal, Bihar, Haryana, Madhya Pradesh, Maharashtra, Punjab, and Uttar Pradesh. In recent years, it has become an important groundnut pest in the northern states. There are several generations per year. The adult is a brown moth with a 40-50 mm wing span, and a red abdomen (Fig. 11). The forewings have black spots. Eggs are laid in clusters of 50-100. The larvae (which can measure up to 5 cm) are covered with long yellowish to black hairs (Fig. 12). Their feeding behavior is similar to that of other species of hairy caterpillars. Pupation takes place in leaf litter close to the host plants.

Figure 11. ***Spilosoma obliqua*** **adult.**
Figure 12. ***S. obliqua*** **larva.**

11

12

13

Gram pod borer

Helicoverpa armigera (Hubner)

(Lepidoptera: Noctuidae)

This species is widely distributed throughout India. It completes seven or more generations a year in the southern, and 3-4 generations per year in the northern states.

The moths have a wing span of about 40 mm, and dull brown forewings (Fig. 13). The creamy eggs are laid singly on young leaves and flower buds (Fig. 14). The larvae are morphologically similar to the tobacco caterpillar but do not have black spots on the thorax. Most larvae are dark greenish brown, but they can also be pink, cream, or almost black (Fig. 15). They do not hide in soil during the day and are therefore easier to find in the foliage than are tobacco caterpillars.

The damage caused by larvae to foliage is similar to that caused by the tobacco and hairy caterpillars, but the pod borer prefers to feed on flowers and buds.

Pupation takes place in the soil. This species is considered important on groundnut in coastal Andhra Pradesh, Tamil Nadu, and Karnataka, particularly in areas where cotton (*Gossypium* spp) is extensively grown and insecticide application is heavy. It is believed that in these areas the pod borer migrates to groundnut from nearby cotton fields.

Figure 13. ***Helicoverpa armigera*** **adult.**
Figure 14. ***H. armigera*** **egg.**
Figure 15. ***H. armigera*** **larvae.**

13

14

15

Control

Spodoptera, Helicoverpa, and hairy caterpillars

During the first 50 days after seedling emergence (DAE), if defoliation exceeds 25%, or if one or more larva per plant is found, then apply endosulfan @350 mL a.i. ha^{-1}, monocrotophos @300 mL a.i. ha^{-1}, or fenvalerate @100 mL a.i. ha^{-1}.

Insecticide resistance has been detected in *Spodoptera* and *Helicoverpa* species. Large larvae may, in any case, not be killed by insecticides. Crop monitoring is advisable. Farmers should be prepared to apply insecticide if pheromone trap catches exceed 100 moths per night, averaged over a week, or if there are more than 1-2 *Spodoptera* egg masses per meter of crop row (7-12 plants). Note that the crop can withstand considerable levels of defoliation after the seeds start developing in the pod without significant reductions in crop yield.

There are a number of ancillary control measures such as village or watershed-based decisions about the best crop combinations, advisability of pesticide application (Fig. 16), and the optimum sowing time to avoid pest attack. Crop surveillance, pheromone trapping (Fig. 17), and the relevant decision-making processes should also be fully understood by farm advisors.

More importantly, there are a number of predators (e.g., spiders, Fig. 18; birds, Fig. 19; and ladybird beetles), parasites, and diseases—the 'natural enemies'—which control the population densities of these pests.

Figure 16. Insecticide application; note protective clothing.

Figure 17. Pheromone trap used to monitor the flight intensity of *S. litura* and *H. armigera* moths.

Figure 18. Spider preying on *S. litura* larva.

Figure 19. Insectivorous bird (drongo, *Dicrurus adsimilis)* in a groundnut field.

16

17

18

19

Groundnut leaf miner

Aproaerema modicella (Deventer)

(Lepidoptera: Gelechiidae)

This species is the key pest of groundnut in many parts of India (particularly the southern states) and in some other Asian countries. It has a limited range of hosts, among which soybean *(Glycine max)* is the most favored alternative to groundnut. The adult is a brownish gray moth, only 6 mm long, with a 10-mm wing span (Fig. 20). Shiny white eggs are laid singly, usually on the underside of the leaflets, close to the midribs, and are just visible to the naked eye (Fig. 21). Each female moth lays about 200 eggs. The young larvae mine into the leaves as soon as they hatch (Fig. 22). This means that an infestation is usually detected by the presence of small brown blotches on (or in) the leaf. The mines are about 1 mm long when first noticeable (Fig. 23). If a mine is opened, the minute caterpillar can be seen inside.

