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LOCUSTS

Locusts and their Role as Plant Pests

In tropical and subtropical agriculture grasshoppers or locusts are a serious economic problem, since they attack many different crops. Their voraciousness leads to injury or destruction of leaves, buds, flowers, shoots and fruits. The grasshoppers and locusts to be reckoned with belong to the family Acridiidae which, like the "long-horned grasshoppers" (Tettigoniidae) and the crickets (Gryllidae), are members of the order Orthoptera. The ordinary term "grasshopper" for representatives of the family Acridiidae refers to the species which always shows solitary habits. The female grasshoppers lay several egg-pods in the ground, one egg-pod containing 30 eggs or more. The hatching larvae, also called "hoppers" because of their peculiar hopping movements, develop and remain within a small area around the hatching sites and do not form swarms. The winged adults fly only short distances.

The term *locust* is usually applied to those species of the family Acridiidae which develop gregarious habits and sporadically leave their breeding grounds in large numbers to fly over distances of hundreds of kilometres, often destroying crops in a few hours.

Some of the most important subtropical and tropical migratory locusts are:

Schistocerca gregaria Forsk.

desert locust (see Fig. 60)

Distribution: Africa (northern half)
Near East
Middle East
India

Male: 40-50 mm long, body pale yellow to yellowish-brown

Female: 50-60 mm long, body pale yellow to yellowish-brown. Elytra greenish-yellow to greenish-brown, transparent, with numerous brown spots.

Schistocerca paranensis Burm.

Distribution: South America

Male: 40-50 mm long, body yellowish-brown to reddish-brown

Female: 50-60 mm long, body yellowish-brown to greyish-brown, elytra transparent, with numerous brown spots

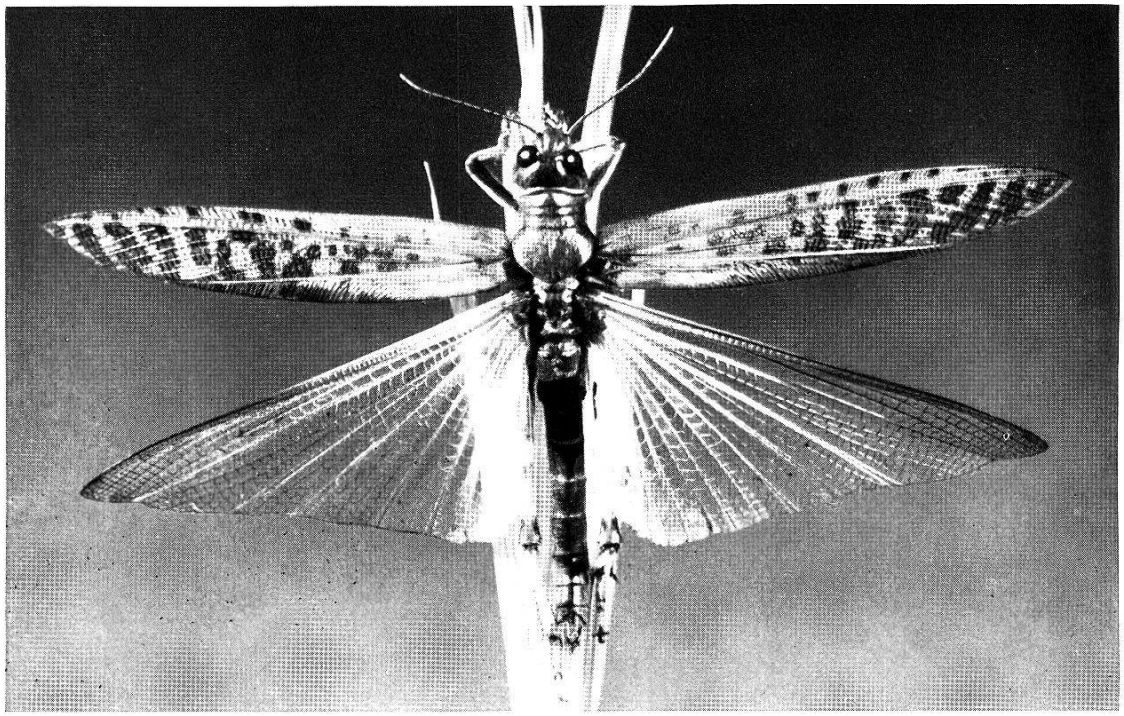

Fig. 57. Adult stage of *Schistocerca paranensis* Burm.

