ICRISAT
Public Awareness Series

Legumes Entomology

A predatory beetle feeding on a caterpillar.

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

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Coordinated Research on Pest Management

Grain legumes are a valuable source of protein and other nutrients for the resource-poor people of the semi-arid tropics (SAT). This is why ICRISAT includes chickpea, groundnut, and pigeonpea in its mandate. However, the SAT climate encourages sudden outbreaks of the pest populations that can decimate these important crops. Research on developing methods of countering these pests involves: (a) breeding varieties with pest resistance that are adapted to the conditions of particular zones; (b) developing other methods of pest control based on a sound understanding of plant-insect-environment interactions; and (c) collaborating with other research specialists to optimize production processes at the farm level.

2. *Diversifying a chickpea field with coriander strips reduces pest damage in chickpea by enhancing natural control processes.*

Habitat Diversification and Natural Control

ICRISAT's entomologists recommend that farmers should adopt management practices that do not interfere with the activities of the insects, spiders, birds, and lizards that feed on the insects that can become pests (cover). For instance, sowing large areas of one crop, monocropping, encourages such pests as the pod borer *Helicoverpa armigera* because the insect's food is highly concentrated in space and/or natural control processes no longer operate in these simplified environments.

ICRISAT emphasizes that there is scope for farmers to reduce the effect of pests if they modify the management patterns of their crops. However, many do this without realizing how or why. For instance, traditional intercroping and multicropping systems can reduce pest incidence perhaps because of a simple interference effect. ICRISAT scientists are studying this phenomenon in the hope of improving upon it. They have already found that the level of pod-borer attack on chickpea is much lower in farmers' fields than on research stations. This may be partly because the flora of farms and the surrounding areas is more diverse than on research stations. Moreover, an ICRISAT study showed that farmers tended to sow their crops at a time that would result in the flowers and pods developing when the pod borer was least active.

Experiments indicate that umbellifers, such as coriander, sown as companion plants, increase the density of the populations of the natural enemies of caterpillar pests (Fig. 1). Intercropping sunflowers in groundnut fields reduces thrips populations, and mulching with neem cake not only improves plant vigor but also reduces the level of termite attack.

Host-Plant Resistance

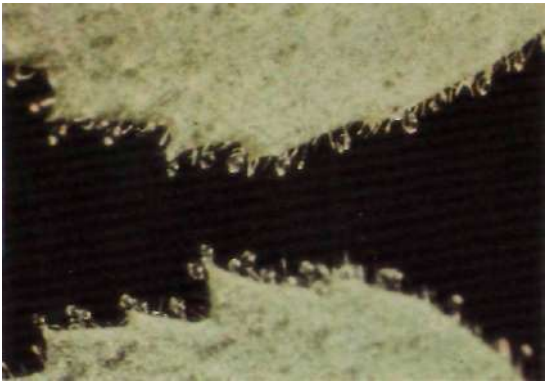
ICRISAT scientists have been successful in detecting strains of pigeonpea and groundnut that have resistance to a range of pests (see Fig. 2). It is possible to demonstrate several forms of resistance. For instance, jassids and thrips are deterred by the long leaf hairs of some varieties whereas a specific chemical in one variety makes it resistant to aphids. Cooperation by breeders and entomologists has resulted in the development of high-yielding, pest (and disease)

2. *Indian farmers produce excellent groundnut and pigeonpea crops on unsprayed fields by growing cultivars with host-plant resistance, following ICRISAT's recommendations.*

resistant varieties, such as ICGV 860312, ICGV 865535, ICG(FDRS) 10, and ICG(FDRS) 44.

The wild relatives of groundnut are the most potent source of resistance to insects. However, they are more difficult to exploit because special techniques are needed to transfer the desired characters to the cultivated groundnut.

Success in this area is not limited to groundnut: chickpea varieties ICCX 730094-18-2-IP-BP-EB (short-duration) and ICCC 13 (medium-duration) give good yields when exposed to pod-borer attack. Pigeonpea lines ICPL 197-1-1-6EB, 2-2EB, 269, and 288 also have resistance to pod borer. One of ICRISAT's Helicoverpa-resistant, high-yielding germplasm selections, ICPL 332, was released in 1989 for cultivation in India.



3. *Chickpea's acid exudates are a form of natural chemical defense.*

Evidence from experiments and from farmers' fields indicates that insecticide applications can induce pest outbreaks, both of the target insect and of other pests. There are two reasons for this. (a) The natural enemies of the pests are killed by the insecticide at the same time as the pest but are not able to recolonize a crop as quickly as the pest. This results in pest resurgences. (b) The pests become resistant to the insecticides as a result of repeated applications. It is not unusual for Asian groundnut farmers to apply insecticides to groundnut crops seven times in a season to kill insect populations that would not have reduced the crop yield. The disturbing factor is that no insecticide would have been needed if none had been applied. In this context it is interesting to compare groundnut crops in Africa and Asia. The former rarely receive insecticide sprays and support few pests, whereas in Asia pesticides are widely used and defoliators cause much concern.

However, ICRISAT scientists are very much aware that insecticides (microbial, botanical, and chemical) are needed to save crops in specific situations. For instance, damage to groundnut by the tobacco caterpillar, *Spodoptera litura,* causes yield losses only if it attacks during the seedling and flowering stages. This indicates that insecticides may need be applied only during the first 4 to 6 weeks of crop growth if the

population is likely to exceed a given population density, as indicated by moth activity or egg-density counts.

Similarly, the groundnut leaf miner is normally kept under control by a wide range of predators and parasites. If this process is disrupted by insecticides, the pest is likely to increase in number and reduce yields. In this case we know that heavy infestations of mature plants will result in a reduction of the number of pods produced, but only when there are more than 60 active mines per plant.

Background Research

ICRISAT scientists tend to concentrate on topics that cannot be addressed easily by their counterparts in national research programs. For instance, they are in a position to carry out pest surveys and to interact with other international research organizations to do specific jobs such as monitoring the migrations of pests, such as the pod borer, across continents. They can also concentrate on topics that are relevant to the needs of the farmers of many countries. The elucidation of the mechanisms of host-plant resistance (Fig. 3) and the determination of pest population densities below which insecticides should not be applied are good examples of this.

Integrated Pest Management

No one method of pest control is by itself perfect and farm management integrates many interacting processes. ICRISAT's legume entomologists see the need to get many people to work together to find ways of helping farmers to grow better crops without putting their environment at risk by overexploitation and polluting it with pesticides. Thus their concern for managing pests must meld with the perceptions and needs of farmers, extension workers, and other crop specialists into an integrated pest management scheme that could include:

- modifying cropping patterns and sowing times;
- sustaining natural control processes;
- breeding varieties with host-plant resistance;
- the judicious use of insecticides.