The mines enlarge as the larvae grow. When they become too large to occupy the mine, the larvae emerge and web adjacent leaflets together, and continue to feed on leaf tissue from inside the webbed leaves. Pupation takes place in the webbing.

A severely attacked field looks 'burnt' from a distance (Fig. 24). Epidemics can result in total crop loss. In southern India this species completes 3-4 generations in a crop season. Leaf miners are favored by the hot dry conditions of the postrainy season.

Figure 20. ***Aproaerema modicella*** **adult.**
Figure 21. ***A. modicella*** **eggs.**
Figure 22. ***A. modicella*** **larva inside a mine.**
Figure 23. Early symptoms of ***A. modicella*** **attack.**

20

21

22

23

Control. Insecticides, preferably dimethoate @200-250 mL a.i. ha^{-1} or monocrotophos @150-200 mL a.i. ha^{-1} should be applied if clouds of groundnut leaf miner moths are seen flying in the cropped area when they are disturbed, or as soon as the first new mines are seen. Chemical control is recommended if five or more active larvae $plant^{-1}$ are found up to 30 days after seedling emergence (DAE), 10 larvae $plant^{-1}$ at 50 DAE, or 15 larvae $plant^{-1}$ at 75 DAE or later.

The role of natural enemies must be considered. For instance, if more than 50% of the larvae are parasitized (the parasites that can be seen as minute white specks, no more than 1 mm long, attached to the outside of the larvae), postpone the spray, and meanwhile closely monitor the development of the pest population.

There are a number of agronomically acceptable pest-resistant groundnut varieties and genotypes available in India, e.g., ICGV 86031 (Fig. 25). In most parts of the country, however, they have yet to find their way to farmers' fields. ICRISAT is anxious to foster procedures whereby scientists in the national and state programs make use of available sources of resistance in breeding programs.

Figure 24. Field plots with different levels of *A. modicella* damage.

Figure 25. Groundnut variety ICGV 86031, resistant to *A. modicella*.

24

25

Groundnut bud borer

Anarsia ephippias (Meyrick)

(Lepidoptera: Gelechiidae)

The groundnut bud borer occurs in northern India, and is normally considered to be a minor pest. Fully grown larvae are chocolate brown in color (Fig. 26) and 10-15 mm long. Larvae prefer to bore into terminal buds and shoots (Fig. 27). Observations in Punjab indicate that this species can tunnel into the stems.

Figure 26. ***Anarsia ephippias*** **larva.**
Figure 27. Damage caused by ***A. ephippias*** **larva.**

26

27

Tussock caterpillars

Euproctis spp

(Lepidoptera: Lymantridae)

Tussock caterpillars, the larvae of *Euproctis* spp, feed on groundnut leaves, buds, and flowers. *Euproctis* adults are medium-sized moths with a 20 mm wing span (Fig. 28). The caterpillars are easily recognized by the presence of prominent, compact tufts of short hair on the back, near the head, etc. (Fig. 29). Populations are seldom large enough to warrant pesticide application.

Figure 28. ***Euproctis*** **adult.**
Figure 29. ***Euproctis*** **larva.**

28

29

Gray weevils

Myllocerus spp

(Coleoptera: Curculionidae)

Gray (or ash) weevils eat groundnut foliage, particularly during the rainy season, notching or scalloping the edges of leaves (Fig. 30). They are generally of minor importance, but may pose problems in special situations like hybridization blocks because they also feed on flowers. These insects are not known to have attained demonstrable pest status in farmers' fields.

Figure 30. Groundnut foliage damaged by *Myllocerus.*

30

Sucking Pests

Several species of insects feed on groundnut sap. Among these, jassids, aphids, and thrips are common in all groundnut-growing areas. Their economic importance as direct pests is not clear, but is probably exaggerated because the damage they cause is conspicuous. In contrast, the potential importance of aphids and thrips as vectors of virus diseases should never be underestimated.

Aphids

Aphis craccivora Koch.

