

## Insect Pests of Finger millet

The grains of small millets are nutritionally superior to rice and wheat, provide cheap proteins, minerals and vitamins to poorest of the poor, where the need for such ingredients is the maximum. Millets are small grained cereals, the smallest of them include finger, kodo, foxtail, proso, little and barnyard millets. Realizing the importance of millets, the nutritional superiority of these grains they are now considered as nutri- cereals (Nutritious grains).

Plant protection deals with both insect pests of various kinds and equally varied types of diseases. There are over a dozen pests, which, when infest the crop, do damage the crop to a varying degree depending upon the stage of the crop growth (Puttuswamy and Channabasavanna 1977, Nagarajan and Channabasavanna, 1977 and Jagadish and Musthak Ali (1983). However, only few of them are severe to cause economic losses.

### Economic Loss:

There are three stem boring caterpillars- pink borer, white borer and sorghum stem borer- in central and southern India. The borer of economic importance is pink borer. Krishnamurthi and Usman (1952) made detailed studies of the life cycle and economic loss caused by this pest to the finger millet. Infestation caused to the extent of 1 to 6 per cent. Puttarudraiah and Channabasavanna (1950) identified *Cacoecia* sp. As causing severe damage to developing finger millet ears in Karnataka, David *et al.*, (1962) recorded 5 different caterpillar species on ear head at Coimbatore, of which *Cryptoblabes* sp., *Eublemma* sp. and *Heliothis* were found to cause extensive damage (26 to 38 per cent). The rusty plum aphid, *Hysteroneurasetariae*, is often found infesting the leaves, stem and shoots in large numbers. Yield loss could be as high as 50 per cent in nursery stage (Nageshchandra, 1981).

Common name	Scientific name	Damaging stage	Plant part attached	Status
<b>Finger Millet –<i>Eleusinecoracana</i> Gaertn.</b>				
Pink or stem borer	<i>Sesamia inferens</i> Walk.	Caterpillar	Stem	High
White stem borer	<i>Saluria inficita</i> , Walk,	Caterpillar	Stem	Low
Sorghum stem borer	<i>Chiloptellus</i> , Swin	Caterpillar	Stem	Moderate
Earhead caterpillar	<i>Cryptoblabes angustipennella</i> Hamps.	Caterpillar	Ear	High
	<i>Helicoverpa armigera</i> , Hb	Caterpillar	Ear	High
	<i>Eublemma silicula</i> , Swin	Caterpillar	Ear	Moderate
	<i>Cacoecia epicyrta</i> , Meur.	Caterpillar	Ear	High

Red hairy caterpillar	<i>Amsacta albistriga</i>	Caterpillar	Leaf	Low
Shoot Aphid	<i>Hysteroneurasetariae</i> , Them.	Nymph & Adult	Leaf, stem, ear	High
Root aphid	<i>Tetraneuranigriabdominalis</i> , Sasaki	Nymph & Adult	Root	Moderate
Leaf hopper	<i>Cicadulinabipunctellabipunctella</i> Matsumura <i>Cicadulinachinai</i> , Ghauri	Nymph & Adult Nymph & Adult	Leaf Leaf	Mod-high Mod-high
Surface grasshopper	<i>Chrotogonus sp.</i>	Nymph & Adult	Leaf	Low

## Pests of Ragi (Finger millet)

### 1. Ragi Stem Borer

There are two types: Pink borer (*Sesamia inferens*) and Ragi White borer (*Saluria inficita*). Pink borer has been the most common pest of ragi. It has limited host range: sorghum, wheat, sugarcane and rice. Krishna Murthy and Osman (1952) made a detailed study on the life history of this pest together with possible control measures including biological control.

**Host range :** It has a wide host range, which include dry and irrigated ragi, sugarcane, sorghum, rice, wheat and maize. However, its preference is to irrigated ragi crop.

**Distribution :** It is widely distributed in all finger millet growing countries. It is more regularly recorded from parts of Orissa, Karnataka, Tamil Nadu and Andhra Pradesh.



#### *Nature of Damage:*

Larval feeding first leads to leaf scarification and then to make small pin holes in the opening of leaves. The 3rd instar larvae migrate to the base of the plant and bore inside leading to the production of central shoot starts drying i.e. typical stem borer 'deadheart'. In mature plants, the larvae bore the stems and make tunnels while feeding on the internal tissues.



#### **Management :**

- Ploughing of the stubbles of the previous crops is more important to prevent the carryover of the inoculums from the previous crop.
- When the seedlings grow to standard size, earthing up the crop minimized its infestation.
- Dimethoate found to be effective against borers.
- The biological agents seen to be effective against the pest were *Trichogramma minutum* and *Telenomus* species.