Locusta migratoria migratorioides R + F

African migratory locust

Distribution: tropical Africa

Male: 35-40 mm long, body yellow to greenish-yellow with fine, dark lateral stripes across and along the abdominal segments

Female: 40-50 mm long, body pale beige-brown to greyish-brown, elytra slightly hyaline, transparent with numerous brown spots

Locusta pardalina Walk.

brown locust

Distribution: South Africa

Male: 30-35 mm long, body yellowish-brown to reddish-brown

Female: 35-40 mm long, body reddish-brown to greyish-brown, elytra transparent with numerous brown spots. Tibiae of hind legs pale yellow. Distinct keel along the prothorax

Dociostaurus maroccanus Thunb.
Moroccan locust

Distribution: Mediterranean region,
Morocco
North Africa
Turkey

Male: pale x-shaped design. Upper side of femora of hind legs with 5 dark, distinct dots. 20-25 mm long, markings similar to those of female

Female: 25-30 mm long, body dark reddish-brown, greyish-brown or yellowish-grey. Forewings with a brownish hue, transparent, with 6-7 dark brown transverse spots.

Nomadacris septemfasciata Serv.
red locust

Distribution: Africa
(south of the Equator)

Male: 50-60 mm long, coloration similar to that of female

Female: 60-70 mm long, body yellowish-brown to dark brown. Prothorax with broad, yellow and reddish-brown longitudinal bands. Costal and inner margins of forewings banded yellow, the remainder brownish and transparent. Tibiae of hind legs reddish. Base of hindwings red.

Locust Life History

The life cycle of migratory locusts, like that of grasshoppers, has three phases: *egg—hopper—adult.*

The ovipositing female introduces its abdomen 5-8 cm into the soil, where it deposits many eggs stuck together with a foamy secretion. The earth tube between the eggs and the soil surface is then closed with a plug of colourless foam which later on enables the hatching hoppers to emerge from the ground.

During its life span of several months a female locust is capable of laying 4-5 egg-pods containing up to 100 eggs each. According to seasonal or climatic conditions of an area the development period from egg to hopper varies; the eggs may hibernate and hatch in spring or, as is often the case in tropical countries, they may hatch after 2-3 weeks, or else the eggs may lie dormant over a dry period.

The behaviour of the hoppers which start to feed within a few hours after hatching seems to be largely governed by environmental conditions. If there are only a few individuals, i.e. if their habitat is

Fig. 58. Section through the ground: Female locust and egg-pod. Some of the foamy secretion has been removed to show the eggs.

large enough to give them living room, they remain in the "*solitary phase*". In this phase the whole development is similar to that of grasshoppers: they remain within a relatively small area without forming bands or swarms. In unfavourable conditions, for instance when large numbers of freshly hatched hoppers are massed together in a restricted area, they develop into the "*gregarious phase*"; the hoppers become darker and more differentiated and tend to form bands. Hopper bands consist sometimes of millions of individuals covering vast areas.

Migration of these hopper bands takes place in daytime and often follows one direction (with the wind). They destroy a great deal of the vegetation they find on their way.

During migration which lasts 30-40 days the hoppers undergo five moults, after which the winged adult stage is attained. A few weeks later they become sexually mature.