(Homoptera: Aphididae)

Aphids are found on groundnut plants and other leguminous crops throughout India. *Aphis craccivora* reproduces without mating (in India). Individual adults are capable of producing about 100 nymphs in their 5-30 day life span. These nymphs are dark brown and turn into shiny-black adults in about 10 days. When the population density in the colony reaches a certain limit, winged individuals are found among the wingless forms. They fly away to form new colonies.

Nymphs and adults suck sap from the tender growing shoots (Fig. 31), flowers (Fig. 32), and pegs, causing stunting and distortion of the foliage and stems. They secrete a sticky fluid (honeydew) on the plant, which is turned black by a fungus. The blackened honeydew is called sooty mould. In the past, aphids were considered important only during the early rainy season, but in recent years severe outbreaks have been

Figure 31. ***Aphis craccivora*** **on shoots.**
Figure 32. ***A. craccivora*** **on flowers.**

31

32

noticed during the postrainy season at ICRISAT Center. Such outbreaks are sporadic and are more intense during periods of drought stress. Heavy rainstorms reduce aphid population densities and favor the development of the fungal diseases that kill these insects. Aphids are particularly susceptible to predators like coccinellids, syrphids, lacewings, and a number of parasites.

Although the feeding activity of aphid colonies can retard plant growth, this species is potentially more important as a virus vector. Fortunately, the most important aphid-transmitted viruses (peanut stripe virus, Fig. 33, and the groundnut rosette virus complex, Fig. 34) are either restricted in distribution or do not occur in South Asia.

Control. Apply dimethoate @200-250 mL a.i. ha^{-1} but only under drought conditions, when the crop is young (<30 DAE), all terminal buds are infested with aphids, and no ladybirds, syrphids, or lacewings can be found.

Figure 33. Symptoms of peanut stripe virus disease.

Figure 34. Symptoms of groundnut rosette virus disease.

33

34

Thrips

Scirtothrips dorsalis Hood.

Thrips palmi Karny.

Frankliniella schultzei (Trybom)

Caliothrips indicus (Bagnall)

(Thysanoptera: Thripidae)

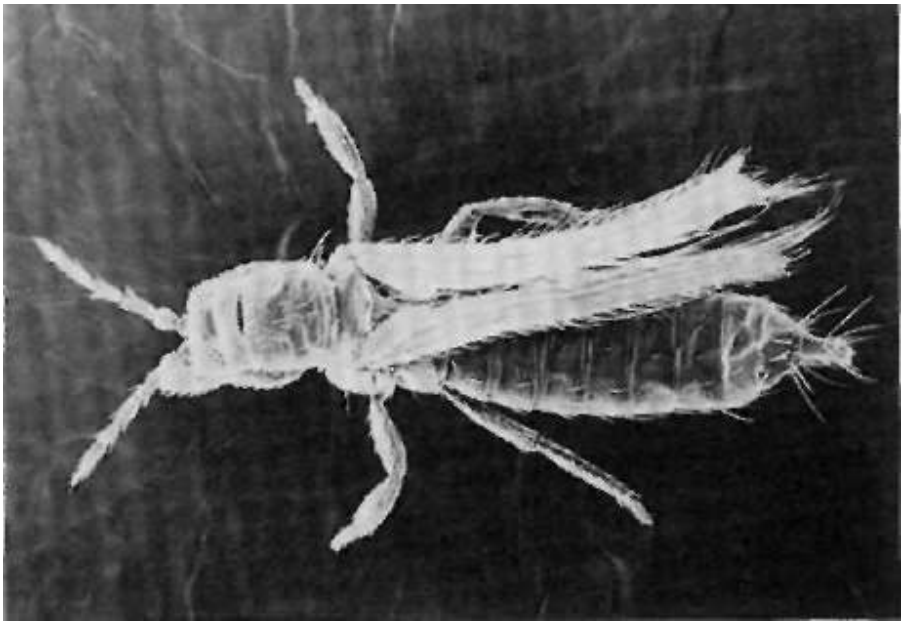
Thrips (Fig. 35) are small insects that live in the flowers and folded leaflets of groundnut. They are only about 2 mm long, pale cream in color, and are usually hidden. For these reasons they are not conspicuous. The most important ones on groundnut are *Scirtothrips dorsalis, Thrips palmi,* and *Frankliniella schultzei.* It is virtually impossible to distinguish between species with the naked eye, although their damage symptoms are slightly different.

