DESERT LOCUST AND ITS MANAGEMENT

Introduction

Locusts are the short-horned grasshoppers with highly migratory habit, marked polymorphism and voracious feeding behavior. They are capable of forming swarms (adult's congregation) and hopper bands (nymphal congregation). Their swarms can migrate hundreds of kilometers per day and invade areas covering millions of square kilometers, resulting in major economic, social, and environmental impacts on an international scale. This group of insects contains hundreds of pest species whose invasions can be disastrous for both the food security and livelihoods of the rural populations in affected areas (one in every ten people worldwide as reported by FAO). They cause great devastation to natural and cultivated vegetation. Desert locust is the most harmful insect in the world. They are indeed the sleeping giants that can flare up any time to inflict heavy damage to the crops leading to national emergency of food and fodder. Only four species *viz.,* desert locust (*Schistocerca gregaria*), migratory locust (*Locusta migratoria*), Bombay Locust (*Nomadacris succincta*) and tree locust (*Anacridium* sp.) are found in India. The desert locust is most important pest species in India as well as in intercontinental context.

Locust behaviour

Many species undergo density dependent phase change and the high-density locusts present during plagues differ greatly in behaviour, colour and shape from those present when population numbers and densities are low. Phase change was originally assumed to occur within geographically restricted 'outbreak areas' from which swarms escaped to breed and initiate plagues in the surrounding invasion area. Prior to the formation of flying swarms, which are extremely difficult and expensive to control, flightless juveniles form vast 'marching bands'. A key step preceding the formation of these marching bands is the expression of a dramatic form of phenotypic plasticity mediated by local conspecific density. The two phenotypic 'phases' exhibited by locusts termed 'solitarious' and 'gregarious' may be distinct in many traits, such as coloration, neurophysiology and behavior. However it is the behavioral transition that responds most rapidly, within a few hours, to changes in local population density. Counter to popular belief, locusts are shy, cryptic and solitary individuals that actively avoid contact with each other. As the local density increases beyond a critical value, however, behavioral repulsion among insects declines and they begin to move towards each other and form mobile moving groups that can extend many kilometers. Locusts can return to the solitarious phase if sufficiently isolated from one another, but this may take much longer. It is reported that physical contact is the single most potent stimulus causing solitarious locusts to assume gregarious behavioral traits.

Life cycle

Egg

The life cycle of the desert locust consists of three stages: egg, hopper and adult and duration of the life is 2-6 months on an average. The eggs are laid by females in pods in the moist sandy soil at a depth of about 10 cms in deserts. Egg pods are laid at intervals of 7-10 days. Gregarious females usually lay 2-3 egg pods, each with about 60-80 eggs. Solitarious females mostly lay 3-4 times. Each pod contains 100-160 eggs. The rate of egg development is dependent upon soil temperature and moisture. There is no development below 15 degree centigrade. The period of incubation decreases from about 70 days at 19 degrees centigrade to 10-12 days at 32-35 degrees centigrade.

Nymph

After completing the incubation period the eggs hatch and nymph (young ones) emerges. There are five instars in gregarious population and 5-6 instars in solitarious individuals. In each instar, there is growth of nymph and the colour of the solitarious hopper is green throughout all instars but the gregarious hoppers have characteristic colouration of black and yellow. The rate of development of nymph is mainly dependent on temperature, from about 22 days under hot conditions (mean air temperature approx. 37 degrees Celsius) to over 70 days under cool conditions (mean air temperature approx. 22 degrees Celsius).

Adult

Fifth instar hopper moults into the adult state. This change is called fledging and young adult is called a fledgling. Thereafter there is no further moulting and the adult cannot grow in size but gradually increase in weight. Fledglings gradually become hard and able to fly. Locusts in this condition are called immature adults. The period of sexual maturity of adults is variable. If conditions are suitable, the adults may mature in 3 weeks. More usually, however, they migrate downwind until they encounter favourable breeding conditions, which may be thousands of kilometers away. Under cool and/or dry conditions they may remain immature for as long as 8 months. Young immature gregarious adults are pink in colour but old ones attain dark red or brown under cool condition. On maturation adults become bright yellow. Males mature before females but oviposition usually commences within two days of copulation.

Breeding seasons

I. Winter-breeding (November-December)

Coastal plain bordering the Red Sea and the Gulf of Aden, coast of South-East Arabia and the Mekran coast of Iran and Pakistan.