## 2. Ragi White Stem Borer, *Saluria inficita* Walker (Pyralidae : Lepidoptera)

It was specific pest on ragi in South India (Ayyar, 1940) and rarely infests navane (*Sateria italica*) and Rice (*Oryza sativa*).

**Distribution :** This pest is found in all ragi growing states of India. Predominantly noticed in Karnataka, Tamil Nadu, Andhra Pradesh and Orissa.

**Nature of damage and ecology :** The caterpillar is creamy-white in colour and bored into stem like ragi pink borer. It lodges at the lower parts of the plant, close to the soil surface. Oozing of the excreta from the bored hole is very conspicuous in the infested plants. Such plants show the presence of symptoms of drying. The adult moth emerges as a dark-brown, medium sized moth with pale-white bands along the margin of each forewing and white hind wings. Unlike ragi pink borer, it is not a serious pest.

Nevertheless, its control measures were the same as for pink borer. The moths have some attraction to light. Hence, setting up of light traps in the field of the inoculums, to catch them before they lay eggs.



## 3. Grasshoppers

The hoppers destroy seedlings and feed on leaves, and when the infestations are heavy, resowing may be necessary. The important species are *Colemaniasphenarioides*, *Hieroglyphus nigrorepletus*, *H. daganensis*, *Oedaleus senegalensis*, *O. nigeriensis*, *Schistocerca gregaria*, *Locusta migratoria*, and *Chrotogonus* spp.

*Colemaniasphenarioides* Bol. (*Acrididae: Orthoptera*) The Deccan Grasshopper. This pest is quite serious on Jowar, Ragi and Foxtail millet in Karnataka particularly in the districts of Chitradurga, Devanagere, Bellary and Dharwad. This appears as a periodic pest on these crops. When it appears continues to cause damage for a period of 3-4 years and declines. It appeared in epidemic form during the years 1909-1912; 1924-25; 1932-34, 1941-48; 1965-66. This is a wingless grasshopper occurring as a serious pest in South India.

**Alternate hosts :** finger millet, jowar, foxtail millet bajra, little millet, ground nut, pulses, chilli and cotton.

**Nature of Damage :** As soon as the rains (monsoon) are received during June-July eggs hatch into nymphs, initially feed on grasses on the bunds for nearly 2 weeks and later they migrate to ragi or foxtail millet crop. The insect feeds on the foliage and may also devour the florets and ripening earheads. Under a severe infestation, the crop may be completely destroyed, and need to be resown. The nymph grows by feeding on the leaves of millets and other low-growing plants and becomes full-fed by September. They continue feeding for nearly 2-3 months and their life cycle continue.



Other species of grasshoppers include *Crotogonussp.* (Acrididae, Orthoptera) and mulberry grass hoppers *Orthacris sp.* The earlier one looks like stone, or mimics soil colour. It mainly appears on crop when there is no greenery around or when the field is brought under cultivation by clearing forest land.

#### **Management:**

- Cleaning of bunds having weeds and grasses
- Use of dusts formulations for management of grass hoppers

#### **4. Grey Weevils and Leaf Beetles**

Grey weevils, *Mylocerusspp* occasionally become serious on millets and have a wide distribution all over India. Among these, *M. undecimpustulatusmaculosus* is a general feeder with an extensive range of host plants (Pande, 1971). When the adult numbers reach outbreak proportions, the entire crop may be skeletonized. The

grubs feed on the roots and remain in the soil. The damaged plants dry up or remain stunted. Adults are small weevils with whitish grey elytra. Leaf beetles (*Lemaspp* and *Chaetocnemaspp*) also result in severe damage occasionally during seedling stage in India (Nayar, 1975).



5. **Leaf roller, *Marasmia trapezalis*** is a sporadic pest of sorghum in India but also feeds upon finger millet. The larvae feed on the inside surface of a folded leaf. As a result of larval feeding, the leaves start drying up from the tips. Broad leaved and succulent varieties are highly susceptible.



## 6. Sucking pests

Sucking pests of finger millet includes four species of Homoptera, of the families Cicadellidae, Pemphigidae and Aphididae. Species of Cicadellidae are commonly known as leaf hoppers. They appear during early crop growth stage both adult and nymphs cause damage to seedlings in the nursery and main field by sucking sap from the tender leaves. Signs of attack on damaged plant show white dots and specks in severe stage these specks coalesce and give burnt appearance. These pests pose severe problem by acting as vectors of streak and mottle streak virus disease. They are key agents in causing epidemics of viral diseases on finger millet.