The eggs are inserted into young groundnut tissues. The nymphs pass through four instars (two nymphal, and the 'prepupal' and 'pupal' instars) before becoming adults. Under optimal conditions, the immature stages last about 15 days. Adults live for 20 days and lay 40-50 eggs. They can be present at any time of the year but are most numerous in the postrainy season (at ICRISAT Center). They have a wide host range.

Nymphs and adults suck sap from the surface of the leaflets with their rasping and sucking mouthparts. This results, initially, in white patches on the upper and necrotic patches on the lower surface of the leaves (Fig. 36). It consists of distortions of the young leaflets and patchy areas of necrotic tissue that puncture and split as the leaflets grow. Injury is normally seen in seedlings.

Figure 35. ***Thrips palmi*** **adult (scanning electron micrograph, x70).**

Figure 36. Groundnut foliage damaged by thrips.



35

36

In severe infestations, particularly in the winter crop (November-sown in southern India), leaf distortion causes stunted plants. The effect of such damage on yield is not precisely known, but is not serious. However, farmers often apply insecticides to kill thrips. This often results in outbreaks of more serious pests.

Thrips palmi transmits peanut bud necrosis virus (Fig. 37), which can cause widespread plant death.

The feeding activity of *C. indicus* is occasionally seen as a pale mottling on the leaves. This species is of no economic significance.

Control. Apply dimethoate (5)200-250 mL a.i. ha^{-1} if there are more than five thrips per terminal (folded) leaf, only up to 30 DAE in the postrainy season. Thereafter, it is not necessary to use insecticides for thrips control. Insecticide application does not help to reduce levels of bud necrosis disease. There are several varieties with resistance to thrips (Robut 33-1, Kadiri 3, and ICGS 86031), which should be grown in endemic areas to reduce the risk of thrips damage and bud necrosis disease.

Figure 37. Symptoms of bud necrosis disease.

37

Jassids or leaf hoppers

Empoasca kerri Pruthi

***Bachlucha* spp**

(Homoptera: Cicadellidae)

The commonest jassid that attacks groundnut is *Empoasca kerri* (Fig. 38), although *Bachlucha* spp can be abundant in western India, especially in Gujarat.

Jassid eggs are inserted into the leaf tissue close to the midrib, or into the petiole. Under normal conditions the eggs hatch in about a week, and nymphs develop into adults in 10 days. About 40 nymphs can be expected from a single female. High density jassid populations are seen during August and September and February and March. High and well distributed rainfall and low temperatures encourage jassid reproduction.

Both adults and nymphs suck sap from young leaves, mostly from the lower surface. The first symptom of attack is a whitening of the veins. Chlorotic (yellow) patches then appear, especially at the tips of leaflets, probably caused by a reaction between the jassids' salivary secretion and plant sap. Under severe infestation, the leaf tips become necrotic in a typical V shape, giving the crop a scorched appearance known as 'hopper burn' (Fig. 39).

Control. If more than 10% of all leaves (not just those in the top canopy) have the characteristic 'hopper burn' up to 30 DAE, apply dimethoate @200-250 mL a.i. ha^{-1}.

Figure 38. ***Empoasca kerri* adult.**
Figure 39. Severe *E. kerri* infestation.

38

39

Root and Pod Feeders

Several kinds of insects feed on roots and pods. The root feeders are always dangerous to a crop because plants suddenly die, especially during periods of drought. In the case of pod borers the damage is usually detected when the crop is harvested, and it is not always easy to work out which insect caused the damage, especially when the pods have rotted. It is therefore difficult to make recommendations for the control of pod borers, in particular, because they are sporadic and extremely difficult to detect before the damage is done.

White grubs or chafer larvae

Lachnosterna (=Holotrichia) consanguinea (Blanch.)

Lachnosterna serrata (Fab.)

(Coleoptera: Scarabeidae)

Of the 126 species of the genus *Lachnosterna (= Holotrichia),* 89 have been recorded in India. The most important ones are *L. consanguinea* and *L. serrata.* The former is common in the light soils of Rajasthan, Punjab, Haryana, and Gujarat. Though present in the southern states, its importance there is restricted to a few pockets with sandy soil. *Lachnosterna serrata* is found throughout the country, but more commonly in the heavier soils of southern India.