II. Spring breeding (January-June)

Western Sahara, Mauritania, South and Central Algeria, Libya, Chad, Red Sea and gulf of Aden coastal plain, South, Central, Eastern Arabia coastal plains and interior Afghanistan.

III. Summer breeding (July-October)

Southern fringes of Sahara extending from Mauritania to Sudan, the interior coastal area of Ethiopia and Southern Arabia, Mekran, Tharparker and Cholistan desert of Pakistan and Tar desert areas of Rajasthan, Gujarat and Haryana in North West India.

Nature of damage

Locusts are voracious feeders, each adult, consuming own weight of vegetation daily. It is estimated that one sq. mile settled swarm contains about 300 tons of locusts. Biggest 300 Sq. miles swarm is on record. Similarly hoppers eat 6-8 times more than their own weight. Locust do cause damage by devouring the leaves, flowers, fruits, seeds, bark and growing points and also by breaking down trees because of their weight when they settle down in masses.

Management

Preventive/prophylactic measures

When the conditions occur that are conducive to an outbreak of a particular locust or grasshopper species, survey teams should then be rapidly deployed so that significant infestations can be located and treated quickly as part of early intervention.

Swarm monitoring

- Geographic information system (GIS) which combines many layers of data on locusts/grasshoppers and their habitats to provide more accurate forecasts
- Landsat remote sensing satellite imagery and improved weather models are required to improve forecasting of locust populations
- All field data from locust surveys, reports, and treatment programs can be geo-referenced using a Global Positioning System (GPS)
- Normalized difference vegetation index (NDVI) technique, which can distinguish areas of green vegetation from bare soil
- MODIS (Moderate Resolution Imaging Spectroradiometer) images and dynamic greenness maps derived from the NDVI index can be used for monitoring
- SMOS (Soil Moisture and Ocean Salinity) and MODIS sensors are useful to desert locust managers to assess moisture and presence of egg pods
- RAMSES (Reconnaissance and Monitoring System of the Environment of *Schistocerca*) can be used to anlayse national locust information and other related data
- SPOT satellite information can be employed to identify new migration pathway of desert locust
- CARMA (http://carma.unk.edu/), an advisory system for managing grasshopper infestations can be explored
- Automatic weather station in desert to assess on set of weather congenial to breeding of locust
- Establishment of International coordination/ collaboration with locust affected countries for sharing locust outbreak information, migration of swarm and forecasting service
- Rates of egg development can be used as an indication to forecast dates of hatching
- Constitution of locust monitoring team in ICAR institutes, functioning in Gujarat, Rajasthan, Punjab and Haryana
- Militants may be employed to monitor the locust movement in the Western Rajasthan and Pakistan border of Tar desert

Breeding sites (Scheduled Desert Area)

In the past, management programs were largely curative, and while some still are, the recognition of how damaging locusts and grasshoppers has led to a paradigm shift from crop protection to preventive management of these pests

- Identification and demarcation of egg pod laying and solitary phase breeding sites
- Earthing-up and destruction of egg pods during winter season, as the incubation period is prolonged to 70 days
- Employ control measures in vulnerable stage (solitary phase) of locust
- Destruction of various immature stages before on set of gregarious behaviour
- Use of UV rays for killing locusts in unmanned deserts before entering into vegetation
- Digging trenches and mechanical trapping into it and burying
- Suitable training to farmers, State functionaries and desert inspectors to identify, locate and demarcate breeding sites and on latest locust control technologies
- The locust control should be focused in the most remote areas of infestation
- Use of poison baits for killing locusts
- Dusting with insecticides (Malathion/carbaryl)
- Use of ULV formulation of mycopesticides, *Metarhizium anisopliae* and *Paranosema*
- Spraying of ULV formulation of insecticides with unmanned aerial vehicles (UAV) for effective coverage of breeding sites and crop canopies with least environmental contamination
- Treating locust hot spots before they can damage crops by intervening early in outbreaks
- Regular monitoring and treating localised outbreak areas that are particularly favorable for breeding to avoid high population increases and subsequent large-scale escapes into cropping areas
- Widespread use of broad-spectrum and often cumulative applications of chemical pesticides, based on early warning system

Curative measures

- Application of malathion 96 ULV with unmanned aerial vehicles (UAV) on set of locust swarm
- Blanket sprays of insecticides as barrier treatments for control of hopper bands of locusts
- Reduced agent and area treatment (RAAT) with the help of all-terrain vehicles or aircraft can be economical to treat 5- to 30-m-wide swaths.