The hoppers lay eggs inside the plant tissue and eggs hatch in a weeks time depending on temperature and humidity. The nymphs on hatching start sucking sap from the tender parts of the plant. Besides this two kinds of aphids viz., shoot and root aphid appear on finger millet crop whenever there is dry spell.

### a) **Leaf or Shoot aphid: *Hysteroneurastariae* (Thomas) (Aphididae: Homoptera)**

Leaf aphids are also called rusty plum aphid, as the name suggests is a brown, small aphid with dark cornicles. It was reported for the first time in India on rice, sorghum, Italian millet and other crops in Madras (Raja Singh, 1968).

**Distribution:** It has been recorded in Madras, Tambaram, Tindivanam, Coimbatore, Madurai, Bangalore, Ananthapur and Coonoor

**Host range:** Ragi leaf aphid is known to attack all graminaceous plants and other grasses

**Nature of damage:** Adult and nymphs of aphids suck the sap of the plant from the base of the spicklets, and spread to the entire plant. Resulting in reduced vigour of the plant and stunted growth, generally infestation starts from the border row and spreads. The infestation is alarming when appears on crop of less than a month old. The occurrence is during the months of August and September. When the crop is caught in dry spell, infestation continues throughout the crop growth stage. In severely infested plants even the earheads are fully covered by aphids.



### b) **Root aphids *Tertaneuranigriabdominalis* (Sasaki). (Homoptera : Pemphigidae)**

These aphids assume serious pest status on ragi by sucking the juice from the roots, so persistently that the whole crop withered unless constantly irrigated and even then the yield was considerably reduced (Fletcher 1914). This aphid was considered as a minor pest of ragi in Mysore, It was also reported from Bangalore, Kolar and Tumkur districts of



Karnataka State. It was also found feeding on the roots of sugarcane (Krishnamurti, 1930 and 1948).

**Distribution :** In India it occurs as endemic pest in traditional ragi growing districts of Karnataka. In the year 1970 outbreak was noticed in Hassan district.

**Alternate hosts:** The eighteen host plants of aphids belong to families Poaceae, Cyperaceae; Commelinaceae and Rubiaceae.

**Nature of damage and biology :** The external evidence of the presence of this pest is gradually fading away of the badly infested plants and the presence of ants visiting the roots, such plants when pulled out will show colonies of the aphids attached to the roots. They suck the sap of the plant from the roots. As these aphids are confined to the root zone, their presence is rarely noticed until the plants show symptoms of wilting, excess tillering, stunted growth and early maturity and occasionally caused drying of the roots. With consequent ill effect on the plant like yellowing, stunting and some time poor seed setting or produce shrivelled grains are the other symptoms. Some times, it causes indirect damage by transmitting plant viruses.

c) **Leaf hoppers (*Cicadulinabipunctellabipunctella* and *C.chinai*)**

Leaf hoppers gained importance in finger millet during 90's because of their role in communicating finger millet mottle streak and streak viruses. The mottle streak virus is transmitted by both the leaf hoppers while the streak virus only by *C. Chinai*.

## 7. Earhead pests

The earhead pests mainly include caterpillars of three different species of Lepidoptera and two species of pentatomid bugs which are minor in nature.

a) ***Helicoverpa armigera*:** Important among the caterpillars is *H. armigera* which is a polyphagous pest. It attacks the ear during dough stage and starts feeding on developing grains and cause damage. They are severe on local varieties of finger millet which have closed fingers giving them a perfect niche for its development and hiding from the natural enemies. While the recent high yielding varieties have semi compact and open type of earheads which are not much preferred by these caterpillar pests to invade.

b) ***Cryptoblabes angustipennella*** Hamp. This is found as a pest of ragi in Karnataka. The early instar larva first feeds on the lemma of the flowers scraping the chlorophyll and later on the milky grains. The caterpillar causes damage by constructing webs on ragi earheads and feeding on the flowers and the grains.



Occasionally **earhead bugs** assume pest status particularly during dough stage. Both adult and nymphs suck the sap from developing grains and cause partial chaffiness of earhead.