The adult beetles (called cockchafers) are 18-20 mm long and 7-9 mm wide (Fig. 40). Mating takes place at the feeding sites. After feeding, the adults reenter the soil to hide and lay eggs. A single female lays

Figure 40. ***Lachnosterna serrata*** **adults.**
Figure 41. ***L. serrata*** **eggs.**
Figure 42. ***L. serrata*** **larva.**

40

41

42

20-80 white, roundish (2.0-2.5 mm diameter) eggs, often in clusters (Fig. 41). Eggs hatch in 9-11 days. The young grubs are translucent, white, and 5 mm long when they hatch. There are three larval instars; fully grown larvae (Fig. 42) are larger than a man's thumb, and weigh 3-4 g. The larvae feed on soil organic matter for a few weeks and then eat roots. They also damage pods (Fig. 43).

Severely infested fields have large patches of dead plants; the surviving plants are often stunted, and show signs of wilt (Fig. 44). Pupation takes place in the soil (40-70 cm deep), where the insects remain as pupae until the following year.

These species have one generation per year. The adult beetles emerge with the first monsoon showers and feed at dusk on the foliage of trees such as neem *(Azadirachta indica),* acacia (*Acacia* spp), and others.

Several other species of white grubs also attack groundnut. All have a similar life cycle, except for a small-sized species (*Maladera)* which has more than one generation per growing season, especially in irrigated conditions. Another species, *Leucopholis lepidophora* Blanch., has a larval period of more than 1 year. It is reported to have severely damaged the summer crop in riverbed areas of Kolhapur district (Maharashtra).

Plants with fibrous roots (monocotyledons) are able to withstand white grub attack better than species with tap roots (dicotyledons). Crops such as pearl millet *(Pennisetum glaucum)* act as 'nurseries' for infestation.

Figure 43. Pod damaged by white grub larvae.
Figure 44. Field severely infested with white grubs.

43

44

Termites or white ants

Microtermes spp

Odontotermes spp

(Isoptera: Termitidae)

Termites (Fig. 45) (mainly *Microtermes* and *Odontotermes* spp) can cause damage to groundnut plants in several ways: (i) They enter the root system and burrow inside the root and stem (Fig. 46); this usually kills the plant. (ii) They bore holes in the pods and damage the seed (Fig. 47). (iii) They remove the soft corky tissue from between the veins of the pods. This is known as scarification (Fig. 48). They do not usually damage the seed, but scarified pods are more susceptible to infestation by *Aspergillus* spp, which results in the production of aflatoxin, a potent carcinogen, in the infected seed tissues.

Termites are widely distributed in all groundnut-growing areas in India. They favor red and sandy soils, and are less of a problem in post-rice groundnut crops and in Vertisols.

Alates (winged forms) emerge from the soil at the onset of the monsoon. Mating occurs after a short dispersal flight and pairs then seek nest sites in the soil. In a few months the foraging caste starts moving out of newly founded colonies in search of food. Soldiers, which have large mandibles, defend their colony from intruders.

Colonies can extend several meters underground. They can be dug up after considerable effort, but cannot be considered destroyed until the large (50 mm long) queen is dead. Nests can often be detected by their familiar earth mounds and ventilation ducts.

Figure 45. Termites (*Microtermes* sp).
Figure 46. Termite damage to stem and root.
Figure 47. Pods damaged by termites.
Figure 48. Pods scarified by termites.

45

46

47

48

Jewel beetle

Sphenoptera indica (Gory)

(Coleoptera: Buprestidae)

The adult is a shiny beetle, 10 mm long and 3 mm wide. The eggs are laid singly on the main stem. The grubs, on hatching, bore into the stem and tunnel into the root (Fig. 49), causing the plant to wilt and die. The larvae are slow movers, and can easily be identified by their globular head and elongated, dorsoventrally flattened body. They grow to a length of 2.5 cm. However, they often go unrecognized in southern India during both the rainy and postrainy seasons. Pupation takes place in the larval tunnel. The life stages are shown in Figure 50.

Pest surveys during the 1992 rainy season revealed that this species was causing up to 15% plant mortality in the dry tracts of Raichur (Karnataka), Anantapur, and Kurnool (Andhra Pradesh).