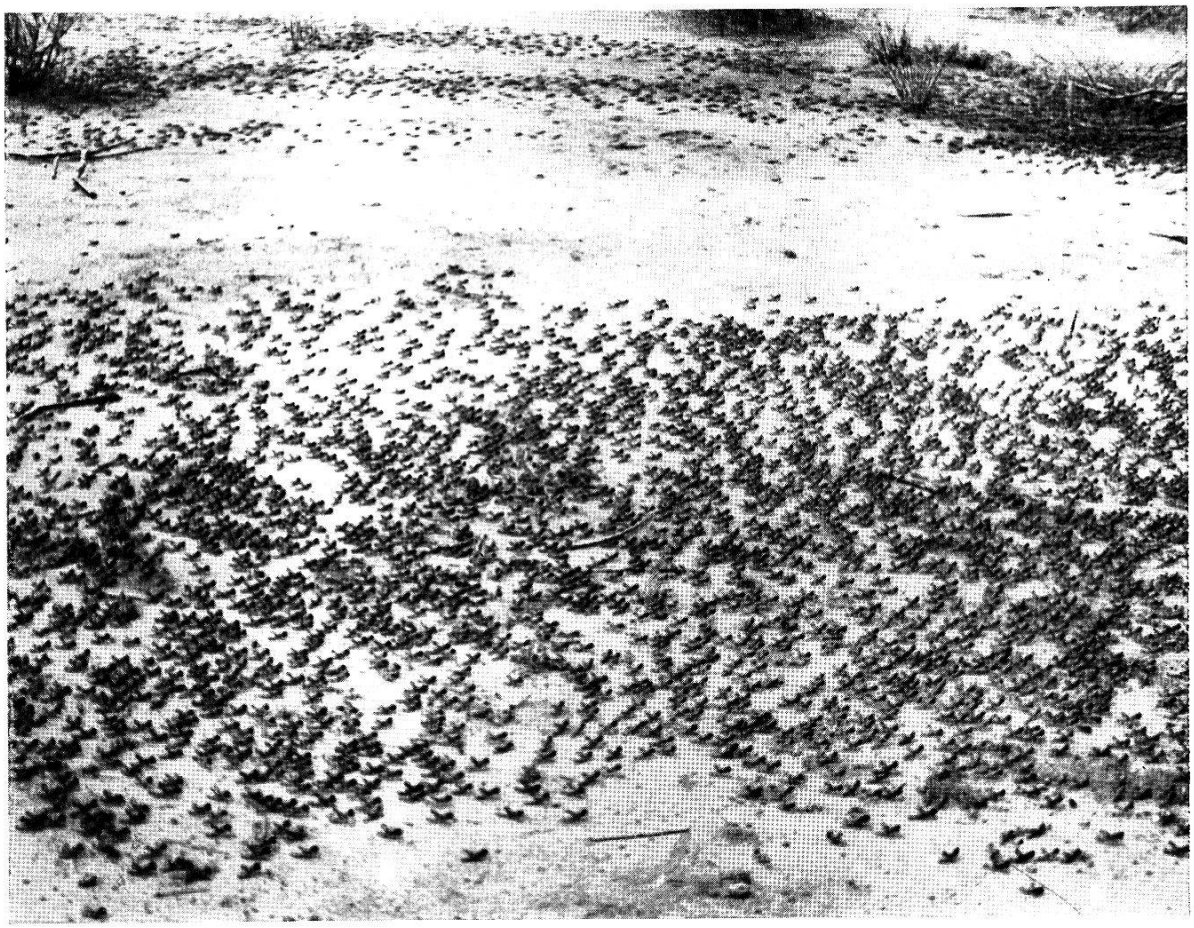

Fig. 59. Desert locust hopper band.

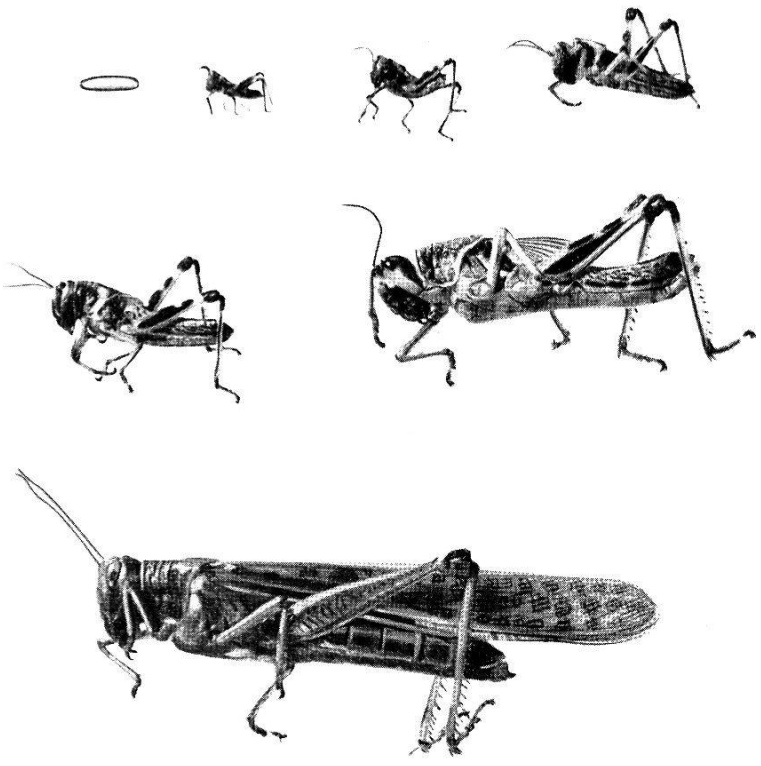

Fig. 60. Development of the desert locust, *Schistocerca gregaria* Forsk; above = egg, hopper stages 1-3; centre = hopper stages 4 and 5; below = adult stage.

Shortly after reaching the adult stage, the winged locusts undertake flights, first over short distances, later forming vast swarms which fly in stages of hundreds of kilometres. The size and intensity of occurrence of such swarms are subject to distinct fluctuations. Direction and speed of a swarm in flight seem to be influenced by the direction and velocity of the wind. According to RAINEY meteorological conditions are also greatly responsible for the choice of breeding and egg-laying sites of flying swarms, the wind carrying them towards so-called "zones of convergence", i.e. zones where the average rainfall is high. The female locust favours damp soil for egg-laying where the eggs develop best. According to climatic zones oviposition and hatching of the various locust species may occur at different seasons.

Control

Locust plagues, moving year after year from one country to another in vast and dense swarms require large-scale, rational and effective control measures, based on a thorough knowledge of the causes of periodical outbreaks, of the biology of locusts, their bionomics and other factors playing a part in their life.