## Integrated Pest Management in Finger millet

### I. Cultural Control :

1. **Sanitation:** Field sanitation, and uprooting and burning of stubbles help to reduce the carryover of stem borers. Stalks kept as animal fodder should be fed before the onset of monsoon rains.
2. **Tillage :** Field tillage before planting and after the crop harvest helps to expose the hibernating/aestivating/hiding larvae and pupae of many insect species. Deep ploughing is particularly helpful in reducing the populations of grasshoppers, and hairy caterpillars.
3. **Intercropping :** Finger millet with Mustard and Niger in the ratio of 4:1:5 and 4: 2: 4 respectively, favours buildup of natural enemies and sustains their population
4. **Weed Control :** Proper and timely weeding of the crop reduces the damage by *Mythimna separata* (Sharma and Davies, 1982) and *Spodoptera* spp (Ndoye *et al.* 1986). A clean crop is often less hospitable to insects as the weeds can provide hiding and oviposition sites for some insects. However, in certain situations, ploughed fields have been reported to suffer higher damage than the no-tillage systems (Shenk and Saunders 1981). Weeds (*Digitaria* sp and *E. indica*) tend to harbour larvae of *Spodoptera* sp. and increase crop damage (Huis 1981).

### II. Mechanical Method :

1. **Mechanical Collection and Destruction:** Egg masses of hairy caterpillars and other lepidopteran pests can be hand collected and destroyed. Aphid infestations can also be reduced by uprooting and destruction of the infested plants. Blister beetles can be collected by hand and destroyed (Jotwani and Butani 1978). Head bugs and other external feeders on the ear-head can be dislodged into a bucket containing water to which kerosene has been added (Nair, 1975).

### III. Physical Method:

1. **Setting up of light traps** helps to attract and kill the stem borers and other moth pests

### IV. Host plant Resistance Sources:

A good number of genotypes are found to be resistant to stem borer and aphids which are presented under separate tables 1 & 2. Plants that are inherently less damaged or less infested by phytophagous insects under comparable environments in the field are termed as resistant (Painter, 1951).

**Table 1: Finger millet genotypes either tolerant or less susceptible to *Sesamia inferens* Walk**

Genotypes	Reference
IE 932, IE 982 and IE 1037	Lingappa (1979)
PES 9, PES 144, PES 224, KM 1, KM 14, HR 228, JNR 1008 and T 36-B	Kishore and Jotwani (1980)
KM 1, RAU 1, RAU 3, Indaf ;7, Indaf 8, HR 154, HR 374, HR 1523, PES 110, PES 400, WR 9, VL 110	Murthi and Harinarayana (1986)
VL 109, VR 530, PR 202, HR 374	Dhamdhare (1988)

**Table 2: Promising finger millet cultures resistant to earhead worms, aphid and shoot fly identified in coordinated multi-location screening**

<b>Earhead worms</b>		<b>Aphids</b>		<b>Shootfly</b>
1980-86	1990-96	1980-86	1990-96	1992
Indaf 7	KM 229	PES 176	PES 400	HR 374
Indaf 8	KM 230	RAU 1	VL 149	PES 400
PR 202	PR 202	HR 374	GPU 36	VL 162
PR 177	PPR 2618		KM 225	VL 171
HR 374	HR 374			VL 231
HR 1523	PES 400			VR 584
PES 110	PES 110			VMEC 35
PES 1877	GPM 36			RAU 8
TNAU 1877	TNAU 551			MR 5
TNAU 294	VMEC 35			MR 6
VL 110	VL 149			L 15-1
	VR 530			
	VR 696			
	VR 708			

### **III. Chemical Control**

1. Dusting the crop with Malathion 5% D or Methyl parathion powder for management of red-headed hairy caterpillar, grass hoppers, weevils and also reduce the leaf eating caterpillars.
2. Quinalphos or Methyl parathion 2ml mixed with one liter of water then sprayed for the management of leaf eating caterpillars.
3. **Use of poison bait:** Use 10 kg of rice bran or wheat bran mixed with one kg of jaggery and keep it for overnight. During evening hour insecticide 100 ml quinalphos mixed with fermented mixture of rice bran or wheat bran. Then sprinkle throughout the field to manage *Spodoptera* sp.
4. Use of systemic insecticide i,edimethoate 1.7ml/lit of waterfor the management of leaf aphid.

#### **Future line of work:**

- **Stem borers and ear-head worms on finger millet :**

Work on different borer and ear worm species need to be intensified with regard to economic status of each species by determining the incidence and losses caused in different areas. Besides, research for natural sources of resistance must be continued.

- **Aphids on finger millet and gall midges and borers on small millets :**

Biology and ecology refinement and standardization of screening techniques and continued search for the sources of resistance deserve attention.

- **Biological Control** : Limited information is available on the natural enemies of pests infesting small millets. Critical studies are, therefore, required of key pests and their natural enemies. Surveys of natural enemies should be undertaken and their relative efficiency assessed.