Figure 49. Roots damaged by *Sphenoptera indica.*
Figure 50. S. *indica* life stages.

49

50

Earwig

Anisolabis stali Dohrn

(Dermaptera: Forficulidae)

Earwigs are important in some parts of southern India, particularly in clay soils. Their eggs (Fig. 51) are laid in clusters of 20-100, usually in the soil, and sometimes inside damaged pods. The eggs hatch in about a week. The five nymphal instars resemble the adults, which can live as long as 250 days. They can be easily recognized by their unique forked abdominal tip. Both nymphs and adults bore into tender developing pods and feed on the seeds. Infested pods (Fig. 52) are prone to fungal infestation.

Figure 51. ***Anisolabis stali*** **with eggs.**
Figure 52. Pod damaged by ***A. stall.***

51

52

Wireworms

(Coleoptera: Elateridae)

False wireworms

(Coleoptera: Tenebrionidae)

Wireworms (click beetle larvae) and false wireworms (tenebrionid larvae) occasionally cause damage to groundnut. Adult wireworms (dusky brown beetles) occur on foliage and flowers; some species apparently do not feed. Wireworm and false wireworm larvae are white or cream, shiny, hard-bodied, and virtually indistinguishable, even to experts. They feed on groundnut roots and pods (Fig. 53). Fully grown larvae are 2.5-3.5 cm long and 2 mm thick. Pupation takes place in the soil. The biology of the wireworms and false wireworms that attack groundnut is not fully known. They are more likely to be found in clay soils.

Figure 53. Pod damaged by wireworms.

53

Subterranean, doryline, blind, or red ants

Dorylus orientalis Westwood

Dorylus labiatus (Shuckerd)

(Hymenoptera: Formicidae)

Subterranean, doryline, blind, or red ants *(Dorylus* spp) bore into mature groundnut pods. They are about 5 mm long, red-brown, and are rarely seen alone or above the soil surface. They make several neat, round holes, 0.5-2.0 mm in diameter, and remove the seed completely, without leaving any soil inside the empty shell (Fig. 54); termites, in contrast, refill the pod cavity with soil. It is not known how common this species is. It completely destroyed an isolated crop at ICRISAT Center during the 1989 postrainy season, indicating that it has the potential to be a serious pest.

Control of soil insects

Soil insects are difficult and expensive to control with insecticides. Applying carbofuran (3 G) granules in the furrow @1 kg a.i. ha^{-1} can be an effective prophylactic measure. A seed treatment (with any insecticide) that is sufficient to protect a crop from all soil insects has not been found; however, the application of 2.5 mL a.i. of chlorpyriphos kg^{-1} seed as a seed dressing can suppress white grub populations. To control white grub adults, spray their feeding trees with carbaryl 50 WP (2 g L^{-1} of water) 3-4 times until mid-July, ideally using a community approach. In endemic areas, plowing deeply after harvesting the crop can also reduce the population, mainly through bird predation and the destruction of pupae.

Figure 54. Pod damaged by *Dorylus orientalis.*

Storage Pests

Storing groundnut in the pod protects the seed against most post-harvest pests. The only exception is the groundnut bruchid *(Caryedon serratus).* The other insects that are commonly found feeding on shelled groundnuts include the rice moth (*Corcyra cephalonica)* and red flour beetle (*Tribolium castaneum).*