The Anti-Locust Research Centre in London, a unit of the British Department of Technical Co-operation, has been investigating the scientific and technical problems of locust control for many years. A great number of research and field workers are engaged in the study of these problems, doing laboratory and field experiments and keeping control measures up to date. Cartographic notes report on the presence and outbreak of locust populations, on the direction of their movements and the sites of egg-laying in various countries. This enables ALRC to issue regular information on swarm movements so that adequate control measures can be planned and undertaken in good time. For many years Algeria, Egypt, Ethiopia, India, Iran, Iraq, Jordan, Libya, Morocco, Pakistan, Saudi-Arabia, Sudan and other countries concerned have maintained anti-locust organizations which undertake joint control operations. FAO and UNO also act as centres for the coordination of research and control measures on an international basis and lend their financial help to such schemes.

Control Measures

Many methods of combating migratory locusts have been known for centuries. Agricultural measures, such as hoeing and ploughing the soil were directed against egg-pods. Trenches used to be dug to

stop hopper bands on their march, i.e. to catch them so that they could be burnt. Iron sheets were erected across their way, or smoky fires were lit to influence their progress. Noise was produced with tins and drums to stir resting swarms and make them fly away again. Flame throwers were also used. All these methods are no more in practice nowadays, as they have been superseded by modern chemical control methods.

If locusts are to be controlled effectively it is necessary to trace the presence of populations or hopper bands as early as possible and to start operations immediately. The hoppers, as they grow older, become less vulnerable to insecticides so that control actions against the youngest hopper stages are the most economical. A well-organized reconnaissance and information service is thus of great importance.

A. *Baiting*

A very efficient and widely used control method against hoppers, and under favourable conditions also against settled swarms of adult locusts is poison baiting. The best baits are: broken wheat; bran; rice bran; rice chaff; cotton seed meal; barley; millet or maize meal. Insecticides are mixed either as dust (dry bait) or as emulsion (wet bait) with the bait. (For concentrations of insecticides see appendix.) The poisoned baits, 20-30 kg per hectare (10.000 square metres) are spread by hand over an infested field. Baits should be applied at dusk and placed in front of the resting hopper bands because the hoppers, hungry in the morning, feed better on them this way. Drawbacks of baiting are: the relatively high cost of application, the transport of the bulky baits and the cost of the baits themselves. Their action is insufficient while the hoppers undergo moulting, since during that period they do not feed for 1-2 days and thus refuse the baits.

B. *Dusting*

When baiting substances are not available, the early instars of hoppers can be killed by dusting. Application has to be directed against the hopper bands themselves and if possible the vegetation ahead of them should be dusted also. Resting swarms of adults can be treated with dusts as well. The effect of these products is enhanced when applied early in the morning or after light rainfall, since the dusts adhere better when moistened by dew or rain.

C. *Ground Spraying*

Liquid insecticides are applied as "low volume spray" or "high volume spray" with suitable ground spraying apparatus (cf. page 482). against locusts and grasshoppers of various stages. In cultivated

areas such as plantations and nurseries the plants can be protected against locust and grasshopper attack with stable, persistent insecticides applied with a knapsack or motor sprayer.

The ideal insecticide should be harmless to the crop it is protecting and at the same time long lasting so that it can be applied preventively before the first attacks, while remaining to deal with subsequent attacks of fresh swarms. While ground spraying is hardly possible against swarms of adults, hopper bands can be effectively controlled with concentrated insecticides used as low volume sprays. Special equipment enables insecticides of suitable formulation to be deposited as fog over relatively long distances on the vegetation where the hoppers are expected to pass. With insecticides of long lasting effect, hoppers that hatch several days after application can be killed.

D. *Aircraft Spraying*

The use of aircraft has been a great step forward in locust control, offering new possibilities for the application of insecticides as well as for reconnaissance and survey of locust invasions. Insecticides applied from aircraft reach not only hopper bands but also

Fig. 61. A desert locust survey aircraft, fitted with boom and nozzle spray gear spraying a swarm in Somaliland.

swarms of adults, difficult to combat from the ground. Highly concentrated oil concentrates, suspensions, emulsions or fog solutions are applied as low volume spray in two different ways: either as air-to-ground spraying or as air-to-air spraying. In the first case application is directed against bands of hoppers or resting swarms of adults in areas where crops are in immediate danger or in areas where ground operations are impracticable. With the air-to-air spraying method the concentrated insecticide is applied right *into* the swarm in flight.

Laboratory tests showed (RAINEY) that locusts in flight are considerably more vulnerable to contact poisons than resting locusts. Aeronautical conditions in relation to the correct drop spectrum, i.e. the suspension and sedimentation rate of highly concentrated and fast acting contact insecticides, are important factors in this method.