Groundnut bruchid

Caryedon serratus Olivier

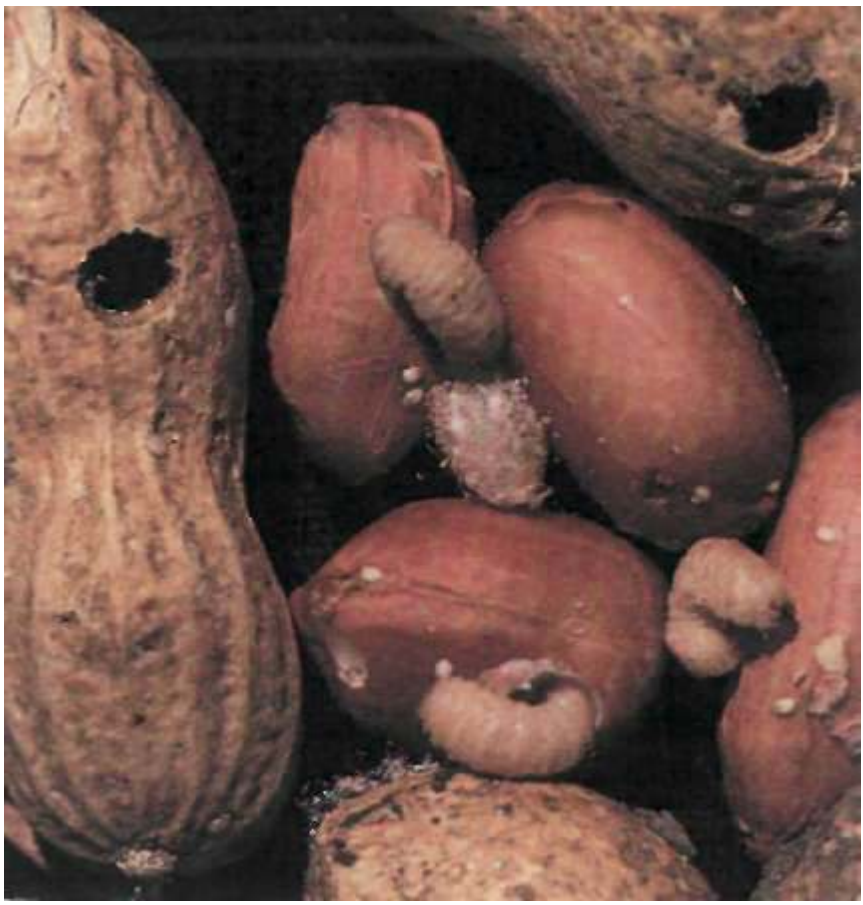
(Coleoptera: Bruchidae)

The adult is a brown beetle about 4-7 mm long and 5 mm wide, with large hind legs (Fig. 55). The translucent milky-white eggs (1 mm long) are attached to the pod wall. After hatching, the larva burrows straight through the egg shell and the pod wall, and starts eating the seed. No damage can be seen at this stage without careful observation. The first sign of attack is the appearance of 'windows' cut into the pod wall by the larva to allow the adult to leave the pod after emerging from the pupal cocoon (Fig. 56). Fully grown larvae sometimes come out through the exit holes made by previous generations. They often leave the storage sack and pupate in large numbers at the bottom of the pile of sacks. By this stage, the groundnut seeds are too badly damaged for human consumption or oil expulsion. Under optimum conditions, the life cycle takes about 40 days. This pest has been found in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, and Tamil Nadu. A systematic search of groundnut storage godowns throughout India is needed to establish the full extent of its severity and distribution.

Figure 55. ***Caryedon serratus*** **adult.**

Figure 56. ***C. serratus*** **eggs and larvae; damaged seeds and pods.**

55



56

Red flour beetle

Tribolium castaneum Herbst

(Coleoptera: Tenebrionidae)

Rice moth

Corcyra cephalonica (Stainton)

(Lepidoptera: Galleriidae)

The most common pests of shelled groundnuts are the red flour beetle (*Tribolium castaneum,* Fig. 57) and rice moth (*Corcyra cephalonica,* Fig. 58). These are considered secondary pests because they are not capable of infesting sound pods. The signs of damage can be easily recognized: the presence of webbing in the case of rice moth infestation (Fig. 59), and powdery remnants—but no webbing—in red flour beetle infestation (Fig. 60).

Adult red flour beetles are 3-4 mm long, oblong, and brown in color. An adult can lay up to 450 individual eggs, distributed among the pods or seed. Eggs hatch in 3-4 days, and the slender cylindrical larvae start feeding on the seed. Pupation takes place in the produce without a cocoon. The pupal period may last for 7-10 days and the adults can live up to 18 months. The developmental period from egg to adult may require about 20 days under optimum warehouse conditions (35℃, 70% relative humidity).

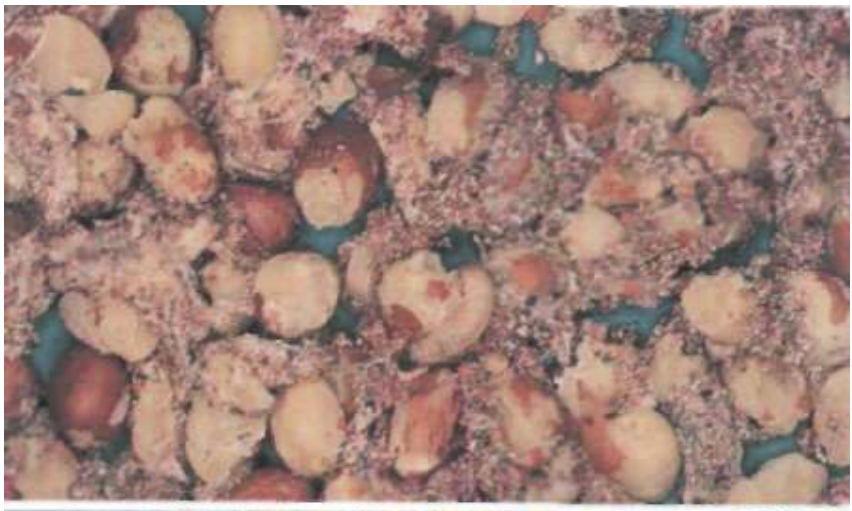
The rice moth has a wing span of 12-15 mm, and grayish brown forewings. The female lays up to 150 eggs within a few days of emergence. The creamy white larvae start feeding on the seed immediately after they hatch. At maturity they construct white, silken cocoons for pupation. Development from egg to adult requires 30-35 days under optimum storage conditions.

Figure 57. ***Tribolium castaneum*** **adult.**
Figure 58. ***Corcyra cephalonica*** **adult.**
Figure 59. Damage caused by ***C. cephalonica.***
Figure 60. Damage caused by ***T. castaneum.***

57

58

59



60

Pod-sucking bug

Elasmolomus (Aphanus) sordidus (Fab.)

(Hemiptera: Lygaeidae)

This species is widespread in India; it feeds on pods left in the field to dry, or on stored pods. The adult is dark brown, approximately 10 mm long and 2 mm wide (Fig. 61). In the field, the females lay their eggs in the soil or on groundnut haulms, but in storage eggs are laid loosely among the groundnuts or on sacks. The first instar nymphs have a bright red abdomen; later instars become progressively darker. All stages feed on seeds, perforating the pod with their rostrum. This causes the seeds to shrivel and increases the free fatty acid content of the oil, producing a rancid flavor.

Control of storage pests

Maintenance of optimum moisture content (not >5%) is always critical in preventing the development of storage pests. For protection against storage pests, except for the groundnut bruchid, groundnuts should be stored unshelled. Fumigation with celphos—3 g tablet per sack of groundnut (40 kg)—and covering the sacks with a polythene sheet for 5 days can effectively control bruchids without affecting seed viability. If groundnuts are stored as seed, care should be taken to avoid breakage. Broken seeds should not be stored for long periods. Dusting with an inert substance such as attapulgite-based clay dust (ABCD) can help to minimize storage insect problems.

Figure 61. ***Elasmolomus sordidus*** **adult.**

61

Notes

Notes

Notes

About ICRISAT

The semi-arid tropics (SAT) encompasses parts of 48 developing countries including most of India, parts of southeast Asia, a swathe across sub-Saharan Africa, much of southern and eastern Africa, and parts of Latin America. Many of these countries are among the poorest in the world. Approximately one sixth of the world's population lives in the SAT, which is typified by unpredictable weather, limited and erratic rainfall, and nutrient-poor soils.

ICRISAT's mandate crops are sorghum, pearl millet, finger millet, chickpea, pigeonpea, and groundnut; these six crops are vital to life for the ever-increasing populations of the semi-arid tropics. ICRISAT's mission is to conduct research which can lead to enhanced sustainable production of these crops and to improved management of the limited natural resources of the SAT. ICRISAT communicates information on technologies as they are developed through workshops, networks, training, library services, and publishing.

ICRISAT was established in 1972. It is one of 18 nonprofit, research and training centers funded through the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an informal association of approximately 50 public and private sector donors; it is co-sponsored by the Food and Agriculture Organization of the United Nations (FAO), the World Bank, and the United Nations Development Programme (UNDP).

RP - 08861

ICRISAT
International Crops Research Institute for the Semi-Arid Tropics
Patancheru, Andhra Pradesh 502 324, India

ISBN-92-9066-275-1 Order Code IBE 039 Printed at Pragati Art Printers 93-303